New ventures in emerging industries: Approaches to business model development

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Abstract

It is well known that ventures in emerging markets are confronted with uncertainty (on the level of the technology as well as the market) complicating the upfront identification of viable business models. Market signals and technical tests may afterwards reveal information that was unknown or uncertain at the outset. As a results, most initial selections of business models by new businesses are re(de)fined later on. This observation directs our attention to the question *how new ventures in emerging industries characterized by uncertainty approach the issue of business model development*, a topic which has received limited attention in the literature so far.

In a first part of the paper, we outline the theoretical background of our research with respect to business models and their development in circumstances of uncertainty. We find that (a) previous entrepreneurship research has demonstrated that – under uncertainty - ventures either commit to a specific business model, or adapt it by making stepwise, sequential changes, (b) these identified approaches of ventures to business model development are less numerous than what can be expected based on literature outside the entrepreneurship scope, and (c) there is no clarity in entrepreneurship literature about the appropriateness of causation/planning versus effectuation/action for business model development under uncertainty.

Given that we want to explore how new ventures in emerging industries characterised by uncertainty approach business model development, we adopt an in-depth case study approach. We retrospectively study and analyze five new ventures. The main selection criterion is that they were all initially confronted with uncertainty regarding their business model. Based on event analysis of these five case studies, we identify different patterns in the way ventures develop their business model. Our most important finding is that commitment and sequential experimentation are not the only development patterns. More specifically, we identify a third approaches to business model development, namely simultaneous experimentation with a range of business models. We see that ventures initially develop a portfolio of business model experiments. Over time, they filter out the most promising ones, until they arrive at a viable business model.

Firstly, this finding adds to the existing literature on approaches to business model development (which – as explained above – only distinguishes between two approaches, namely commitment and sequential experimentation). We explain in detail how simultaneous experimentation with a range of

business models differs from these two approaches. Secondly, since simultaneous experimentation with a range of business models is very successful for the ventures in our study, this also challenges traditional investment models pushing ventures to focus on the development of one single business model. Thirdly, whereas existing literature juxtaposes experimentation and planning, our case studies show that these are not necessarily opposites. The ventures that simultaneously experiment with a range of business models, do this in a conscious, planned way. They even explicitly plan for it in their initial business plans. Our work hence also adds insight into existing research on effectuation/bricolage versus planning/causation. Whereas existing research disagrees on whether or not experimentation/bricolage is more appropriate than planning under uncertainty, we propose that a combination of planning and experimentation is feasible and may even be preferable under uncertainty.

Corporate Motivation for Integrated Management System Implementation

Why do Firms Engage in Integration of Management Systems: A Literature Review & Research Agenda

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Corporate Motivation for Integrated Management System Implementation

Abstract:

Integration of management systems such as for quality, environment, occupational health and safety, risk management, and corporate social responsibilities is a viable organisational approach to cost reduction, efficient utilization of resources, greater motivation of employees, and better compliance to social obligations and stakeholders' requirements. Identification of drivers for corporate motivation for IMS decision making and its implementation is a matter of interest for academicians, practitioners, industry, and government regulatory agencies; paradoxically literature on this subject is pretty thin. This paper describes the literature review and research agenda for the exploration of drivers of IMS implementation and factors influencing IMS implementation. The exploratory research is meant to be executed by an inductive approach through case studies in Pakistani manufacturing firms.

Keywords:

Integrated management systems (IMS), quality management system (QMS), environmental management system (EMS), occupational health and safety management system (OH&SMS), and corporate social responsibilities (CSR).

1. Introduction:

Integration is the complete harmony and alignment of strategy and operations of an organization. It means that different departments and levels speak the same language and are tuned to the same wavelength (Garvin, 1991). In the literature, integration of management systems has been discussed as the merger of the quality management system (QMS), environmental management system (EMS), health & safety management system (OH&SMS), and corporate social responsibilities (CSR). Indeed, to survive and thrive in a period of global competition, organisations need to look at every aspect of their processes, including cost cutting, well-being of their employees, the working environment and the impact that organisational operations have on their neighbors and on the local community. Moreover companies must address these issues while continuing to provide quality products and services. The concept of integrated management systems (IMS) has arisen from this need.

The motivation behind this research is that there is a need to know; why some companies integrate their management systems while others in seemingly similar context don't adopt even individual management systems. Understanding the drivers of IMS decision making and factors affecting IMS implementation is

critical for two reasons. First, it will help organisational theorists to predict behaviors regarding IMS implementation, secondly this understanding will expose the mechanism that fosters IMS implementation, allowing researchers, managers, and policy makers to better understand the dynamics of IMS implementation. Significant research opportunity exists to develop a model that identifies distinct conceptual categories of IMS motivation, corresponding antecedents and outcomes associated with each motivation, and factors that influence IMS implementation.

1(A). Research Objective:

1. To achieve better understanding of the IMS in the specific context of Pakistani manufacturing organisations.
2. To understand "Why organisations implement IMS?" and what factors influence IMS implementation

1(B). Central Research Question:

Why organisations implement IMS and what factors influence IMS implementation in Pakistani manufacturing firms

Based on this central research question, following research sub questions have been stated.

1(C). Research Sub-questions:

1. Why organisations implement IMS. (What motivates the organisations to implement IMS)?
2. What factors influence IMS implementation, and how IMS implementation process, its influencing factors and its outcomes are managed to improve organisational effectiveness through IMS implementation?

1(D). Practical value of this study

The findings of this study would be useful for the

1. Practitioners (who are looking for reasons and motivation to implement IMS and the factors that could facilitate /hamper IMS implementation),
2. Regulatory agencies (how could they motivate and facilitate the IMS implementation), and
3. Academicians for better understanding of the process of IMS decision making, implementation, and for further research in this area.

2. Literature Review

IMS is a new area of research and the existing literature in this area is pretty thin (Karapetrovic & Jonker, 2003). With the help of available literature so for, this paper first defines the commonly accepted meanings of an IMS in theory and practice and what actually constitutes an IMS. This is followed by a

discussion on the analysis of literature on IMS. This analysis of the literature is meant to identify those aspects of IMS which have been covered so for in research and the current status of research in IMS implementation.

2(A). Composition of IMS:

There is no agreement among different authors regarding the constituents of an IMS. The conventional literature considers IMS to be composed of three management systems i.e., QMS, EMS, and OH&SMS (see, for example, Jonker & Karapetrovic, 2004; Tine H. Jørgensen, Remmen, & Mellado, 2005; Karapetrovic, 2002, 2003; Karapetrovic & Jonker, 2003; Rocha, Searcy, & Karapetrovic, 2007). However more recent literature also focuses on the CSR as the essential component of an organization's IMS. Table 1 describes an analysis of literature to explore meanings of IMS as discuss in literature.

QMS	EMS	OH&SMS	CSR	Other systems	Author
✓	✓	✓			Douglas & Glen, 2000; Fresner & Engelhardt, 2004; Labodova, 2004; Mackau, 2003; Zeng, Shi, & Lou, 2007
✓	✓	✓	✓		Jonker & Karapetrovic, 2004; Tine H. Jorgensen et al., 2005; Karapetrovic, 2002, 2003; Karapetrovic & Jonker, 2003; Rocha et al., 2007
✓	✓	✓		Ergonomics	Matias & Coelho, 2002
✓	✓	✓	✓	Dependability (IEC 60300)	Karapetrovic, 2002, 2003

Table 1: Commonly described meanings (composition) of IMS in literature

Table 1 shows the commonly described meanings of IMS in the literature. As it is revealed from literature that the overall picture of IMS that emerges from the literature is that an IMS is a composite of QMS, EMS, OH&SMS, and CSR. However author believes that an IMS should be capable to integrate in it the sector specific management systems (such as GMP for pharmaceuticals, HACCP for food, WRAP for apparels, and QS 9000 for automotive industry etc) as well as the new generic management systems or the new versions of existing management systems.

An IMS is usually represented by the Venn diagram showing three components of IMS (see, figure 1)

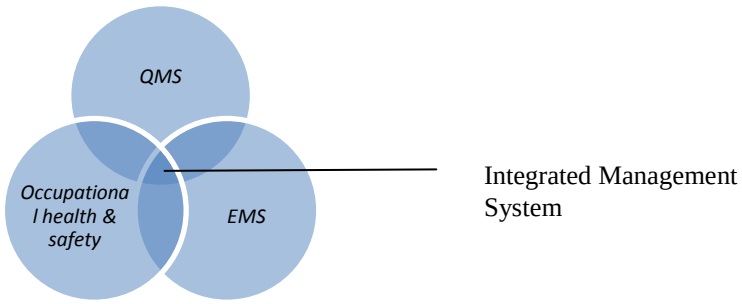
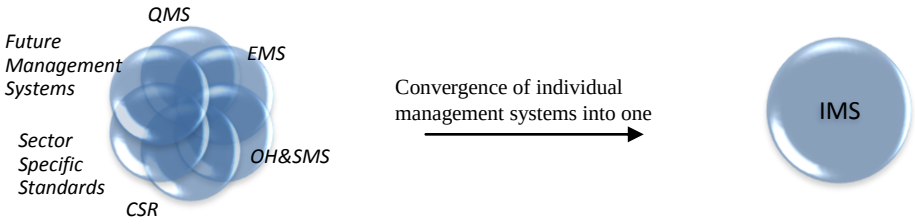


Figure 1: Venn diagram for IMS

The management systems are mushrooming and it is expected that new management systems would keep appearing. A true IMS would be one that accommodates all existing management systems and is capable of incorporating prospective management systems as well.



2(B). Areas surveyed in the IMS:

The knowledge of current status of research in IMS is imperative since it will determine future directions of research. The figure 1 shows broad categorisation of different aspects of IMS discussed in literature. These aspects include a) philosophy of integration of management systems, b) empirical research, c) strategies of integration of MSS, and d) IMS as a means to implement other management systems such as sustainable development.

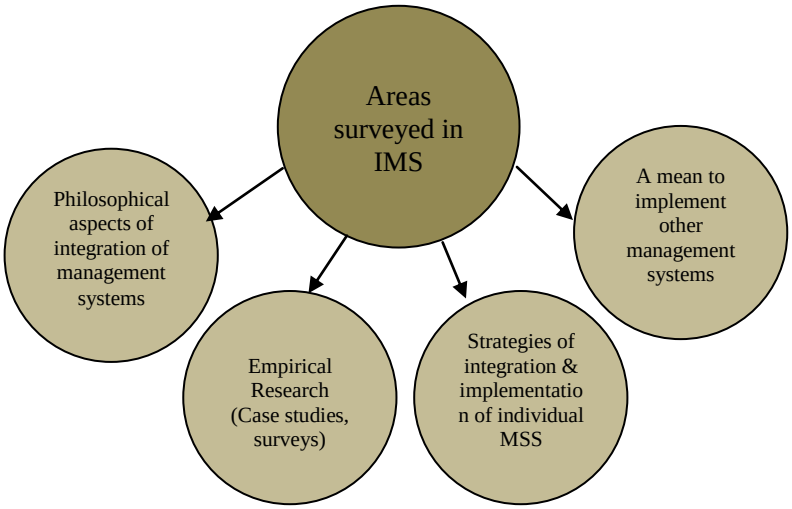


Figure1: Categorisation of areas surveyed in the IMS

Table 2 further elaborates each category of IMS discussed in literature and mentioned in fgure1.

Aspect of IMS	Explains (Main focus &/or additional focus)	Supporting Literature
Philosophical aspects	Exploration of prevalent concept of integration	Karapetrovic, 2003; Wilkinson & Dale, 1999
	Benefits from integration	McDonald, Mors, & Phillips, 2003; Wright, 2000
	Evolution of IMS from quality management.	Mangelsdorf, 1999
Empirical Research	Factors affecting IMS implementation	Salomone, 2008; (Salomone, 2008; Zeng et al., 2007; Zutshi & Sohal, 2005
	Advantages of integration	Douglas & Glen, 2000; Zutshi & Sohal, 2005
	Strategies of integration (empirical research based)	Douglas & Glen, 2000; Fresner & Engelhardt, 2004; Jørgensen et al., 2005; Labodova, 2004; Wilkinson & Dale, 2001; Zeng et al., 2007
	Role of culture and of formation of sub cultures (within a culture) in integration	Wilkinson & Dale, 2002
Strategies of integration (Normative based)	How to integrate individual management system standards into one IMS	Jonker & Karapetrovic, 2004; Karapetrovic, 2002, 2003; Karapetrovic & Jonker, 2003; Karapetrovic & Willborn, 1998
Means to implement other management systems	Means to integrate sustainability in business processes	Rocha et al., 2007
	Means to sustainable management systems	Jørgensen, 2007

Table 2: Different aspects of IMS discussed so for.

Figure 1 and table 2 describe the areas of IMS explored in research but it is also imperative to know the context in which such research has been carried out. Pettigrew & Whipp (1991) also emphasised the need of context to better understand the implementation process in addition to content and context. Table 3 thus lists the countries in which empirical research regarding IMS implementation have been carried out.

Country		Research	Author(s)
Europe	**Germany**	IMS for SMEs	Mackau, 2003
	Austria	Case studies in two Austrian companies	Fresner & Engelhardt, 2004
	Italy	Integration of ISO 9000 & ISO 14000	Renzi & Cappelli, 2000
		IMS: Experiences in Italian organizations	Salomone, 2008
	UK	IMS in SMEs	Douglas & Glen, 2000
		An IMS model based on Total Quality	Wilkinson & Dale, 2001
	Denmark	IMS: three different levels of integration	Tine H. Jørgensen et al., 2005
		Towards more sustainable management systems: through life cycle management and integration	Tine Herreborg Jørgensen, 2007
	Czech Republic	IMS using risk analysis based approach	Labodova, 2004
Asia	**China**	IMS implementation based on synergistic model	Zeng et al., 2007
Australasia	**Australia**	IMS: Experiences of Australian organisations	Zutshi & Sohal, 2005

Table 3: IMS empirical research subjects- List of countries

The research on the integration of management systems is really scarce. The thinness of literature on IMS has also been mentioned by many authors. Karapetrovic & Jonker (2003), for example, have put it this way, "existing literature on the theoretical aspects of IMS is still pretty thin" (p. 453) and that "…one of the lingering questions in IMS research and practice is the existence of 'the path' itself. Is there really one best way to integrate management systems, or are there many ways that depend on contingencies? Also, which particular elements should be integrated, and in what order?" (p.452). The literature on the "drivers of IMS" and "factors influencing IMS implementation" is even scarcer which further necessitates the need of research in this area. An understanding of the drivers and factors influencing IMS implementation is important since it will, in turn, determine the motives and incentives that could be used by practitioners and government regulatory agencies to facilitate the IMS implementation. Likewise identification of factors fostering as well as hampering IMS implementation would be of immense practical value. Also this is an area of rich academic interest and would promote further research in the integration of management systems. With that in mind the following section presents a discussion of drivers/motives of IMS and then factors influencing IMS implementation.

2(C).Motivation for IMS implementation

The motives for the decision of IMS implementation may be both intrinsic as well as extrinsic. Intrinsic motives are those that originate from socio-techno-economic arenas of an organization and could further be classified as reactive or proactive. Reactive motives arise from the outputs of processes, management is not satisfied with and thus IMS is sought for as a remedial measure. They may also result from repeated failures to comply with preset operational, financial, and/or regulatory objectives and targets. On the other hand extrinsic motives influence organization from outside environment. They may be due to requirement of customer who insists on integrated management systems or due to competition in global market which forces organisation to adopt best business practices and regulatory requirements.

What motivates organisations to implement IMS can be viewed in terms of what can be gained from IMS implementation. The benefits from the integration of management systems could be potent motive for IMS implementation. Table 4 describes a list of benefits that could be obtained from IMS implementation.

Benefits from IMS implementation		
Benefit of IMS		**Supporting literature**
Documentation reduction	Elimination of documentation duplication	Douglas & Glen, 2000; McDonald et al., 2003; Zutshi & Sohal, 2005
Customer's demand	Pre requisite for business	McDonald et al., 2003
	Enhanced customer satisfaction	Douglas & Glen, 2000; Zutshi & Sohal, 2005
Cost Reduction	Cost reductions, e.g., in manufacturing, operations, and insurance premiums.	Jørgensen et al., 2005; Wright, 2000, Douglas & Glen, 2000; Zeng et al., 2007; Zutshi & Sohal, 2005; McDonald et al., 2003
Operational benefits	Operational improvements	Fresner & Engelhardt, 2004; Holdsworth, 2003; Jørgensen et al., 2005; McDonald et al., 2003
	Simplified systems	Douglas & Glen, 2000; Zutshi & Sohal, 2005
	Time saving	Zutshi & Sohal, 2005
	Better synergies between systems	Rocha et al., 2007
	Unification of internal audits	Salomone, 2008
	Unification of training activities	Salomone, 2008
	Common framework for continual improvement	McDonald et al., 2003
	Overall organisational performance improvement	McDonald et al., 2003
Resources allocation and utilization	Better allocation of resources	Zeng et al., 2007
	Saving of human resources	Salomone, 2008
	Better utilization of resources	Rocha et al., 2007
Cultural Change	Teamwork promotion	Wright, 2000
	Greater acceptance by employees	Zutshi & Sohal, 2005
	Cultural change (Learning organisation)	Wright, 2000; Zutshi & Sohal, 2005
Other benefits	Strategic planning	Zutshi & Sohal, 2005
	Holistic view	Zutshi & Sohal, 2005
	Enhanced interdepartmental communication	Douglas & Glen, 2000; Wright, 2000; Zutshi & Sohal, 2005
	Better definition of responsibilities	Salomone, 2008
	Means to sustainable development	Fresner & Engelhardt, 2004; Rocha et al., 2007

Table 4- Gains from IMS implementation

However this is worth noting that most of benefits mentioned above could be categorized in few general domains. These benefits could be broadly categorized as operational, financial, and marketing benefits. We could not find substantial research work on the corporate motivation for implementation of IMS, however we have lent theoretical and research methodological justification from the research work of Bansal & Roth (2000), Zhang et al. (2008), and Salomone (2008). This has led us to develop some preliminary and tentative drivers that could be used to steer this exploratory research. These preliminary and tentative drivers for the corporate motivation of IMS include operational, regulatory, financial, marketing, and social drivers and have been discussed in detail in what follows.

I. *Operational drivers* are related to the routine operations of a business. They originate from the supply chain activities and are measured in terms of various performance yardsticks such as productivity,

efficiency[1], cycle time, through put rate, wastages proportion[2], and number of accidents etc. The important role of pressure from supply chain in engaging firms in environmental management has been mentioned by Zhang et al. (2008). Table 4 also lists the operational benefits (reported in literature) that could be gained from IMS implementation. The notable are time savings, simplified systems, better synergies between various organisational functions, and development of a common framework for continuous improvement.

II. *Regulatory drivers* are related to the legal requirements for environment, health and safety, corporate social responsibilities, or quality requirements of products or processes. They are measured in terms of legal non conformances or inability to comply industry's self developed yardsticks. By developing the industry standards for self regulations, these firms can pre-empt cumbersome government regulations. Institutional processes can work through coercive pressures imposed by institutions that directly influence firms (DiMaggio & Powell, 1983). Failing to comply with institutional pressures, particularly imposed by urgent and more powerful stakeholders can result in loss of earnings, a damaged reputation, or even loss of the license to operate (Oliver, 1991). Firms previously fined are also on the watch list of media, government regulatory agencies and other special interest groups for further indiscretions. Such firms that have been previously fined are more vigilant to avoid non conformities next time. Firms that have been subject to fines and penalties will also become more sensitive to acceptable sustainable development practices and be more informed of what they need to do to avoid further infractions (Bansal, 2005).

III. *Financial drivers* are related to financial gains from IMS implementation. IMS has been reported to result in cost savings directly (through audit costs reductions, certification costs reduction) and through other drivers that also lead to ultimate cost savings and improved financial portfolios , for example, operational and regulatory aspects ultimately affect financial aspects of a business. They are measured in terms of financial yardsticks such as annual profits. Social drivers arise from the expectations of employees and general community. Organisation do not operates in isolation; they interact with outside world, use and deplete natural resources, and also utilize human resources. Employees and community thus expect organisation to comply with the practices appreciated socially. Although such

[1] Productivity is calculated as ratio of output to input and efficiency is calculated as ratio of actual output to the standard output. Organisations may use different types of yardsticks to determine productivity and efficiency of processes. E.g., Partial productivity, multifactor productivity and total factor productivity.

[2] Toyota the Japanese automobile manufacturer, has identified the following seven types of waste as the most prominent ones: waste due to overproduction, waiting time, transportation, processing, inventory, motion, and product defect

requirements are covered by individual management systems and standards; for some of the management systems (such as CSR and health and safety) there is not sufficient regulatory push at this stage and even no ISO approved standards exist (as compared to QMS and EMS for which ISO approved standards exist). IMS highlights such issues and brings them on the top of agenda.

IV. *Marketing Drivers:* Marketing drivers concern the pressures from the customer to implement an IMS and are measured in terms of sales figure and soft image of company. Some empirical studies (such as those conducted by (Douglas & Glen, 2000; Zeng et al., 2007; Zutshi & Sohal, 2005) have reported that IMS results in better compliance to customer requirements and thus results in positive market image. The role of marketing pressures on EMS implementation has been mentioned by Dasgupta, Laplante, Nlandu, and Wang (as cited in Zhang et al., 2008) who noted that capital markets may react negatively to the announcement of adverse environmental incidents, such as violation of permits, spills, court actions, complaints or react positively to the announcement of superior environmental performance. However the substantial role (if any) of marketing drivers in IMS implementation still remains to be explored.

V. *Social Drivers:* Social derivers refer to the pressures on firms from community and employees to carry out practices that are socially acceptable. Indeed an organisation must endorse social responsibility and make it a part of its value system since non compliance with social responsibilities can give a bad impression (negative publicity) of organisation and affect its profitability. One such example is of Talisman, a large oil company, who in late 1990s, had to withdraw from Sudan in response to strong public pressure against its business decisions that violated social rights of inhabitants. Another example of increasing awareness of social responsibilities is the development of "Kimberley process certification scheme" which ensure that diamonds (trade) come only from conflict free source (i.e., their trade does not finance the weapons acquisition in areas under civil war).

Although the literature on the drivers of IMS implementation is really scarce, recently Salomone (2008) noted that market forces (customer, image and competitiveness), human resources, and continual improvement are potent motives for IMS implementation. However augmentation for the reason to select preliminary and tentative drivers also comes from literature in management systems other than IMS (such as EMS and sustainable development). Bansal and Howard (1997), for example, have mentioned marketing, financial, social, and regulatory drivers for sustainable development. Bansal and Roth (2000) found three motivations for corporate ecological responsiveness which are competitiveness, social responsibility and legitimation (desire of the firm to improve the appropriateness of its actions within an established set of norms, regulations, values or beliefs (Suchman, 1995). Finally Zhang et al.

(2008) noted government regulations, community participation, market demands, and pressures from supply chain play important role in engaging firms in environmental management in china.

2(D). Factors influencing IMS implementation

Indeed an important aspect of IMS research is to find out the factors that influence IMS implementation. This includes factors that facilitate IMS implementation as well as factors that hinder IMS implementation. A survey of the literature shows that this remains the least explored area in IMS research. However we find some isolated studies in Australia (Zutshi & Sohal, 2005), China (Zeng et al., 2007), Denmark (Jørgensen, 2007; Jørgensen et al., 2005), UK (Douglas & Glen, 2000), and Italy (Salomone, 2008) which attempt to identify the factors influencing IMS implementation in various contexts. However such studies have certain limitations; this has been elaborated in table 3 which provides an overview of the analysis of the empirical studies on the IMS to further elaborate the research strategies used in research, main findings and limitation of these studies.

Analysis of IMS empirical studies				
Country	**Research methodology**	**Sample size**	**Main findings**	**Limitation**
Australia (Zutshi & Sohal, 2005)	Case studies	03 Australian organisations	**Benefits of integration:** I. Effective strategic planning II. Better resources utilisation III. Holistic view IV. Better acceptance & understanding among employees V. Benefits from integrated training programs VI. Enhanced communication VII. Cost savings & positive market image VIII. Benefits from integrated audit and housekeeping **Obstacles in integration** I. Resistance from employees II. Lack of strategic planning III. Lack of expertise & consultants IV. Continually changing regulations & guidelines (such as for environmental management system) V. Need of fast reporting system	Problem of generalisability of findings from 03 case studies across larger population
China (Zeng et al., 2007)	Survey	104 firms	**Factors affecting IMS implementation:** **Internal factors** I. Human resources II. Organizational structure III. Company culture IV. Understanding and perception **External factors** I. Technical guidance II. Certification bodies III. Stakeholder and customers IV. Institutional environment	It is not known whether survey was country wide or some provinces wide
UK (Douglas	Survey	28 SMEs	**Benefits of Integration**	Having integration

& Glen, 2000; Wilkinson & Dale, 2001)			I. Less procedures II. Less paperwork III. Multi-functional auditors IV. Easier to manage systems V. More effectiveness - internally & externally better communications between staff VI. Improved image with customers VII. Reduced costs	of only QMS and EMS. Does not take into account OH&SMS and CSR
	Survey	150 firms	Develops & tests a model that describes the culture aspects.	Neither describes drivers of IMS implementation nor factors influencing IMS implementation
Denmark (Jørgensen, 2007; Jørgensen et al., 2005)	Interviews	02 firms (Danish & Spanish organisations for standardisation)	Three ambition levels of integration: from increased compatibility of system elements over coordination of generic processes to an embeddedness of an integrated management system (IMS) in a culture of learning and continuous improvement.	Problem of generalisability of findings from 02 interviews across larger population
	Archival analysis, synthesis from literature	One organisation	To achieve sustainable management systems, organisations must consider integration in life cycle perspective. An extended focus on life cycle management (LCM) is thus needed.	Problem of generalisability of findings from 01 interviews across larger population
Italy (Salomone, 2008)	Survey	103 firms (out of 103 firms, only 75 had achieved full integration for QMS, EMS and OH&SMS but not CSR)	**Drivers of IMS implementation** Local community pressure Customer pressure Distributor pressure Public authority pressures Competitiveness pressures Image improvement Product improvement Productivity improvement Management cost reduction New market opportunities Continual improvement **Factors affecting IMS implementation** Standard not clear Incompetent human resource Management difficulties Inadequate financial support Costs too high Lack of information	Excludes CSR from the IMS

Table 5: Analysis of empirical studies on IMS

The limitation of these studies include

a) Firstly, many of these empirical studies (such as Douglas & Glen, 2000; Jørgensen, 2007; Jørgensen, 2005) focus merely on the benefits and strategies of integration; while others focus on the testing of models (such as Wilkinson & Dale, 2001) but no focus on the factors that influence IMS implementation.

b) Secondly, all these studies have been conducted in more economically developed countries (except china which is although a developing country but indeed a rapidly developing economy) and none in developing countries. It remains questionable whether the research findings from few developed countries (also called industrially advanced countries) could be applicable to and generalised across large number of developing countries with under developed industrial base.

c) Thirdly, regardless of the context in which such studies shave been executed, none of such study is widely generalisable across diverse contexts. This is best reflected in the "sample size" and "other limitations" mentioned in table 5.

d) Fourthly, generation and accumulation of knowledge is an iterative process of continuous cycling between theory and data. Since most of the research leads from theory to data, some researchers should complete the cycle by choosing less common way, i.e., from data to theory. The surveys based studies are usually deductive in approach (see, for example, Saunders, Lewis, & Thornhill, 2006) and build upon the constructs/factors selected from the relevant literature to test their applicability in particular contexts. Such studies usually view organisational microcosms from the lens of a limited number of categories and formalization and thus blind themselves from the rich and fresh potential insights. Evered & Louis (1981) has mentioned the limitation of this approach by noting that "this approach is methodologically precise, but often irrelevant to the reality of organisation" (p. 392). Gummesson (2000) has put it this way, "even if the methods of collecting and processing data are sophisticated, the well known adage garbage in, garbage out can't be discounted" (p.14). Thus the generation of fresh insights requires an inductive approach to research to find out constructs/factors that influence IMS implementation. These factors could later be used to establish a connection with IMS implementation through a survey type research.

3. Conceptual Research Framework

Development of a conceptual research framework is an important pre requisite for a systematic research. A conceptual research framework explains, either graphically or in narrative form, the main things to be studied - the key factors, constructs or variables- and presumed relationship among them (Miles & Huberman, 1994). A conceptual framework tells researcher what to research and what not. It keeps the researcher on the track and keeps from getting superfluous and irrelevant data. The conceptual framework for research has been shown in figure 2.

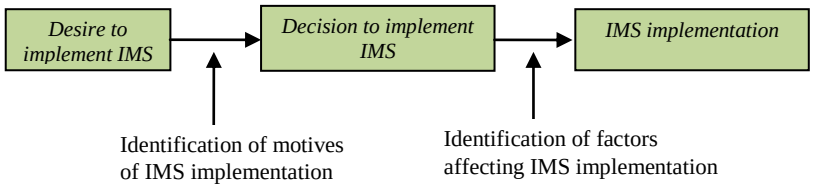


Figure 2 Provisional Research Framework

Provisional research framework consists of two areas of research.

I. First part is concerned with identification of drivers that motivate the firms to implement IMS. This part concerns the research question "why organisations implement IMS? (What motivates the organisations to implement IMS?)

II. Second part is meant to identify the factors that influence IMS implementation (once IMS implementation decision is made). This part concerns the research question "what factors influence IMS implementation.

The first part of the provisional research framework "identification of motives of IMS implementation" has further been elaborated in figure 3 which makes use of five preliminary and tentative drivers named regulatory, marketing, financial, social, and operational to build a preliminary and tentative framework. The purpose of such a provisional schema (as in figure 3) is to define the research scope so that research remains within predefined scope and superfluous and abundant data is not generated. However these drivers are only preliminary and tentative in the sense they are not guaranteed a place in final schema/model. Other limitations of theses preliminary drivers are that, firstly, all have not been explicitly reported to affect or to be associated with IMS, rather being associated with individual components of IMS or entirely different but related aspects such as EMS or sustainable development. Secondly, these preliminary drivers have not yet been tested empirically for IMS. A conceptual research framework to identify drivers of corporate motivation of IMS has been shown in figure 3.The operational measure for each of the driver is also shown.

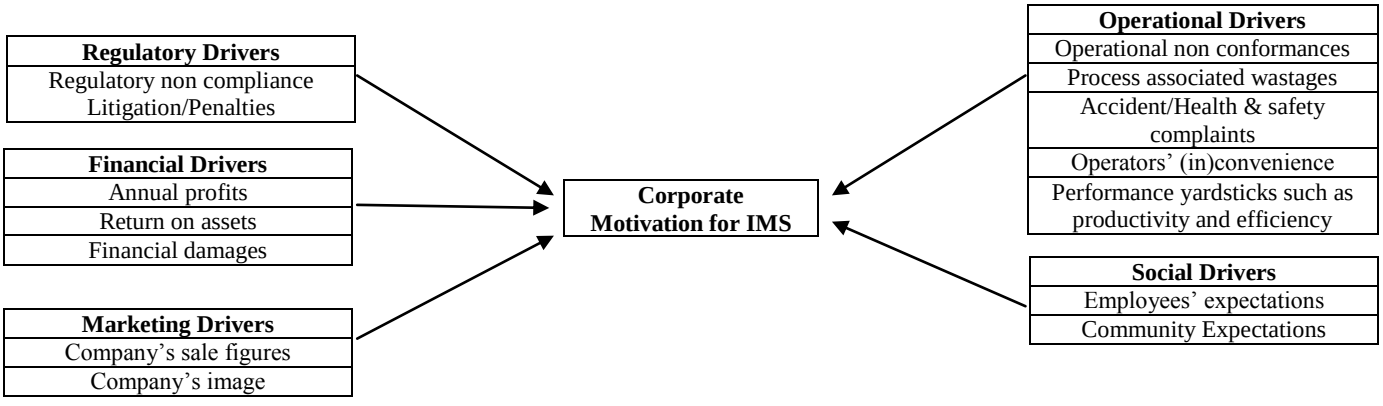


Fig. 3 Preliminary Conceptual model of corporate motivation for IMS implementation

The second part in the provisional research framework represents the area of exploration for the factors that influence IMS implementation.

4. Research Methodology

The research methodology applied to any research work depends upon the nature of research questions. Research questions "why firms implement IMS" and "what factors influence IMS implementation" could be placed in the category of exploratory research. Ghauri & Gronhaug (2005) mentioned that when research questions take the form of "how and why"; case studies are preferable. Yin (2003) notes that for questions of "what" type, any exploratory study could be used e.g., exploratory case study, exploratory survey, or an exploratory experiment. The selection of research strategy has been further elaborated in table 6.

Choosing a strategy			
Strategy	**Form of research question**	**Requires Control of behavioural events**	**Focus on Contemporary events**
Experiment	How, why	Yes	Yes
Survey	Who, what, where, How many, how much	No	Yes
Archival Analysis	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case study	**How, why**	**No**	**Yes**

Table 6: Choosing a research strategy (source: Yin (2003)

As the table 6 shows that for "how" and "why" type of questions, both case studies and history research are useful. However cases studies are more suitable in circumstances when some contemporary phenomenon is to be researched and research is to be carried out in a setting that is inclusive of the specific organisational context (Yin, 2003). Case studies also make use of other sources of evidence such as direct observations, participant observations, archival records and physical artefacts. A case study is an empirical inquiry that investigates a contemporary phenomenon with its real life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003). This means that an important strength of case study research is to take the research subjects' context into consideration. Case studies are rich, empirical descriptions of particular instances of a phenomenon that are typically based on a variety of data sources (Yin, 1994).

In order to explore the corporate motivation for IMS implementation and for identifying the factors that influence IMS implementation; an inductive approach has been proposed. To develop theory that is empirically grounded, an inductive methodology is most appropriate (Glaser & Strauss, 1967; Yin,

1989). In inductive paradigm of research, we have two most viable options, i.e., grounded theory and inductive case study (such as mentioned by Eisenhardt, 1989).

Grounded theory is an empirical research methodology meant to dig out what actually happens in practice. The grounded theory approach requires the researcher to enter field with no prior knowledge of the subject (otherwise it could put the bias in research through pre mindset). Grounded theory results in the theory development that is empirically grounded. However it is usually criticised for following reasons. Firstly the very basic assumption "researcher going in field without prior knowledge of subject and investigating in detail some empirical phenomenon seems contradictory since later would require sound (or at least some basic) knowledge of the subject". Secondly, the approach requires understanding of the topic from the perspective of people who deal it. Thirdly, the grounded theory owing to its limited prior knowledge approach does not take into account the previous research work to build further research work on it.

However many of the criticism on grounded theory is covered by the *inductive case study approach* as described by Eisenhardt (1989). In this research approach, researcher could consult the previous research work to identify the constructs (but no hypothesis/ theory) to better ground the construct measures. However the link between the constructs cannot be established beforehand. Later approach is preferable when existing theories are to be considered and when research is based on the existing theories.

Based on conceptual model, cases are selected and data collection protocol is designed (Yin, 1994). Since IMS is an organisation wide management system that affects every function of organisation and people from all organisational functions are involved in the designing and implementation of one integrated management system, the holistic case study approach is more appropriate. The organisations involved are considered as units. Multiple holistic cases studies would be carried out followed by a cross case analysis. A further description of case study research is provided in what follows.

4(A). Characteristics of Case Study Research

Verschuren & Doorewaard (1999) have described following characteristics of case study research.

1. A small number of research units
2. labor intensive data generation
3. More depth than breadth
4. A selective , i.e. a strategic sample
5. Qualitative data and research methods
6. An open observation on site

Case studies are carried out on a small number of cases. The reason for this is that case studies are meant to get a deeper insight into the context. A better understanding of the context of the social events or actors is required. This also requires laborious data collection and then analysis. The complete understanding of the context requires various sources of data to be utilized. The common types of data sources which case studies build upon include interviews (individual &/or group), documents, direct observations, participant observations, archival records and physical artifacts (Yin, 2003). These attempts produce an overall and broader picture of research object. That is why case studies are said to be "holistic and rich in insights". The "holism" is achieved, at least in part, through prolonged contact with data source during data collection process and the flexibility at the end of researcher. Researcher in inductive case studies (Eisenhardt's approach) does not use any highly structured instrument for data collection. Indeed Eisenhardt approach to case studies execution is far more flexible than other research strategies; however flexibility is not the license to be unsystematic. Rather this flexibility is controlled opportunism in which researchers take advantage of the uniqueness of a specific case and the emergence of new themes to improve resultant theory (Eisenhardt, 1989). To keep research systematic, researchers need to design and follow a case study protocol that systematically describes all the activities, research instrument, procedures, and general rules to be followed during research, description of cases, time plan, bindings of researcher, analytical strategy etc. In brief a case study protocol is the "correct code of conduct of case study protocol".

4(B). Advantages of case study:

In addition to the "holistic perspective" and their firm groundedness in the context, case studies offer other advantages owing to the use of qualitative data. The advantages of qualitative data are as follow (Miles & Huberman, 1994):

1. Collects the perceptions of the actors from an "Inside perspective". This is in sharp contrast to other data collection techniques in which researcher remains quite dissociated from the context and collects data through tools such as telephone survey, mail survey and questionnaire etc.
2. Main objective is to understand the way local actors understand, account for and take actions in their daily life based on their perceptions of events.
3. Confidence reinforced by firm groundedness of data in local settings. Data is collected in close proximity to the specific situation
4. Greater possibility of identifying latent, underlying or non obvious issues.

Verschuren & Doorewaard (1999) have described following advantages associated with the use of case studies.

5. It is easier for the fledgling researcher to delimit this type of research into manageable portions. This would not be possible with other research methodologies such as surveys and experiments
6. Possibility of obtaining significant results despite lack of research methodological trainings. The researcher would run few risks during research process, especially in data analysis when compared to experiments and methodologies involving quantitative data.

4(C). Cases Selection:

To explore the key research questions of this research multiple case studies would be conducted. Eisenhardt & Graebner (2007) have used the term "polar types" in which a researcher samples extreme cases in order to more easily observe contrasting patterns in the data. Samples may be chosen for revelation of an unusual phenomenon, replication of findings, elimination of alternative explanations or elaboration of emergent theory. There is no ideal number for number of cases, usually 4-10 cases work well (Eisenhardt, 1989). But the selection of number of cases is always influenced by other constraints such as time, distance and resources required for the execution of research. This research is also limited by these time constraints. Therefore cases are selected in such a way that theoretical saturation is achieved within the available constraints. For this research four cases have been selected and they include a pharmaceutical manufacturing plant, an automobile assembling plant, a textile manufacturing plant, and a fertilizer manufacturing plant. These four companies have been selected primarily on the basis of their long term involvement (more than five years) in IMS implementation and secondarily due to their willingness to participate in this research. Selecting multiple cases also has the advantage it increases the generalisability of the findings and results is a comprehensive theory (Meredith, 1998).

Conclusion

Research on IMS implementation is scarce. Better understanding of corporate motivation for IMS implementation and of factors influencing implementation would help various stakeholders to facilitate IMS implementation. A provisional conceptual research framework has been proposed to identify drivers of IMS implementation and factors that influence IMS implementation. The inductive case studies have been proposed to find the answers to research questions. The research is expected to be of interest/value to practitioners, government regulatory agencies, and academicians involved in facilitating IMS implementation.

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Management team change in venture capital-backed firms

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Abstract

In this paper we elaborate on several theoretical explanations that underlie past empirical work on top management teams (TMT) and explore the factors driving TMT changes in new venture-capital backed firms. We found demographic and functional team heterogeneity, CEO tenure and prior start-up experience, and the presence of dismissal covenant to be positively related to the TMT change. We also examined and did not find support for team size and team conflict's relation to TMT change. We attempt to integrate our empirical results with well established TMT literature and suggest future research directions that may be helpful to researchers seeking to further explore these issues.

Keywords: Turnover, change, top management team, new venture, venture capital.

Introduction

While the bulk of top management team (TMT) research has been conducted on existing large firms, primarily because of the ready availability of secondary data, the richest and most interesting studies of TMTs are likely to involve new ventures (Ensley et al. 2002). Indeed, recent research reflects a growing interest in the entrepreneurial TMTs, which we define as the group of people involved in the creation and management of a new venture (Cooper & Daily 1997; Kamm et al. 1990). The interest in studying entrepreneurial TMTs stems in part from the recognition that team founded ventures are often more successful than those founded by solo entrepreneurs (Chandler and Hanks 1998; Roberts 1991). Entrepreneurship scholars and theorists further acknowledge that the skills and capabilities required of the team members who lead entrepreneurial firms change over time; thus, new team members need to be brought in and founders whose skills have become outmoded need to be replaced (Rubenson and Gupta 1996; Boeker and Wiltbank, 2005). This pervasive "firm life cycle" perspective on entrepreneurship makes understanding the impact of TMT composition and the lead entrepreneur characteristics on TMT change an important theoretical and empirical endeavor.

Yet, little research has systematically examined the dynamics of TMTs in general (Ucbasaran et al. 2003; Chandler et al. 2005; Forbes et al. 2006), and there are few studies that address team dynamics in the context of venture capital-backed high-technology start-ups (Ensley and Hmieleski 2005; Vanaelst et al. 2006; Beckman et al. 2007). Filling this research gap is important in helping VCs, universities, science parks, incubators and others who are interested in support of and dealing with high-tech small firms to avoid management changes that can be detrimental to venture success. In this paper we use and adapt multiple theories and perspectives to enhance our understanding of what are the antecedents of TMT change in new VC-backed firms.

Venture capitalists (VCs) consistently mention TMT quality as an important funding criterion (MacMillan et al.1985; Zacharakis & Meyer 1998).This emphasis makes sense because while new ventures do not have history, inertia, and precedent, the entrepreneurial team is a relatively observable and controllable entity. Because changes can be a costly and ineffective way to improve venture performance, it is in a VCs' interest to know when to avoid funding ventures that are likely to be impacted by changes. Most importantly, if we understood the factors that were driving TMT changes, we could begin to evaluate how

changes might be used to create long-term value for a venture's backers. If well understood, the process of TMT change could be shaped to enhance ventures' chances of success.

The paper is structured as follows. First, we present the theoretical framework underpinning the study and develop the hypotheses exploring the factors that drive the change in entrepreneurial TMT of the VC-financed high-tech venture. Second, the sample, methodology and the variables utilized are discussed. Then, we discuss the results of the study identifying future directions that may be helpful to researcher seeking to further explore these issues. The final section presents conclusions, limitations, and suggestions for further research.

Theoretical perspectives on TMT change and hypotheses

The literature on the change in TMT suggests that change can be viewed in at least three different ways. First, it can be viewed as an attempt to attract team members who possess all the skills and knowledge necessary to survive in a highly dynamic and uncertain environment. This is a human capital interpretation that typically prescribes having a certain type and amount of prior experience on a team, as a means of ensuring that the TMT acts to maximize the venture's value. Looking at the type and amount of prior experience and gained knowledge within the team members is what VCs do prior to funding (Cooper et al., 1994; Gimeno et al., 1997; Schefczyk and Gerpott, 2000; Baum and Silverman, 2004).

Second, in contrast to the human capital perspective providing convincing reason for changes in new venture team, but offering not much guidance to the process for achieving optimal team configuration, organizational demography literature theorizes about team composition and diversity in addition to the existence of any particular experience. The change in TMT may be due to demographic heterogeneity or an effort to create desired heterogeneity (Reagans et al. 2004) and high levels of conflicts (Amason 1996; Jehn 1997).

Lastly, the life cycle literature suggests the high-tech ventures go through a number of phases of activity in their development and face different dominant problems in each phase (Kazanjian 1988; Vohora et al. 2004). In order to progress to the next phase the entrepreneurial team needs to develop or acquire resources and capabilities, including managerial capabilities. For instance, it is common for fresh expansion capital to be needed, and the management team then needs capital-raising skills and experience (Dorf and Byers 2007). Thus, as the venture develops, the emphasis on each core capability within the team changes, although a base level competence across all dimensions is needed for resilience and the venture success.

In the rest of this section we develop hypotheses by treating human capital issues first. Then we discuss issues related to organizational demography, including heterogeneity, conflicts and tenure. We conclude by examining those issues related to firm life cycle and timing.

Human capital

Human capital theory implies that teams should attract individuals who have the capacity to generate returns or to procure resources. Taken to its extreme, the human capital view may suggest that teams that possess all the skills and knowledge necessary to survive in a highly dynamic and uncertain environment should be formed. For example, building a successful technology company demands three types of business knowledge: knowledge of how to develop and manage a new company, knowledge of the process of product

development and production, and knowledge of the particular market in which the new company will operate (Shane, 2004). The problem is that "owning" all the resources necessary to compete and survive is rarely possible for young ventures (Stevenson & Gumpert 1985). Yet, by this logic alone, if a single individual possessed the skills and knowledge needed, building a team or adding even one member would be redundant.

As showed by Ensley et al. (1999) and Timmons (1979) even in organizations managed by entrepreneurial teams, there is a preeminent entrepreneur who shapes and maintains the organization's collective vision. The lead entrepreneur brings value to the new venture as the person who identifies the opportunity, although he or she may have substantive skills needed by the venture as well. Team members bring skills needed by the venture which the lead entrepreneur does not have. The reasoning leads us to expect that if the lead entrepreneur has the necessary business knowledge needed it is less likely that he or she will bring more members to the team who have the same experience.

Research has shown that venture capitalists (VCs) state that the quality of the founding team is one of the most important criteria when they decide to invest in a start-up (Clarysse and Moray 2004). High-tech start-ups, especially academic spin-offs, tend to be founded mostly by homogenous teams including only engineers lacking commercial experience and networks (Vohora et al. 2004; Shane 2004; Ensley and Hmieleski 2005).Often, one of these engineers is acting as a champion and perceives himself as a future CEO of the company. VCs tend to react against these start-ups by looking for a CEO themselves and changing the founding team drastically before investing. In the same vein as mentioned above, the reasoning leads us to expect that if the lead entrepreneur has the necessary business knowledge needed it is less likely that the VC investor will insist on replacing the lead entrepreneur with an outside CEO. Formally stated these two hypotheses are:

H1: CEO's working experience in the particular market/industry in which the new venture operates will be negatively related to TMT change.
H 2: Prior start-up experience of the CEO will be negatively related to TMT change.

Organizational demography

The theoretical underpinnings of organizational demography typically rely on one or two substantive traditions to explain the advantages and disadvantages of demographic heterogeneity (Beckman et al. 2007). Some scholars draw upon classic social psychological theories and emphasize group dynamics and interpersonal processes (Williams and O'Reilly 1998). Others draw upon sociological theories and emphasize social network correlates of demography (Hoang and Antoncic 2003). As Reagans et al. (2004) articulate, there are "optimistic" and "pessimistic" views of heterogeneity in both traditions. In the pessimistic psychological view heterogeneity is problematic because it disrupts group processes and produces interpersonal conflict. Similarly, in the pessimistic sociological view, there is a lack of social closure and trust. In contrast, optimists of both psychological and sociological persuasions emphasize the information advantages of heterogeneity. Demographic heterogeneity brings together people with different skills, experiences, and social ties and is advantageous because it expands network resources and provides more and better information.

Upper echelons and strategic decision-making literatures suggest that demographic heterogeneity (prior working experience in industry, education, age) among new venture team members may be related to the (in)stability of the team. Wagner et al. (1984) argued

that heterogeneity reduces social integration, communication, and cohesion. Past research (Harrison et al. 1998; Jackson et al. 1991; Wagner et al. 1984, Wiersema and Bird 1993) provides some indication that heterogeneity may be positively related to team turnover. Thus, both theoretical and empirical evidence suggest that team heterogeneity is likely to be associated with changes of membership in the new venture team.

H3: Demographic and functional heterogeneity in the new venture team will be positively related to TMT change.

The TMT's incentive to consume company resources to their own personal advantage is generally lower in VC-backed firms than in large, public firms where top manager's ownership is relatively small. However, at times the interests of the founders and VC-investors diverge. For example, if the venture has to raise additional funds to finance further development, it is in owner-manager's best interests to have the venture valued as high as possible so that less equity will be given up. Similarly, it is in VC's interests to have the value set as low as possible in order to gain greater equity. Existing VCs on the firm may also wish to discourage other groups of investors from providing funds so as to limit competition for equity (Sapienza et al. 2002). Entrepreneurial managers and VCs can also come to disagreements on strategic decisions and goals. These disagreements were shown to be associated with conflict (Sapienza and Gupta 1994). The conflicts often arise when the a priori expectations of the VC director and CEO are not met (Deakins et al. 2000). Greater potential for disagreement may encourage the team members to leave (Amason 1996; Jehn 1997). Hence, we expect that the new ventures teams experiencing the conflict are more likely to disband and thus experience change in TMT.

H 4: High level of conflict within a team is positively related to the change in TMT.

The Law of Requisite Variety (Ashby 1956) suggests that the variety of resources required is contingent on the conditions in the environment (Chandler et al. 2005). Because the task environment is not yet clearly defined for newly emerging organizations, it is unlikely that the new venture can clearly define the relevant resources, competencies, and capabilities from the outset, but only through experimentation (Sarasvathy 2001; Starr and MacMillan 1990). In addition, research evidence suggests that increased size has a negative effect on the social integration, informal communication, and communication frequency of teams. Amason and Sapienza (1997) found that larger teams often produced high levels of affective conflict, which has been shown to have negative impacts on group cohesion (Jehn et al. 1997). Taken together, these arguments lead to the following hypothesis:

H 5: The entrepreneurial TMT size is positively associated with changes in TMTs.

Relationship building and bonding takes time (Smith et al. 1994). During the emergent phase of a business, cohesive bonds are less likely to have formed, which also makes it easier to add or drop members. If team members like working together and share the same values and beliefs they are more likely to stay longer in the team than people who dislike each other and have conflicting views. The longer the member stays on management team, the stronger bonds and working routines are developed between this individual and

other members. The new venture team has always a leading entrepreneur, a champion who leads the team and the venture (Ensley et al. 1999). The longer the champion stays on the team, more commitment he or she gets to the team and more experience he or she gets of leading the team. If the CEO has not worked together with other team members for long period, it is easier for CEO to add or replace team members. Prior to funding, in addition to CEO's business knowledge discussed above the VC will look at the CEO's tenure (Franke et al. 2006). The longer CEO's tenure may serve as an indicator of the team members working well together under his/her supervision. Therefore, we anticipate the number of years spent by CEO in the venture to be negatively associated with team change. Hence:

H 6: CEO tenure in the new venture will be negatively related to change in TMT.

Firm life cycle and timing

Another aspect of entrepreneurial TMT composition is time and its affect on the team. The research has found that effects of diversity, especially for demographic characteristics, within the TMT decreased over time as the TMT engaged in lengthy discussions and solved disagreements and complex problems (Glick et al. 1993; Harrison et al. 1998). This may be beneficial to the venture as it develops and as tasks become routine which are more efficiently handled by homogeneous TMTs. However, the need for a heterogeneous TMTs may still be desired because the heterogeneous team can make more effective decisions. Therefore, a change in TMT composition may be desired, and a mechanism that will make departure from the TMT graceful is needed.

The practical value of having a life cycle view of the venture is that it helps the team to identify key points where change in the business will occur (Baxter et al. 2007). According to life cycle approach, the high-tech start-up goes through the different phases of development, in which the venture faces different dominant problems and needs to develop different resources and capabilities to solve the problems (Kazanjan 1998; Clarysse and Moray 2004; Vohora et al. 2004). This requires having different types of skills and knowledge on a TMT in different development phases (Vanaelst et al. 2006). In VC-backed firms a dismissal covenant is frequently used (Fiet et al. 1997) – conditions to force a change in the composition of the new venture team. Dismissals covenants are intended to prevent top managers from engaging in actions that would be in conflict with the profit-maximizing goals of the venture. These actions would be punished by dismissing the guilty team member. Adapting to entrepreneurial setting and applying the life cycle perspective the mechanism to force a change in the composition of the new venture TMT can be viewed as an important tool. With the help of the dismissal covenant VC directors can adjust an entrepreneurial TMT's demographic and cognitive composition according to the venture's needs, in terms of development stage and venture environment.

H7: The presence of covenant to potentially force a change in the TMT will be positively related to the TMT change.

The overview of all hypotheses may be found in figure 1.

Insert Figure 1 about here

Methodology

The data set originates from a survey addressed to the CEO of 240 current and newly exited portfolio companies in Norwegian venture capital funds. This sample constitutes the portfolios of the primary members of the Norwegian Venture Capital Association as of 2004. Seventy companies returned their questionnaires resulting in a response rate of 29%. Fifty-four of the respondents were CEOs. Sixthteen questionnaires were completed by others in the management team (e.g. Chair, CFO, CTO). Only twenty-seven of the respondents identified themselves as founder managers.

The sample comprises eight academic spin-offs, nine corporate spin-offs, and the remaining cases are classified as independent start-ups. We registered membership change in top management team in thirty-four firms. We evaluated non-response bias by comparing respondents and non-respondents according to business sector and sales. The analyses reveal no significant differences across these variables.

Measures

In the questionnaire, we asked if changes in the management team had taken place (yes/no). We also asked about the CEO prior experience with start-ups, industry, and within the firm. We measured team heterogeneity by three diversity items, and created a factor based on these items (capture diversity by education, industry experience and age). We also asked a set of questions regarding mechanism in the contract they had with their VCs. When measuring conflict, we used conflict items from the Intragroup Conflict Scale by Jehn (1995), and Shah and Jehn (1993). The nine conflict measures (with facets of goal, process and affective conflict) loaded on one factor, and this factor was used as a proxy for management conflict.

Analysis

Since we have a single measure of management member change, a discriminant analysis is the most appropriate assessment technique (Hair et al. 1998). Table 1 lists the variables that were employed in the discriminant analysis, and their effects. The canonical correlation is .50 which means that the metric variables account for 25 % of the variance in the categorical variable. The function is significant (Wilks' Lamda is 0.75, a Chi-square equivalent of 14.92; $p<.037$). The overall quality of the function is best demonstrated by its predictive ability, and the function classifies approx. 74% of the cases correctly based on these metric variables.

Insert Table 1 about here

Discussion

We did not find support for the first human capital based hypothesis. CEO's prior working experience in the particular market/industry in which the firm operates was not found to be negatively related to TMT change. Industry-specific expertise and knowledge enable a more accurate evaluation of the environment in terms of customers, suppliers, competitors, technology and the interaction between them (Cooper et al. 1994; Chandler 1996) and inform superior strategic issue processing (Jackson 1992). Experienced managers

may bring with them a network of customers, suppliers, and advisers that help to establish the credibility of the venture as it emerges (Cooper et al. 1994). As for VC-backed academic spin-off firms, industry-specific expertise and knowledge is the next most important resource after finance obtained by academic spin-offs from outside the firm through outside directors (Bjornali and Gulbrandsen 2008). As one fourth of all firms in our sample were identified as academic spin-offs, this may be the possible explanation for not finding the support of our first hypothesis. As for other types of VC-backed start-ups in our sample, that is corporate spin-offs and independent start-ups, we may only speculate that if the CEO does not have prior industry experience, this experience can be obtained in two ways: either through venture capitalists who back start-up or through outside board members with prior industry experience who are former or current CEOs in other companies operating in the same or related industry. Chambers et al. (1998) has shown that it is the balance of experience (prior industry, prior management, functional and start-up experience) that is crucial in new firm success. Future research is needed to examine in more details to which extent the (dis)balance of experience drives the changes in TMT.

Contrary to our expectations, we find a weak support for our next hypothesis that the prior-startup experience of the CEO is negatively related to TMT change in new VC-backed firms. Our firms in the sample are those already financed by the venture capitalists. In VC-backed firms, founders are likely to be replaced with experienced executives as firms grow and age (Hellmann and Puri, 2002) implying that venture capitalists place more emphasis on the presence of executive experience than start-up experience. This also means that prior start-up experience may be more important for the firm when it seeks VC capital. Once VC attracted, the executive experience on the team becomes more important. Further empirical investigation of these issues is needed.

Our data does not allow us to look closer whether the CEO is the original founder or appointed from outside. We can only speculate here in attempt to relating our finding to previous research. In case of CEO being the original founder of the firm Tashakori (1980) concluded that most entrepreneurial owner-founders were not able to make the transition to more formal professional styles of management, thus they may depart from the team leaving the leadership to professional executive. Roberts (1991) referred to “founder’s disease”, and noted that some entrepreneurs were inadequate managers from the start and others could manage the first stages competently but not later stages. We are unable to discern whether the companies from our sample were in earlier or later stages. Future research may want to take this into consideration and investigate in more details the effects of the founder-CEO and outside CEO on the TMT change in early and late stages of the firm growth.

Lastly, another alternative explanation may be linked to the individual characteristics of entrepreneur implying that CEOs with long prior-startup experience may be not interesting in running the company. Instead they may tend to be more attracted by the opportunity of starting a new company once they recognize that their skills are no longer needed in the company they started up (Russo 2008).

We found demographic and functional heterogeneity to be positively related to TMT change, which we measured by diversity items education, industry experience and age. Chandler et al. (2005) have also found support for three out of six indicators of heterogeneity that they used: major field of educations, years of industry experience, and diversity in functional expertise. These indicators all relate to the work activities that individuals perform in the firm, suggesting that individuals bring into the work environment cultural and disciplinary perspectives that impact the organizational dynamic. Teams composed of members whose disciplines and employment background yield alternative paradigmatic approaches appear to result in higher turnover, perhaps due to increasing levels of conflict as previous research suggests (Amason and Sapienza, 1997).

Another stream of research on teams stemming from social psychology suggests a phenomenon of a single "token" group member, which almost all teams have (Thompson 2000). Because they are different, token members attract more attention from others (Lord and Saenz 1985; Taylor et al. 1978) and are more aware of the characteristics that distinguish them from others (Cota and Dion 1986; Frable et al. 1990). Applying to our context of VC-backed high-tech firms such token member can be a VC-appointed CEO in the management team, which mainly consists of the original founders. Such outside CEO may differ from others by representing interests of the VC and emphasizing short-term financial goals, while the original founders may be more focused on the technology the firm is based on. This visibility that distinguishes token members from others in the team can distract such members from their tasks and interfere with their performance (Lord and Saenz 1985).

We hypothesized that high level of conflict within a team is positively related to the TMT change. Our findings do not support this hypothesis. Perhaps, the voluntary nature of participation in an entrepreneurial venture outweighs problems associated with interpersonal relations and group dynamics. In large established firms, internal promotion systems and bureaucratic politics can influence who occupies an executive position leaving incumbent executives with minimal voice in the choice of and little influence over the actions of their executive counterparts. In contrast, entrepreneurial TMTs are often deeply involved in the choice of prospective team members. Because founders decide to band together and subsequent new TMT members both choose to join and are also chosen by their peer incumbents, the interpersonal chemistry appears to be much less problematic in entrepreneurial settings than in established firm settings.

Another characteristic, which may outweigh problems associated with conflicts and which we were not able to control for, is the teams who have affiliation overlap (i.e., having worked for the same firm). Applying to the context of high-tech small firms, it often happens that a group of people have previously worked together on developing the technology while working in either university or large corporation before they decided to leave their jobs and establish the firm based on the developed technology. In the case, in which co-founders come from university, the firm is academic spin-off. In the case, in which co-founder come from the corporation, the firm is corporate spin-off. In our sample the half of all firms who have experienced TMT change was either academic spin-offs or corporate spin-offs. The other half was identified as ordinary start-ups.

The teams with affiliation overlap may be able to communicate effectively with each other and have a common frame of reference, especially since these individuals have chosen to work together in the new venture (Beckman et al. 2007). As previous research shows, founding team members who worked together before appear to be more effective and have greater trust (Eisenhardt and Schoonhoven 1990; Roure and Maidique 1986), and trust is an important component of social capital (Coleman 1988). These common work experiences may increase the likelihood that individuals have similar priorities and vocabularies and has been shown to affect the development of common beliefs and cultures (Chattopadhay et al. 1999). With affiliation overlap, the internal network is likely to be stronger, with straightforward discussions and a clear sense of appropriate actions. This may lead to fewer conflicts, and thus fewer changes in the TMT. These common work experiences may also increase the sense of belonging, which is the indicator of team cohesion (Ensley et al. 2002). Teams whose members experience a high sense of belonging are shown to be better able to manage conflict than teams with a lower sense of belonging, thus, experiencing fewer TMT changes (Ensley et al. 2002). A detailed analysis of conflict in entrepreneurial top management teams is an interesting research path; however, it lies beyond the scope of this study.

As for the team size, we hypothesized that the increased team size is positively associated with TMT changes. This hypothesis was not supported. Also the previous research

shows contradicting results. A big problem of large teams has to do with the equality of member participation (Thompson 2000). Shaw (1981) shows that the equality of individual members' contributions decreases dramatically as group size increases. In contrast, there are advantages to smaller teams. Members of smaller teams work harder, engage in a wider variety of tasks, assume more responsibility for the team's performance, and feel more involved in the team (Arnold and Greenberg 1980; Thompson 2000). Having reviewed team literature Birley and Stockley (2000) concluded that no mention of optimum team size has been made. One research shows that large teams have been associated with success and faster decision-making (Eisenhardt and Schoonhoven 1990). Other research has failed to demonstrate that team size confers significant advantages, showing that large teams have a greater potential for heterogeneity (Jehn 1995), slowing decision-making (Hambrick et al. 1996) and increasing conflict level (Amason and Sapienza 1997). Taken all arguments together, we may speculate that the relation between team size and TMT change is curve-linear, in which too small and too large teams lead to the TMT changes depending on the firm's stage of development. Future research may want to investigate closer this relationship.

We found CEO tenure in the new venture to be negatively related to the change in the TMT, which is the support for our sixth hypothesis. We hypothesized that the longer the champion stays on the team, more commitment he or she gets to the team and more experience he or she gets of leading the team, and that the longer CEO's tenure may serve as an indicator of the team members working well together under his/her supervision. This appears to be confirmed and in line with previous research. Again, we do not know whether the CEO is also the original founder. However, founders were shown to be central to the creation of the firm (Schein 1983), and in technology-based firms, they may be central to the invention of the technology used by the firm (Chandler and Hanks 1998). The technological champion of the new venture team often automatically becomes CEO. This automatic evolution of the champion role into that of the business manager was demonstrated in the longitudinal studies by Burgelman (1983) and Clarysse and Moray (2004) showing that the transformation process from technological champion to the venture manager occurs almost naturally and automatically. In case of the outside or VC-appointed CEO, CEO's tenure may serve as an indicator of being not only a good leader, but also a person with a high integrating ability and the ability of overcoming difficulties of being a token member in the team.

We found the presence of covenant to potentially force a change in the TMT to be positively related to the TMT change. We hypothesized that with the help of the dismissal covenant VC directors can adjust an entrepreneurial TMT's demographic and cognitive composition according to the venture's needs, in terms of development stage and venture environment. For instance, using this covenant VCs may appoint the outside CEO after the initial VC funding is made and when the need for more professional management becomes clear. Assuming that VCs are not concentrated on short-term goals, which may be detrimental for the new ventures, but that they are adding value to the firm focusing on long-term goals, the covenant may be considered as an important tool to bring the venture on the path of long-term and stable growth. Future studies may explore in-depth how VCs use to implement the covenant to potentially force a change in the TMT (dismissal covenant) and under which conditions and when the dismissal covenant may serve as an appropriate tool for maintaining the desired team heterogeneity and cognitive composition in VC-backed high-tech start-ups.

Conclusions

The growing interest in entrepreneurial teams represents a promising and important development in the domain of entrepreneurship research. In this article, we have advanced that particular line of work dealing with the antecedents of top management team change in venture capital-backed young firms. In this paper we use multiple theoretical perspectives to explore the factors that drive the change in TMT in new VC-backed firms.

We find demographic and functional team heterogeneity, CEO tenure and prior start-up experience, and the presence of dismissal covenant to be positively related to the TMT change. We also examined and did not find support for team size and team conflict's relation to TMT change, which we tried to account for in this study.

Our work adds to existing research in a number of different ways. First, we have clarified the existing state of knowledge on TMT change in new VC-backed ventures by elaborating on the theoretical explanations and complementing to existing theoretical frameworks that underlie the past empirical work. In particular, by employing the human capital, organizational demography and life cycle approaches, we have helped to integrate past work with well-established theories and literature from various domains relevant to management research. Second, in contrast to the bulk of TMT research, which has been conducted on existing large firms from the US, we add to growing research on entrepreneurial teams by providing empirical evidence on VC-backed start-ups from outside US, namely Norway.

There may be some differences in the Norwegian and US culture and business environment. However, Hofstede (1984) shows that the United States and Norway are relatively close to each other with respect to individualism, power distance, and uncertainty avoidance. In his plots showing overall cultural similarity, the United States, Norway and Canada fall in one cluster. This suggests that there are many more similarities than dissimilarities between the cultures of the United States and Norway. We cannot eliminate a competing cultural explanation, but believe the effects that we have attributed to the VC-backed ventures and entrepreneurial setting to have a greater influence than cultural differences.

Our data are not as complete and extensive as data for more established firms. Our study is an exploratory study with a limited number of cases, in which we use a less stringent significance level as decision criterion. However, we attempt to integrate our empirical results with well established literature and past research on teams and identify the specific aspects of TMT change in VC-backed new ventures that are especially interesting and promising. While discussing the results we suggest future research directions that may be helpful to researchers seeking to further explore these issues. In particular, we suggest for the futures studies to distinguish between founder-CEO and outside or VC-appointed CEO. Our findings also suggest, in line with other team studies (e.g. Chandler et al. 2005), that when studying the factors driving the changes in the TMT it is important to take into consideration the firm's stage of development.

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Figures and Tables

Figure 1

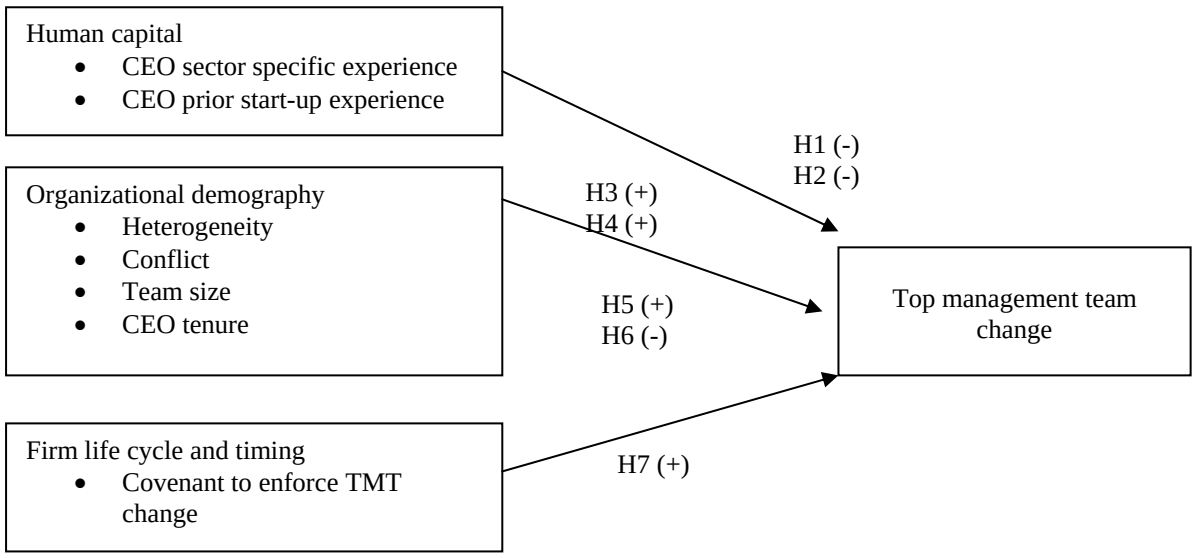

Table 1: Group means and their F equivalents

	Change	No change	F	Sig.	
CEO experience within the industry	11,24	14,94	2,717	,105	Not supported
CEO involvement in previous start-ups	2,12	1,38	2,744	,103	Supported*
Team heterogeneity	,43	-,27	8,684	,005	Supported
Team conflict	,21	-,11	1,433	,236	Not supported
# of team members	4,00	4,44	,786	,379	Not supported
CEO company exp	4,10	6,64	3,366	,072	Supported*
Mechanism in the contract with the VC_ conditions to force a change in the management team	3,32	2,22	5,175	,027	Supported

*As this is an exploratory study with a limited number of cases, we apply a less stringent significance level (.1) as a decision criterion.

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LEARNING TO INCUBATE:

EVIDENCE FROM GREECE (1995-2005)

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ABSTRACT

Aim of the present study is to analyze and explain the contribution of business incubators to the promotion of entrepreneurship. Drawing upon previous research findings and three distinct theoretical perspectives, namely the resource-based view, the resource dependence approach and the social capital theory, we propose a theoretical framework allowing for a pattern-benchmark model for successful business incubation. After gathering secondary data on the business incubation industry in Greece, and qualitative data through face-to-face interviews with Greek incubators' managers, the model is empirically validated in order to sketch the particular incubation landscape and identify best practices. The cases that are examined through a comparative analysis based on our research framework revealed that incubators were developed in two expansion waves, representing different ownership structures and objectives. The findings are further discussed for their theoretical, managerial and policy implications, while some recommendations for the further development of the industry are provided.

1. INTRODUCTION

The business incubation industry is a key feature of the modern knowledge economy, contributing to the development of dynamic regional clusters by supporting new start-ups. Given the importance of the incubation industry, a vast amount of research has addressed the different aspects of the business incubation. Researchers have investigated the incubation phenomenon through the application of economic, organizational and social theories (Bollingtoft & Ulhoi, 2005; Clarysse *et al*., 2005; Gassmann & Becker, 2006; Hansen *et al*., 2000; Peters *et al*., 2004; Remedios & Cornelius, 2003; Rice, 2002; Studdard, 2006), while others have analyzed how business incubators are organized and managed in an attempt to identify best practices (Duff, 1994; Bagby *et al*., 1989; Martin, 1997; Autio & Klofsten, 1998; CSES, 2002; NBIA, 2002; Murphy *et al*., 1996). Another research stream analyzed how business incubators contribute to their tenants (Cooper, 1985; Lumpkin & Ireland, 1988; Merrifield, 1987; Sherman, 1999; Grimaldi & von Zedtwitz, 2006), or the contribution to regional entrepreneurship and economic development (Aernoudt, 2004; Allen & Rahman 1985; Honadle, 1990; Lalkaka, 1996). Although there is an abundance of research papers describing business incubators and their operations, only a few have unified theoretical knowledge to explain their success ~~of incubators~~ (Pena, 2004; Stevens, 2004). Furthermore, in spite of the diversity of actors involved in the process of business incubation, the incubators' interactions with external actors participating in the incubation process remains largely unexplored (Remedios & Cornelius, 2003; Ascigil, 2006).

This paper aims to establish a theoretical research model of business incubation that includes the contribution of business partners in the development of new ventures. The theoretical research model draws on three organizational theories: the resource based view, the resource dependency theory and the social capital theory. These organizational theories have been used to explain the incubation phenomenon separately (Starr & Macmillan, 1990), however, they have never been consecutively combined to analyze and explain the contribution of business incubators in the entrepreneurial process. Our objective is to explain how business incubators facilitate the development of new ventures and to provide a comprehensive conceptual model of how these organizations can effectively be managed and operated. Moreover, we seek to contribute to local incubation studies by empirically investigating the phenomenon in Greece. The application of the conceptual model; modulated in the local industry, is oriented to offer a valuable assisting tool for the further development of business incubators operating in Greece and kindred markets. To come in compliance with research objectives, the present study investigates three research questions.

(1) What are successful Business Incubator models?
(2) How do Greek Business Incubators function?
(3) How can Greek Business Incubators developed further?

2. THEORETICAL VIEW ON BUSINESS INCUBATION

In examining the role of business incubation, we draw on three organizational theories that are often used to explain firm performance: the resource based view, the resource dependency theory, and the social capital theory.

Resource Based View

The main contribution of the **resource based view** is that it can explain how firms obtain and sustain competitive advantages and thus how firms achieve long term profitability (Barney, 2001). The primary principle of this theory is that strategic positioning lies in the identification and intelligent application of a unique bundle of valuable for the firm resources; resources that provide competitive advantages (Wernerfelt, 1984). The resources

that a new entrepreneur needs in the process of creating a new venture can be classified into various categories such as technology, financial, physical, human, social and organizational. The human, social, and organizational resources are more intangible resources and often more difficult to acquire (Clarysse *et al.*, 2005; Fernandez *et al*., 2000). Similarly, Dierickx and Cool (1989) divide resources into two types: tangible and intangible resources. Tangible resources are, for example, machines, equipment and housing; intangible resources are carried within the members of the organisation, such as knowledge and skills, or are ascribed to the organisation, like reputation and image. Following the above, we distinguish two major types of resources, the tangible physical resources and the intangible knowledge-based resources. For business incubation, the physical resources can be infrastructure and financial resources, whereas intangible knowledge-based resources are the pre-incubation services, administrative support, technology expertise, professional services and consulting.

Resource Dependence Theory

The resource dependence theory is an organizational theory that explains firm behavior as a result of their access and dependence on critical resources (Pfeffer & Salancik, 1978; Johnson, 1995). The fundamental argument of this theory is that organizations will respond to demands made by external resource providers and receivers and try to minimize their dependence when possible (Pfeffer, 1982; Johnson, 1995). Depending on the resource needs of an organization, the transaction partners and the exchange balance, the emergent relationship could be dependent, reciprocal or dominant (Silver, 1993). Scott (2003) and Johnson (1995) analyzed the strategies that organizations use to manage their dependency on resource providers or receivers. They argued that organizations can implement buffering strategies to increase the tolerance in case of resource shortage and, or use bridging strategies to strengthen the relations between organizations and suppliers. The resource dependence theory has significant implications within the incubation process. For example, the dependence that a spin-off has on the university or incubator, may affect its strategy. In this research we analyze four managerial issues concerning the resource dependency: organizational structure, admission criteria, management, and performance evaluation.

Social Capital Theory

The social capital theory claims that the social structure of relationships and networks facilitates certain actions of individuals. The resources available within social networks provide opportunity to leverage contacts' resources, and is the motivation and to enter social relationships (Adler and Kwon, 2002). In correspondence with the social capital theory, we suggest that business incubators may provide a link between vital resources and the incubated firm. We follow the distinction of internal and external networks (Nahapiet and Ghoshal, 1998). Internal networks refer to the exchange and transfer of knowledge and resources among members in an entrepreneurial team (Coleman, 1990) whereas external networks refer to the broader network of contacts. We conceptualize the internal networks as the connections within and between the start-ups that are accommodated in the incubator, and the external networks are the contacts outside the incubator.

Theoretical Framework

The theories utilized in this study are complementary to each other and can explain different aspects of the incubation process. To examine their influence on business incubation we developed a theoretical framework which is presented in Figure 1. The Resource Based View explains which resources are important and available for firms. The resource exchange that flows from resource needs result in relationships which can be explained by the social capital theory. The interactions among exchanging parties and their behavior can be analyzed using the Resource Dependence Theory.

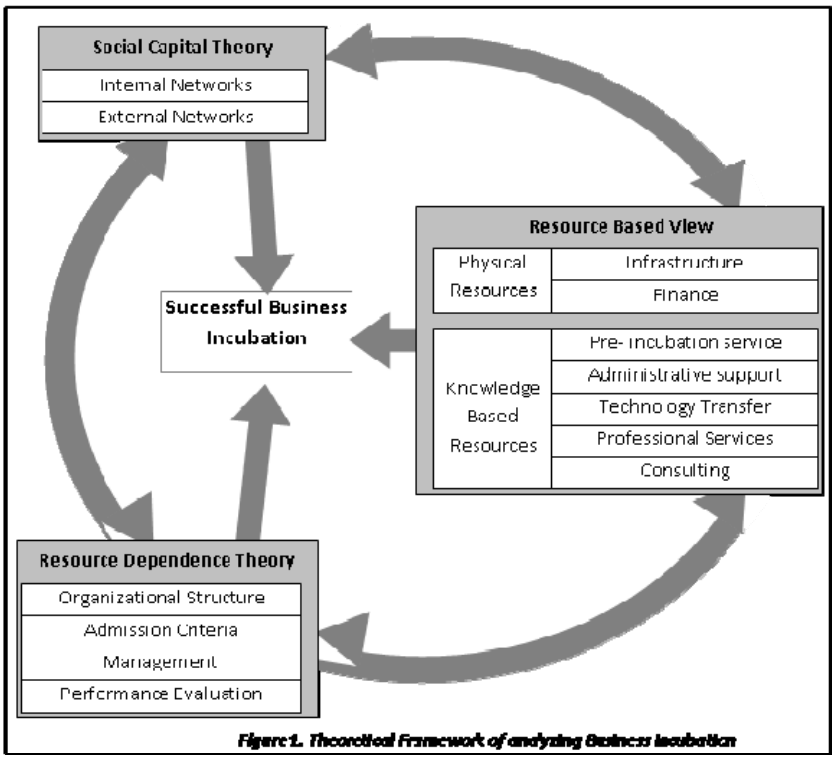

Figure 1. Theoretical Framework of analyzing Business Incubation

3. ENTREPRENEURSHIP AND INCUBATION IN GREECE

The incubation phenomenon has been a topic of interest, not only in innovation and entrepreneurship research but also in the domains of strategic management, organization studies and regional science; all trying to provide a better understanding. Although, the first privately owned business incubation center was founded in 1959 in New York (Brown et al 2000), the research about incubation started at the early 80's. The common understanding is that business incubators can be described as supporters of new business development. The facilities that they offered to their tenant firms range from rental space up to business assistance services. In this paper we employ the general accepted definition of National Business Incubation Association, as mentioned on their website (www.nbia.org):

> *A business incubator is an economic development tool designed to accelerate the growth and success of entrepreneurial companies through an array of business support resources and services. A business incubator's main goal is to produce successful firms that will leave the program financially viable and freestanding.*

Despite the effort to develop a general definition for Business Incubation, there are still a variety of types of business incubators. Scholars have tried to classify these organizations into different archetypes. The most common criterion to classify business incubators is based on funding (Allen, 1985). Allen (1985) identifies 1) publicly funded business incubators that contribute to regional development and job creation; 2) privately funded which goal is the return on the invested capital, and 3) the university funded incubator aimed at commercializing academic research. Recent studies introduced mixed-models such as private-public partnerships (Lalkaka, 2000) or distinguished between non-profit and for-profit incubators (Aernoudt, 2004).

Before we investigate the incubation practices in Greece, we first analyze the levels of entrepreneurship, entrepreneurial attitude and availability of a venture capital community in Greece. In 2006, Greece realized a significant increase in the early stages of entrepreneurship

comparing to previous years, according to the GEM report. About 7.9% of its population is concerned to be potential or nascent entrepreneurs. This percentage, ranked Greece in the 4th position in Europe among countries participating in GEM's (2006) report. Uncertainty and fear however, could prevent people to undertake entrepreneurial activities in a percentage of 60%, one of the highest among GEM countries; although 22% of population believes that entrepreneurial opportunities exist. The MRB HELLAS (1998) survey indicates that almost 96% of SME are funded by personal or family capital, while around 68% of SMEs' operations are financed by bank loans, a fact that is imputed to the lack of venture and seed capital (European Observatory 2003).

Regarding financing, as also stated before, data from the last 15 years indicate that more than 95% of funds for the development of new ventures reflect own savings and its close network (family and friends). The country is positioned in the bottom of EU's-15 list of venture capital investments, while the last years Greece is experiencing one of the highest growth rates in EU. Slightly better is the picture for seed capital investments, a fact that endorses the strong financing support of entrepreneurs from their close network. The lack of venture capital and in general of high-risk investments is one of the main obstacles of entrepreneurship in Greece according to the same research. As a consequence of those mentioned before, in Greece is reported an inequality regarding the financing opportunities for entrepreneurs as well as irrational utilization of capital for investors. Mentality of informal investors, lack of trust and lack of relevant education, could count as reasons for the current status of informal investments.

The birth and early stage development of supporting organizations (S&T parks, business incubators) in Greece, was started with the support of the government and the EU in the matrix of extensive policy initiatives for the development of the Greek economy. The expansion, took place in two "waves" of supporting initiatives. At first, in the beginning of the 90s, the Greek government started to provide funds to universities and public research institutions for the establishment of parks, through which the research institutions could exploit and commercialize their R&D results. Intention of the government was to attract to the parks, knowledge-intensive enterprises, in order to support them through the interactions with the research institutions and the information exchange. These governmental initiatives initially led to the development of four science and technology (S&T) parks across the country. At the late 90s, three more S&T parks were added to the project, resulting to the today's shape, with the existence of seven parks stretching the whole territory of Greece.[1]

The second wave of policy initiatives for the development of supporting organizations started in 2001 and was on course till the end of 2006. Focus of this second initiative was the establishment of private business incubators, with the argument that active participation of the private sector in financing would lead to active involvement also in managing; a fact that could enhance the effectiveness of these organizations. The realization of the second wave of development was sponsored by the European Commission and took the form of an industrial 'Competitiveness' program that would improve the entrepreneurial environment, especially in sectors where the first initiative presented weaknesses, namely: venture capital, seed

[1] So far no comprehensive evaluation of performance has been undertaken. The only known study (Bakouros et al 2002) included the first three S&T parks and reported underperformance on the basis of only one successful graduation. The study included a relatively small sample of firms located in the parks till 2001 and identified as probable factors for the underperformance: the inadequate funding, the lack of managerial expertise (i.e. running the facilities and to the provision of specialized consulting services), the confusion between research and commercial needs and the ineffective infrastructure.

capital and unwieldy incorporation procedures. The program 'ELEFTHO'[2] provides incentives for the development of private business incubators and S&T parks, in order to foster the development of knowledge intensive, innovative ventures. Public funding; which takes the form of grants, cannot exceed the 50% of the total cost of investment, while emphasis is given -beyond infrastructure- to more value added factors such as consulting-services provision and access to risk capital.

The recipients of the public assistance are private enterprises, planning to establish and operate business support units in the Greek territory and to host knowledge based tenants. These enterprises are expected to serve as channels through which financial support will be transferred to tenants. Proposals for participation to the initiative are evaluated from national authorities and international experts. During the implementation period of ELEFTHO (2002-2006) ten business incubators' start-ups were supported, from which three do not exist today and one is still in the setting-up process. Those that operate today are counting for the majority of private funded incubators in Greece. From the available data, seven S&T Parks were identified in Greece and nine operating Business Incubators.

4. METHODOLOGY

This research focuses on business incubation in Greece. Greece was chosen for two reasons. First, in order to limit political, cultural and economic factors that may affect the results, we collected data from a single country. Second, incubators in Greece were created during two relatively short waves of expansion. This short time period allowed us to make better comparisons since incubators have approximately the same age and were developed under the same economic and political setting.

Method

The main research method is case study analyses of the business incubators in Greece. Two data collection methods are employed. Initially, secondary literature was addressed to investigate the case of business incubation in Greece. The incubators were identified through research papers, the General Secretary of Research and Technology (Ministry of Development/ ELEFTHO database), regional Chambers of Commerce and web search. The case studies were created using data from web-sites, promotional brochures and presentations on business incubation in Greece. Then, qualitative data were collected through face-to-face interviews with incubator managers. The qualitative data collection followed quite a structured procedure, built on two distinct parts, both of them grounded on the literature. The first part was based on the main components of our theoretical framework. The second part explored the interactions among the main components.

Structured interviews

The topics that were discussed during the structured interviews with the business incubation managers are based on the resource based view: physical and knowledge based resources; the resource dependence theory: managerial issues, and the social capital theory which included the networking.

Physical resources refer to the incubator's *infrastructure* that is offered and the availability of *financial capital.* Literature indicates that business incubators usually have the ability to provide seed capital, either from own funds, or through network of contacts (business angels).

[2] ELEFTHO is the name of the initiative for the development of private business incubators. The initiative, which is part of EU's 'competitiveness' program, is run by the General Secretariat of Research and Technology, a department of the Greek Ministry of Development.

Given that venture capital is still under-developed in Greece, an incubator's ability to provide own seed capital or to enable capital flows from other sources, may influence its success.

Knowledge based resources reflect the services provided to tenants in the context of a business supporting organization. Depending on the development stage of incubate, some services are more valuable than others. To be more specific, when a business idea is transforming to a new venture, the *pre-incubation services* provided by an incubator may simplify bureaucratic procedures. This is an essential service in Greece, as bureaucratic procedures are –to an extent– accused for the lack of entrepreneurial activity. In later stages, ventures may struggle with operational issues and *administration support*, such as joint use of photocopiers and secretary may reduce their operational cost. Also *professional services* like accounting, legal, and marketing, can help start-ups as they often lack the people and, or knowledge in these fields. Another type of service that the incubator can provide incubates is the *technology expertise*. Technological know-how and knowledge of using technological equipment can help incubates in translating their research findings into commercial products (Murray, 2004). Incubators may also provide *consulting* and training-programs. Particularly in Greece, the business incubators' ability to cultivate entrepreneurial spirit to entrepreneurs is important. In Greece, people do not commit easily to entrepreneurial activities because of the high levels of fear and uncertainty that they feel. A business incubator can implement this by selecting the entrepreneurs they host and by interesting potential entrepreneurs.

The **managerial issues** refer to the *organizational structure* of the business incubation, either flat or hierarchical. The structure influences the communication and information exchange in the context of the organization (Jones, 2004). Another important factor that influences the incubator is the admission criteria. *Admission criteria* refer to the entry criteria as set by the incubator. This will involve whether the new venture can benefit from the services, resources and networks as provided by the incubator. Similarly, the exit criteria determine the extent to which the new venture can take advantage from the benefits as provided by the incubator. In addition, the tenant firm can become dependent on the incubator if the incubator managers are involved in managerial tasks. For instance the incubator manager can help and, or provide assistance in negotiations with potential clients and investors. Also incubators will use performance evaluation criteria during the period incubate is at the incubator. These criteria will involve objectives of all the involved parties, along with pure financial goals (Hackett & Dilts, 2004). We will investigate here the extent to which the objectives are clearly defined in the *performance evaluation*. Management involvement is another managerial issue that follows from resource dependency. It reflects the inclusion of incubator managers in the tenant's operations, either trough the advisory board, or through incubator's assistance in negotiations while setting up business contracts.

The **network** of the business incubator can be important to the incubate as it provides access to benefits such as important information and resources, but may also provide the incubate with legitimacy, influence, and power. We distinguish in internal networking and external networking. Internal networking is between the tenants. These networks may facilitate the distribution of knowledge and experience regarding setting up a new business. External networks refer to the access to the business environment and venture capital community.

Validity

This research focuses on a local incubation market. Although its objective is to contribute to the national studies, the findings cannot generalize without validation. Another validity concern is due to the research method. The main method of data collection is interviewing that reflect memories and subjective judgments of the respondents. This constraint could have been limited if in the analysis, multiple respondents from the same organization have been

interviewed. This was not possible in the case of Greek business incubators where many incubators were management by a single manager. Also, the nature of the examined phenomenon, the way that the data was collected and the way that insights are presented, are highly dependent on the researchers interpretative skills, knowledge and experience. This may cause bias regarding the questioning as well as the way that responses are interpreted.

5. CASE DESCRIPTIONS

Thessaloniki **T**echnology **P**ark:

The TTP was founded in 1988 by the Chemical and Process Engineering Research Institute (CPERI), an institute of the Foundation of Research and Technology Hellas (FORTH). Operations started in 1994 based on non-profit motives and aimed at facilitating the exchange of technology, people and ideas between industry and university, and thereby contributing to local wealth creation. The shareholders are both public and private. Since its establishment, TTP has assisted approximately 28 businesses and can accommodate about 10 firms. The maximum length of time that tenants can be located at the incubator is limited to three years.

Patras **S**cience **P**ark

The PSP was founded in 1989 from the Foundation of Research and Technology Hellas (FORTH) to exploit the research capabilities of the University of Patras. In 1992 a business incubator started at PSP as a private non-profit company, entirely owned by the Ministry of Development. Aim of the incubator is to contribute to competitiveness and local job creation, through the hatching of innovative projects and R&D exploitation. The incubator, which is operating on its capacity limits, has currently 25 tenants and has assisted approximately 30 companies as far. More than half of the current tenants are start-ups, with the majority of the rest being spin-offs mainly from the university and R&D centers. Tenants are theoretically expected to leave the incubator's units after five years, but the rule has been flexible in the past and tenants are not pushed to exit as long as they achieve the goals of their business plan. The park is considered to be attractive because of the flexible rental terms, low prices, and their strong ties with the Ministry of Development which may make it easier to get informed about and participate in sponsored projects.

Science & **Te**chnology **P**ark of **C**rete

The Foundation of Research and Technology-Hellas (FORTH) was the founder organization also in the case of STEP-C in the late 80s. The managing company of the park (EDAP SA) was established in the late 1993 with 30% participation in the initial capital from FORTH, 30% from Piraeus Bank and 24 smaller shareholders; mostly private companies. The managing company of the Park is a private entity operating for-profit. STEP-C main objective is to help universities and research institutions to commercialize academic knowledge. Encouragement and assistance on start-up firms and the establishment of an educational center for executives' and entrepreneurs' specialization are additional objectives of the Park. The incubator has assisted more than 60 companies and has a failure rate of 9%. In the park there are currently located 20 businesses, half of them start-ups, 9 academic spin-offs and 1 corporate start-up of. The Park is operating with an occupancy rate of 85%.

Science & **Te**chnology **P**ark of **Epirus**

The STEP-Epirus was established in 1999 by the University of Ioannina. Its function as an incubating organization though, started in 2004, after the establishment of the managing company STEP-Epirus SA. The incubator is designed to be for-profit, in contrast to the previous examined organizations, despite the fact that it is funded by 70% from the public segment. The University of Ioannina, the local municipality and the Ioannina Cooperative

Bank are some of the main shareholders. The incubator has no graduates as far, because of its young age and it is currently hosting 14 ventures; the maximum of its capacity. From the businesses that are located in the Park, three are spin-offs from the University and R&D centers, five are branches of existing firms and seven started as new ventures. The length of time that a firm can occupy incubator's units is three years (plus two after evaluation) but from the as far experience, rules are flexible. The park is considered to be attractive for new businesses, firstly because of its infrastructure, and then because of the image it infuses to tenants and because of the abilities for networking that provides; so internally as externally.

Technology **Pa**rk of **The**ssaly

The Technology Park of Thessaly SA was established in 2001 and manages the incubator TEPATHE. TEPATHE is a private for-profit company, which has 39 shareholders equally coming from the public and the private segment. A public company (Metallurgical Industrial Research & Technology Development Center – MIRTEC SA) is the main shareholder; participating with 30% in the initial capital, through the provision of the premises where the incubator's facilities were developed. TEPATHE facilitates the transfer of technology and knowledge from Universities and R&D institutes to the private sector, through supporting new and existing companies. The Park is currently assisting ten companies and operates at 80% of its occupancy. More than 25 firms have been assisted from TEPATHE. The current tenants are all private start-ups, while University spin-offs and branches of established firms have been hosted before. The Park does is considered to be attractive because of its location in the region's industrial area. TEPATHE does not take equity position on tenant firms due to the lack of the appropriate fund. However, consulting regarding finding the appropriate fund and advices on pursuing it are provided from the incubator's manager.

Incubator of new enterprises **CHANIA**

Although the organization is called 'Incubator of new enterprises' it is classified in the first 'expansion wave' of business supporting organizations. The Incubator of new enterprises CHANIA was established in the mid 2000 from the Hellenic Organization of Small & Medium Enterprises and Handicraft (EOMMEX) which is the major shareholder, owing 90% of the shares. The Prefecture of Chania and the Industrial & Commercial Chamber of Chania participated also with equal shares (5% each) a fact that results to a entirely public owned organization. The incubator is not for-profit and its management reports to EOMMEX. EOMMEX is part of the Ministry of Development, General Secretariat of Industry. Main objective of the incubator is to cultivate innovation in the local region and to create new jobs by supporting new start-ups. The incubator differs from other incubators because it is not allowed to offer professional services to external clients. The incubator has assisted so far 19 businesses, while is currently hosting 8 start-ups and 2 spin-offs. Maximum time that tenants can stay is determined to be 3 (plus 2) years; but shows this rule is flexible.

Business Incubator **BIC-of-Attika**

'Business Incubator BIC-of-Attika' is the most recently established incubator in Greece, started operating during 2007. The incubator is branch of BIC-of-Attika, member of the European Community of BICs and is located in the Technological Cultural Park of Lavrion. The Mother-Corporation; BIC-of-Attika, is a private non-profit company, owned by public as well as private organizations. The Athens Chamber of Small & Medium Sized Industries, private banks, Universities, the Municipality of Piraeus and the Hellenic Organization of Small & Medium Enterprises and Handicraft are some of the main shareholders. The incubator is positioned neither to the first, nor to the second wave of policy initiatives as it did not receive support from subsidies. However, for the discussion we placed it in the first

wave because of its non-profit character. The incubator mainly helps universities commercialize know-how and helps companies to generate spin-offs. The incubator is currently assisting three firms; operating at a 25% rate of its capacity, while several admission requests are under examination to cover the remaining positions. The most attractive characteristics are considered to be: the flexible rental agreements, as well as the availability of professional services in low charges through the BIC-of-Attika.

i4G (Incubation for Growth)

i4G was set-up in 2003 during the second 'wave' of policy initiatives to support entrepreneurship. It was established by EUROCONSULTANTS SA, the largest consulting company in Northern Greece, as a private for-profit incubator with a capacity of 15 tenant firms. EUROCONSULTANTS SA is located next to the facility. The incubator, has assisted 22 companies as far, and is now operating at its capacity limits. i4G helps entrepreneurs in realizing their business ideas and in generating spin-off activities. The incubator focuses on the development of internal networks and business clusters in the facility, and this is considered to be attractive from the tenants' perspective. i4G has three successful stories to present as far; ex-tenants, which grew fast and needed more room to expand.

VCI (Velti Center for Innovation)

VCI is a corporate incubator, established in 2005 by Velti; an international company providing platforms and services to enable mobile marketing in 12 countries worldwide. The incubator VCI was established as a distinct private company, in order to participate in ELEFTHO program. VCI is a profit-oriented incubator, specialized in information, new media, telecommunications and related services. Mission of VCI is to assist mainly start-ups in these sectors. The project is relatively small, which is reflected in the limited capacity. Currently, six start-ups are located at the incubator and it operates at its capacity limits. Due to the young age of the incubator (two years), no successful graduations have been achieved yet. VCI does not employ strict rules regarding the maximum length a tenant can stay. Despite the successful graduations, the project is considered to be very competitive because of the specialization of VCI and the parent Velti in the fore-mentioned sectors. This is also the main reason why the incubator is perceived as an attractive location for new start-ups.

THERMI (**The**ssaloniki **R**esearch & **M**anagement **I**ncubator)

THERMI is a business incubator that hosts technology-based start-ups. The incubator started in 2004, when the managing company; THERMI SA was founded with the support of ELEFTHO initiative. The incubator's mission is to transform innovative entrepreneurial ideas into new business and to contribute to competitiveness and job creation in the region THERMI is a privately owned company seeking financial results. The incubator is considered to be one of the larger facilities in SE Europe, with a capacity of around 30 tenants. Currently, the occupancy rate is with 27 firms 90%. Two of them are established firms and two R&D spin-offs. Tenant firms cannot stay linger than 3 years, but management intends to be flexible. Taking into account the relatively newness of the incubator, it is quite successful with three graduations yet. People, infrastructure and the availability of business support services are considered to be the most attractive characteristics of THERMI.

6. CASE STUDY RESULTS & ANALYSIS

In Table 1 we report the findings of the 10 case studies of the Greek Business Incubators. We distinguish in the table two categories: incubators established during the first expansion wave and during the second expansion wave. The former have increased public involvement and aim to commercialize mainly R&D results, whereas the later are coming from the private

sector and focus at general start-ups. For each business incubator the table presents the level of business support with respect to the categories of the theoretical framework. We scored the level of services by ranging from 'no service' provided (-) to high levels of service provided (*****).

The *physical resources* were distinguished in infrastructure and financing. Table 1 indicates some large differences among incubators established during the first expansion wave. Specifically, TTP, STEP-C and PSP ranked high for infrastructure. TEPATHE and STEP-Epirus do not offer advanced laboratories, and together with the private incubators of the second category (i4G, Thermi and VCI) they ranked medium. The incubator BIC of Attika is a very young organization which is probably still developing its facilities, while the Incubator of New Enterprises Chania scored as last. Regarding capital provision, incubators developed during the second expansion wave have a clear advantage. Their private character and financial incentives allowed them to participate in the equity structure of tenant firms: VCI, i4G and Thermi scoring highest. BIC of Attika that also invests in tenant firms, follows and the Incubator of New Enterprises Chania, which neither provides own seed capital, and has insufficient links with capital providers, scores as last.

With respect to the *knowledge-based resources*, the incubators developed during the second expansion wave are more effective. Particularly the private incubators VCI and i4G score high. This may be the result of the influence by the parent corporation that supports these functions. The third private sector incubator, Thermi, is scoring third. The public-sector incubators are scoring considerably lower with the Incubator of new Enterprises Chania and the BIC of Attika as last. It is clear that the private-sector involvement in the incubation industry hatched the provision of knowledge-based services. Some other interesting conclusions can be drawn by analysing one by one the aspects of knowledge-based resources that were investigated. In particular, the empirical investigation indicates that Greek business incubators provide little pre-incubation services. Merely VCI contributes to the development of business concepts for entrepreneurial ideas in fields of its interest: multimedia, IT, internet services. Administrative support is especially provided by the private sector incubators. Technology transfer is provided mainly by the first expansion wave incubators. Their focus on the commercialization of R&D results is clear from their objectives and their infrastructure. The more effective organizations in terms of technology transfer are STEP-C, TTP and PSP. The business incubator VCI is scoring relatively high on technology transfer because of its focus on IT and multimedia. Professional and consulting services are again more present in private incubators. The corporate incubators i4G and VCI are again scoring highest, followed by Thermi, and leaving PSP, TTP and BIC of Attika next. It is worthy to mention, that public policy has the intention to extent their support with more knowledge-based resources.

Flat structured organizations are beneficial for internal communication and information exchange. Business incubators that are constructed in that way may be more supportive in developing a collaborative environment among their tenants. The empirical research revealed that private incubators are not implementing flat structures as public ones do. Incubator of New Enterprises Chania, TEPATHE and STEP-Epirus are ranking highest in terms of flat structures. TTP, VCI, i4G and Thermi, however, are more supportive in cultivating an internal collaborative environment despite their hierarchical structures. This apparent paradox may be because of the small management teams of the incubators, which is often a single manager. The *admission criteria* of the potential clients screening process is believed to be one of the determinants of business incubators' success. The business incubators i4G and VCI correspond closely with the criteria recommended in literature. Thermi and PSP are following, while the other business incubators employ in the screening process also criteria

related with the ability of potential tenants to participate, together with the incubator, to subsidized research programs. This criterion is implemented because participation in research programs is a major source of income for business incubators, especially in the public sector. In terms of *management competencies*, the private incubators developed during the second expansion wave (VCI, i4G, Thermi) are scoring higher than those in the first wave. BIC of Attika, although very young, presented effective competencies. It seems that the emphasis to knowledge based services promoted by the second policy initiative found response. The fact that public incubators score lower; Incubator of New Enterprises Chania, TEPATHE, STEP-Epirus, may reflect the fact that they are managed mainly by academia instead of business experts. PSP and BIC of Attika seem to be more consistent with the propositions of previous research regarding criteria of *self-performance evaluation*. These organizations, in accordance to their objectives are monitoring their performance in terms of graduates and gather feedback from tenants and shareholders. The private incubators (VCI, Thermi, i4G) and also most of the remaining public monitor their performance on a financial-return basis. Hence, tenants are not pushed to exit the facility as far as they pay the rents, a fact that may lead to disagreement with incubator's objectives; development of free-standing enterprises.

Regarding *networking*, the empirical research focused on two categories. Internal networks is the first category and aims at the development of peer-supporting environment and of business clusters, the second category is external networks which consists of partnerships and informal connections with the marketplace. The private incubators, VCI, i4G and Thermi, were the most sufficient in enhancing collaborations and corporations among tenants, while the public support incubators scored low. With respect to the external networks, VCI and i4G were the most effective, followed by BIC of Attika to foster partnerships with business partners. Those are all corporate incubators, and connections were provided mainly through the network of the mother-corporation. Regarding the external networks, the main resources that an incubator can offer are access to knowledge/information, access to capital, legitimacy and other knowledge-based services. Given that seed and venture capital are underdeveloped in Greece, the incubators that are able to provide access to capital are those who have an international character and connections with foreign investors. These organizations are mainly the corporate incubators, VCI, i4G and BIC of Attika; because of their mother corporation. On the other hand, incubators developed during the first expansion wave; specifically STEP-C, TTP and PSP, are more effective to offer access transfer capabilities because of their close relations with universities and R&D centres.

Table 1. Support provided by Business Incubators in Greece.

	Criteria	First Expansion Wave							Second Expansion Wave		
		Chania	**TTP**	**STEP-C**	**PSP**	**Tepathe**	**STEP-Epirus**	**BIC of Attika**	**i4G**	**Thermi**	**VCI**
	Founded	2000	1988	1993	1989	2001	1999	2007	2003	2004	2005
	Aim	Public NP-JC	Public NP-TF	Public NP-TF	TF	Private FP-TF	70%Public FP-TF	Private NP-TF	Private FP-SE	Private FP-SE	Private FP-SE
	Capacity	10	10	20	25	12	14	12	15	30	6
	Record	19	28	60	30	25	14	3	22	27	6
Physical Resources	Infrastructure	*	****	*****	****	***	***	*	***	***	***
	Financing	*	**	**	**	*	*	***	*****	****	*****
Knowledge -Based Resources	Pre-incubation Services	-	*	*	*	-	**	*	*	**	***
	Administrative Support	-	**	*	*	-	-	*	***	***	****
	Technology Transfer	-	****	*****	****	**	**	-	*	*	***
	Professional Services	**	***	***	***	**	**	***	*****	****	****
	Consulting	*	*	**	**	*	**	**	****	***	****
Managerial Issues	Organizational Structure	****	***	**	**	****	****	***	***	***	***
	Admission Criteria	*	***	**	***	**	**	**	****	***	****
	Management	*	***	***	***	***	***	***	*****	****	*****
	Performance Evaluation	***	**	**	****	***	**	****	***	**	***
Networking	Internal Networks	*	**	***	**	**	*	**	***	***	****
	External Networks	**	***	***	**	***	***	****	*****	***	*****
Total Score		17	33	34	33	26	27	29	45	38	50

TTP = Thessaloniki Technology Park
STEP-C = Science & Technology Park of Crete
PSP = Patras Science Park
TEPATHE = Technology Park of Thessaly
STEP-Epirus = Science & Technology Park of Epirus

I4G = Incubation for Growth
THERMI = Thessaloniki Research & Management Incubator
VCI = Velti Center for Innovation

JC = Job creation
NP = Non-profit
FP = For profit
TF = Technology transfer
SE = Support Entrepreneurship

7. CONCLUSION AND DISCUSSION

In Greece, where the market is small and has no long industrial tradition, the establishment and success of new technology-based ventures is subject to several problems related to investment gap, research gap and information/trust gap. To deal with the obstacles of entrepreneurship, policy makers have undertaken some actions to support the establishment of business incubators. The development of business incubators in Greece occurred in two expansion waves. The first took place with the policy's initiative to promote the Universities' technology transfer in the early 90's, while the second took place after 2001 with the policy's intensive to transfer funds (through private incubators) to new ventures. Based on the case study analysis we can draw some conclusions regarding the effectiveness of business incubation. In terms of capital provision, incubators developed during the second expansion wave are in advantageous position as they are able to utilize public funds, together with their own, to invest in tenant companies. Corporate incubators can make more use of the capital and network available at the parent corporation.

Regarding knowledge-based resources, the research identified in Greece a necessity for the provision of pre-incubation services and support in administrative issues; mainly because of the uncertainty that nascent entrepreneurs face and the complex-bureaucratic procedures to incorporate a new venture. Again, private incubators seem to be more effective here. Technology transfer is achieved mainly through incubators developed during the first expansion wave. TTP, STEP-C and PSP are considered the most effectively functioning incubators in this aspect, because of their close ties with universities and R&D centres. Furthermore, the findings reveal that tenants do not use the services provided extensively. This is even clearer for incubators with a public character. The private incubators that are managed by business experts seem to resolve this inconsistency by offering training workshops and seminars. VCI, which moreover has a specialized client focus, seems to be most effective. Worthy to mention are the attempts by TTP to reactivate tenants to make use of the knowledge-based offerings.

Regarding networking, we distinguish between internal and external networks. Private incubators are more efficient in fostering internal collaborations; Thermi, i4G and VCI are successful examples. In terms of external networks, the corporate incubators; VCI, i4G and BIC of Attika are the most efficient providers of resources through their network of contacts. Another interesting result is that none of the Greek business incubators has links with its graduate firms. Unfortunately little can be learnt from these graduates. The identified best practices, lead to the conclusion that the most effective incubator model is the private incubator. More particularly, the corporate incubators seem to be in advantageous position as they utilize the expertise, the experience and the networks of the mother corporation. Additionally, the links with the market, which provide information flows and potential customers for tenants' products, are considered valuable. Connections with the research field should also exist, although only public incubators seem able to utilize research knowledge.

Implications for Policy

Overall, analyzing the Greek business incubators indicate that the university-based incubator model is facing a decline in comparison to the private sector business model. This corresponds with findings by Finer's and Holberton's (2002). Also the empirical findings are consistent with the results of Ryker's (2001) research on the Norwegian incubation industry. He claims that the 'run as a business' model is more efficient. The policy shift in Greece to follow the private model may be effective. Still, in order to improve the entrepreneurial activity we recommend that policy makers should tackle some of the core constraints of entrepreneurship in Greece. More specifically, as far as the lack of the appropriate funds is an

obstacle for the emergence of new ventures, policy makers should promote the development of high-risk funds. By encouraging business incubators to reduce their dependencies on public funding, they could deregulate capital as to be used to subsidize the development of private high-risk funds. Additionally, policy should tackle the bureaucracy embedded to the procedure of incorporating a new enterprise. These regulations discourage the promotion of entrepreneurial activity, and more simple procedures should be implemented. Also, the uncertainty that keeps entrepreneurial activity in low levels can be tackled by the education system. Concluding, as aforementioned the policy shift to the private sector for the development of business-supporting organizations is considered as quite successful. We suggest that some time has to pass; in order for a rational assessment to take place, before the next wave of policy initiatives. The age of incubation facilities is however a crucial determinant of success (Allen and McCluskey, 1990), so after some time their impact in entrepreneurship could more rationally be assessed and measured.

Limitations & Recommendations for Future Research

The young age of incubators is one of the main limitations of the present study, and does not allow testing the progress over longer periods or larger amount of incubator tenants. Future research may be better assessing the impact of business incubators in Greece. Moreover, the current project does not offer any performance measurement. Future research may consider individual goals of the sponsors, but also the goals of participants involved: tenants, institutions, investors, etc. Also the performance of business incubators can be related to business models and theory, which will additionally help to explain to what extent the theoretical framework is able to predict the success of business incubators' functioning.

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The Web 2.0 as Marketing Tool: Opportunities for SMEs

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Abstract

The new generation of Internet applications widely known as Social Media or Web 2.0 offers corporations a whole range of opportunities for improving their marketing efficiency and internal operations. Web 2.0 applications have already become part of the daily life of an increasing number of consumers who regard them as prime channels of communication, information exchange, sharing of expertise, dissemination of individual creativity and entertainment. Web logs, podcasts, online forums and social networks are rapidly becoming major sources of customer information and influence while the effectiveness of traditional mass media is rapidly decreasing. Using the social media as a marketing tool is an issue attracting increasing attention. The hitherto experience is that large public corporations are more likely to make use of such instruments as part of their marketing and internal operations (McKinsey, 2007).The paper defines the Web 2.0 phenomenon and based on the experience of large corporations examines how SMEs could engage the various Web 2.0 instruments in order to efficiently market their products, improve customer relations, increase customer retention and enhance internal operations.

Keywords: Web 2.0, Social Media, E-Marketing, Online strategy, Consumer Influence

Introduction

The Internet with more than 1.3 billion users worldwide is a social and commercial reality that no corporation big or small, can anymore ignore. The influence of the Internet on business and consumers has been substantial in the past and most observers expect that it will become even more substantial in the future. During the past three years two important developments have shaped the future of the Internet i.e. the fast penetration of

the broadband connectivity and the advent of the so-called Social Media, often referred to as Web 2.0. Focusing on the second development, widely considered as the next stage of the Internet evolution, one could observe that a fast increasing number of Internet users are becoming familiar with Web 2.0 applications like Web logs, online communities, collective games and social networks. Many consumers – and mainly the younger ones - regard such environments as key elements of their social life and much of their social activity takes place online: communication, information exchange, sharing of experiences, dissemination of individual creativity and entertainment.

The impact of Web 2.0 on consumer perceptions, attitudes and behavior is substantial; social media are becoming major sources of customer empowerment and influence (Urban, 2003) while the impact of traditional mass media and conventional marketing tools as consumer influencers is steadily declining.

The Web 2.0 (often referred to as Social Media[1]) is the most recent phase in the evolution process of the Internet as commercial environment. While some skeptics reject the whole notion as nothing more than the new technology hype, the growth and success of the phenomenon suggest that Web 2.0 is here to stay. There are three main reasons supporting this argument:

- The Internet / Web 2.0 as communication platform becomes increasingly part of the consumer's daily life at the cost of traditional media. According to a recent survey by Alloy Media & Marketing 96% of US teens participate to online social networks at least once a week (Biz Report.com, June 27, 2007). Internet users read less print and two third of them consider the Internet to be a very or extremely important source of information (up from 56% in 2005)[2]. Newspapers and other forms of print media experience a steady circulation decline[3] and similar trends are visible in the television and broadcasting industries; while attendance and advertising incomes of traditional media is in a free fall the Internet and cable news see the numbers of their users and their share on advertising budgets increasing (TNS Media Intelligence, 2007)[4]. The rejection of traditional media is

[1] In this article the terms Web 2.0 and Social Media will be used as interchangeable
[2] USC Annenberg School Center for the Digital Future, 2007 http://www.digitalcenter.org/

[3] http://www.washingtonpost.com/wp-dyn/content/article/2005/05/02/AR2005050201457.html

[4] http://www.tns-mi.com/news/09112007.htm

more dramatic among the younger consumers; according to a 2006 Arbitron study (www.arditron.com) the time spend on radio listening among the ages 12-24 years has fallen between 1999 and 2006 by 15%, much higher than all other age groups.

- The popularity of Web 2.0 among professionals is rising. According to the Social Network Practitioner Consensus Survey of May 2007 (BizReport.com, June 5, 2007) more than 50% of business people said using social networks and an increasing number of corporations are already experimenting with social media as part of their organizational structure and marketing strategy.
- The Web 2.0 becomes popular among mainstream consumers as instrument of customer empowerment. The consumer becomes increasingly aware of the fact that Web 2.0 applications offer new and previously unknown possibilities and empowerment (Urban, 2003), not only due to access to more and better information but also due to the network effects of peer to peer connectivity and community building. Customer empowerment means that consumer voice is getting louder; increasingly social media sites become forums of criticism, dialog and confrontation of commercial firms with their social, ethical and commercial responsibilities. The power of these media is substantial: on an almost daily basis “citizen journalists” expose cases of corporate misconduct or product glitches forcing companies to respond. Web log postings about product or services problems often prompt “blog swarms” (Gillin, 2007) frequently reaching the mainstream media with significant effects and consequences. Dell Computers was forced to recall one of their laptop models after bloggers reported about a malfunctioning and potentially dangerous battery and the bicycle lock maker Kryptonite was forced to withdraw and replace one of their high security locks after a video appeared in video exchange sites demonstrating how anyone could open the lock with a simple ball point pen.

What is Web 2.0, what are its dimensions and possible consequences on the marketing practice? What are its effects on consumer behavior? What are the lessons already learned from the experience of the pioneers in this field? How can SMEs effectively adopt Web 2.0 technologies as part of their marketing strategies and what are the expected benefits?

This paper attempts to address some of these questions by explaining the basic principles of Web 2.0, looking to different ways these technologies are utilized by larger firms and makes some basic recommendations on approaches that smaller enterprises should consider in embedding the Web 2.0 concepts as part of their (direct) marketing strategies.

What is Web 2.0?

The term Web 2.0 has been introduced by O'Reilly (2005) and was quickly adopted by Silicon Valley circles as well as by many practitioners and observers. There is no definition widely accepted and the issue is at the moment open to discussion. A simple Google search query of this term produces more than 3 mil results and there are several definitions already proposed. In the academic literature there is no agreement as to the delimitations of this term (Needleman, 2007; Coyle, 2007). The definition applied in this paper is the one proposed by Constantinides and Fountain (2007)

Web 2.0 is a collection of open source, interactive and user-controlled online applications expanding the experiences, knowledge and market power of the users as participants in business and social processes. Web 2.0 applications support the creation of informal users' networks facilitating the flow of ideas and knowledge by allowing the efficient generation, dissemination, sharing and editing/refining of content.

On the basis of this definition the Web 2.0 can be described along three main dimensions: The Application Types, the Social Effects and the Enabling Technologies. These dimensions are illustrated in the following picture (Illustration 1).

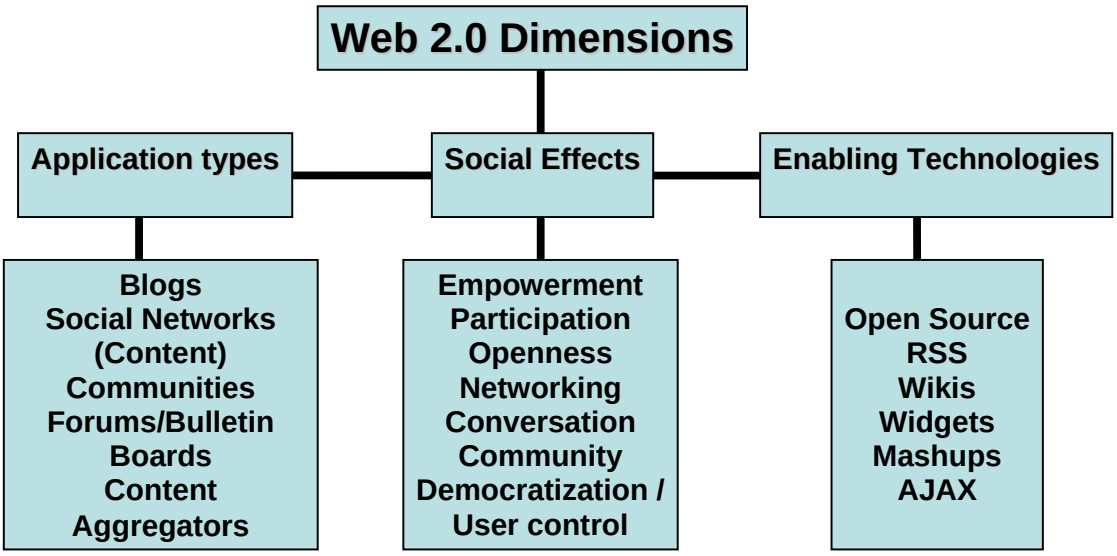

Illustration1: The three dimensions of Web 2.0

Application Types: There is a wide variety of application types fulfilling the criteria of the above-mentioned definition. In order to simplify the issue the application can be classified in five many categories.

1. Blogs: Short for Web logs: online journals, the most known and fastest growing category of Web 2.0 applications (Du and Wagner, 2006). Blogs are often combined with Podcasts i.e. digital audio or video that can be streamed or downloaded to portable devices.

2. Social Networks: allow users to build personal websites accessible to other users for exchange of personal content and communication.

3. (Content) Communities: Web sites organizing and sharing particular types of content. Examples are applications of Video sharing, Photos sharing, Social Book marking and publicly edited content sites like online encyclopedias

4. Forums / Bulleting Boards: sites for exchanging ideas and information usually around special interests.

5. Content aggregators: applications allowing users to fully customize the web content they wish to access. These sites make use of a technique known as Real Simple Syndication (RSS).

The user is a vital factor for all categories of Web 2.0 applications, not only as consumer but also as content contributor. The term User Generated Content (UGC) is often used to underline this special attribute of all above Web 2.0 application categories.

Social Effects: Enabling the seamless generation of information and easy access to it is the key advantage of Web 2.0 applications. Copying, sharing, editing, syndicating, reproducing and re-mixing information are common practices in the Web 2.0 domain. The generation, sharing and dissemination of information results to democratization of knowledge and active participation of the user as contributor, reviewer and reporter. Users can easily create communities of special interests and further share their experience and knowledge but also engage in a transparent conversation with the industry or even politicians. The result is as explained earlier a unique form of customer empowerment allowing customers to affect as never before the market power structures and more importantly the shape of the future marketing. The Social effects of the social media are by and large a fascinating research area and a field most likely to shape the future consumer or even human behavior.

Enabling Technologies

While several technologies involved in the Web 2.0 domain are not necessarily new, there is a basic difference between Web 2.0 and the previous software applications namely the fact that many of these applications are open source (O'Reilly, 2005; Constantinides, 2007). This fact has places the application user in the chair of the application co-developer and has lead to a fast, low cost and efficient application improvement. Next to existing applications the Web 2.0 movement founded on some unique new software applications and development techniques. The purpose of this article is not to examine this aspect of Web 2.0 but bellow there is a short description of the most important new enabling technologies and development tools applied in this domain.

RSS is short for Rich Site Summary, a way to syndicate and customize online content

Wiki is an application allowing collaborative publishing

Widget is a generic term for the part of a Graphical User Interface that allows users to interface with the application and operating system

Mash-ups are aggregators of content from different online sources to create a new service

AJAX is a web development technique used for creating interactive web applications

The Web 2.0 as a marketing management tool

The effects of the Web 2.0 on business and their environments are recently attracting more and more academic attention. Research interest is focused on the impact of the Web 2.0 applications on corporate processes (Craig, 2007; Yakel, 2006), the importance of online communities for corporations (Du and Wagner, 2006; Korica et al., 2006; Swaine, 2007) or issues regarding the effects of these new technologies on business (Karger and Quan, 2005; Biever, 2006; Deshpande and Jadad, 2006; Boll, 2007). Non-academic sources provide also plenty of evidence as to how corporations integrate the Web 2.0 applications into their operations (DeFelice, 2006). An increasing number of studies suggest that corporate interest on the Web 2.0 domain keeps growing and more and more firms are introducing different forms of social media into their daily business routines as well as into their marketing strategies (Cymfony, 2006). In a global survey conducted in 2007 McKinsey found that the popularity of Web 2.0 applications is raising among businesses; while most companies surveyed have so far integrated a limited number of such applications into their business strategies the large majority think that "investing in them is important for maintaining the company's market position, either to provide a competitive edge or to match the competition and address customer demand". (2007 McKinsey survey on Internet Technologies). The study concludes that the Web 2.0 applications affect a wide spectrum of marketing activities from building product or brand awareness to sales services.

Large corporations are the pioneers: Experiences from the field

Understanding the nature, possibilities and effects of Web 2.0 applications could place marketers in the position to utilize this domain to their advantage but lack of systematic research means that engaging social media as marketing communication tools is still a trial-and-error process. This process is obviously requiring new thinking and mew approaches as traditional push marketing methods are inappropriate for social networking

sites (Forrester, 2007). In this respect there is a considerable knowledge gap on the nature of Web 2.0 and its added value for marketing strategy. Most of our knowledge on the role of Web 2.0 applications as marketing tools is primarily based on anecdotal evidence. This evidence also suggests that the vast majority of firms engaging Web 2.0 as a marketing tool are large corporations. Based on field experience this chapter will classify the main ways marketers have attempted so far to extract value from the Web 2.0 domain.

Marketers could influence the customer decision-making process by means of Web 2.0 tools in two principle ways: The Passive and the Active way.

1. The Passive way or *Listening-In*: *Using the Web 2.0 as an intelligence source i.e. as a source of customer voice and market information.*

Marketers can learn a lot by listening to the customer's voice i.e. what people say about the firm and its products on line, by monitoring the social media space: blogs, podcasts, forums and online communities. Listening to the customer is especially important in order to identify market experiences, new market needs and receive early warnings for product problems: warnings indicating the need to improve, modify or drop products. What customers say online is vital and viral sharing of customer experiences can lead to success or failure of brands and products and seriously disrupt costly marketing actions. "Listening –in" to the customer's voice provides companies with early warnings about customer dissatisfaction and allows for fast corrective reactions.

Common sense suggests that if properly collected and analyzed the online customer voice can provide precious and high quality information at a fraction of the time and cost required in using traditional market research for this purpose.

The important question is how to find and tap the customer's voice but there are already different options available. Web sites like the TIMES Online List with the 50 best business blogs [5], the Corporate Responsibility Group[6] or Bized [7] are examples of useful

[5] http://business.timesonline.co.uk/tol/business/industry_sectors/media/article1923706.ece

[6] http://www.corporateresponsibilitygroup.com/

[7] http://www.bized.co.uk/current/index.htm

online sources of consumer voice. Next to that marketers must trace discussion forums, communities or even video sharing sites where exchange of information about the firm's and competitive products takes place. There are several specialized tools and search engines that could help marketers in locating and gathering this type of content. Nielsen Buzz Metrics, a commercial service monitoring several millions of blogs, can provide marketers with a lot of information as to what is discussed online and even what is said about the company or its products. Specialized classification tools like Technorati (http://technorati.com/), blog search engines like BlogPulse (http://blogpulse.com/) or the "index aggregator" TalkDigger (http://www.talkdigger.com/) are easy to use and low cost alternative solutions.

2. The Active way: Using Web 2.0 applications as PR, Direct Marketing and Customer Influence tool as well as a means for personalizing the customer experience and tapping customer creativity.

a. Using Web 2.0-based application as PR and Direct Marketing tools

Several businesses are actively engaged in dialog with the customer by launching their own corporate blogs and discussion forums. Business executives like Jonathan Swartz, CEO of Sun Microsystems, Steve Jobs, CEO of Apple Computers and McDonalds Vice President Bob Langert post daily on their corporate blogs, encouraging customers to interact and freely express their feelings, ideas, suggestions or remarks about their postings, the company or its products. A widely applied variant of this strategy (initiated by Microsoft back in 2003) is to encourage company employees to become publishers of content themselves in corporate blogs and forums. This approach requires openness and trust of employee capabilities from the part of the firm (McAfee, 2006; Bryan et. al., 2007). Censoring of employee content is counterproductive; a good practice is to agree in advance on the basic principles and possible limitations on corporate blogging.

An alternative and more simple way to engage social media as PR tool is to use content communities - like the video sharing sites YouTube, GoogleVideo and others - as broadcasting media for distributing advertising material. Commercials uploaded to these sites have the potential to be viewed by thousands or even millions of viewers or virally distributed among users at practically no cost.

b. Engaging Web 2.0 personalities for customer influence

This approach is based on proactively engaging the online sources of customer influence (blogs, podcasts, online forums etc.) as customer influence tools. This requires identifying, reaching and informing the "New Influencers" (Gillin, 2007) about the firm, its brands or (new) market offers. The objective is to attract the attention of leading blogs or users forums so that they review, discuss, comment on or even recommend the usage of the firm's products. Next to reaching and engaging these sources as company advocates, marketers can also reach very specific audiences by advertising in well-selected blogs and special interests networks or communities. This enables immediate access to target markets, even to very specific market segments at a fraction of the costs required by traditional media. Finding the major influencers per product or product category requires some effort but the tools mentioned in the previous section are also suitable for this purpose.

c. Engaging social media for personalizing the customer's online experience

This approach could lead to closer ties between the customer and the firm by offering customers the possibility to personalize their online experiences in an environment created and controlled by the firm itself. Brick-and-mortar firms like Nike, Disney, Coca Cola, TIME magazine, The Hearst Media etc are already experimenting with such tactics as part of their direct marketing: seeking communication, interaction and customer feed back. They do this by introducing web sites based on user generated content, encouraging customers to customize them to their needs and often create their own social networks.

d.1. Tapping and disseminating customer creativity in the form of advertising concepts or product reviews.

Tapping customer advertising creativity is likely to result in increasing customer goodwill and customer advocacy. SONY, Frito-Lay's, Sunkist and Coca-Cola are indicative examples of a growing number of corporations partnering with talented amateurs who review their products, generate advertising concepts or even create TV commercials for them. The idea behind such partnerships is that advertisements created by peers are perceived as being more credible and therefore more effective than one created by advertising experts. There is some evidence that this is often the case: According to a Bizrate survey (2007) 59% of web users consider customer product

reviews – a concept initiated by Amazon and widely applied by now - to be more reliable than those from experts. A study of Deloitte Touche USA indicates that 62% of the US consumers read consumer-generated online reviews and 98% of them find these reviews reliable enough. Next to that 80% of these consumers say that reading peer reviews has affected their buying intentions. In a study conducted by Carlson Marketing 85% of consumers say that they recommend a company with which they have a trusted relationship to others. The trust of consumers on peer rather than expert opinion is based on the perception that the former is more reliable since it reflects the genuine feelings of the product user like them. This strategy requires either creating Web 2.0-type corporate web sites where users or customers can place their own product reviews or creating communities and Forums / Bulletin boards where customers can express their views.

d.2. Making the customer a co-producer

The second variant of the strategy of utilizing the customer creativity is capitalizing on the growing customer individualism by making available online tools allowing the partial or full customization of the company products. Pioneers in this area are companies like Kleenex (myklenextissue.com), photostamps.com allowing consumers to create their own (US Postal Service approved) stamps from their photos, Heinz (myheinz.com) inviting customers to create their own personalized labels of their ketchup bottle and M&M (nymms.com) make it possible for customers to select their favorite candy colors and have a personalized message printed on it. Pepsi invites fans to design their soft drink cans in the Design Our Pepsi Can Contest (www.designourpepsican.com) with the best idea adopted as the new look of the product in regular intervals and NIKE offers similar tools to its customers allowing customizing the sport articles they order online (http://nikeid.nike.com). The popular chain IKEA recently launched an online campaign in The Netherlands called “Everyone is Designer” encouraging customers to create their ideal living space (http://www.iedereenisdesigner.nl/designyourownlife).

Web 2.0 and its potential value for SMEs

It is not surprising that the main efforts so far for utilizing the social media as marketing tools have been initiated by large corporations is not surprising. Large corporations are traditionally the early adopters of new and often untested technologies; they often operate

globally where such technologies can provide substantial economies of scale while the availability of financial and human resources make the risk of exploring unknown terrains more acceptable. SME's and mainly the smallest ones among them, are often struggling to keep up with even the more traditional online web activities like having a presentable and functional web site; lack of financial and human resources and lack of time are usually serious barriers for such parties (Veen van der, 2004). Yet investing in Web 2.0-based marketing activities could be potentially rewarding for this category of firms. The payoff can be more efficient and less costly marketing. This section will examine the main ways SME's could utilize the Web 2.0 and extract value from it.

a. A basic condition: willingness to invest

Any SME interested in utilizing the social media as marketing tools must be willing to allocate some financial resources and assign a number of persons (the number depending on the ambition level) to this activity as well as be willing to review and improve their "traditional" online presence. A well-designed and usable web site is necessary not only as the company window to the online world but also as a site that will actively support Web 2.0 – type applications.

b. Review options

The second stage is to review the different options mentioned earlier and decide what of these methods are vise and feasible to apply. The main Web 2.0 applications related to the marketing objectives identified on the basis of the existing experience are summarized in Table 1.

Web 2.0 Applications as Marketing Tools					
	Passive	Active			
MARKETING OBJECTIVE	Listening In	PR and Direct Marketing	Reaching the New Influencers	Personalizing customer Experience	Tapping customer creativity
APPLICATION TYPE					
Web logs	XXX	XXX	XXX		X
(Content) Communities	XX	X		XXX	XXX
Social Networks	X	XX		X	XX
Forums / Bulletin Boards	XXX	X	X	XX	XXX
Content Aggregators		XX	XXX		

XXX: very suitable, XX: suitable. X: suitable sometimes

Table 1. Web 2.0 applications as Marketing Tools

The table identifies the combinations of marketing objectives and online applications or approaches available and identifies the suitability of each application type in reaching the marketing objective.

Looking to the two general approaches described (Passive or Active) for engaging Web 2.0 applications as marketing tools and the efficacy of each category in reaching the marketing objectives it can be argued that for many SMEs the passive form of engaging the social media as marketing tools is not easily applicable in all its forms. Given to the small size and often limited market coverage of the SMEs there is little chance that the majority of them will be able to catch any substantial online customer murmur about their products. Listening-in to the customer's voice makes sense if the company is known enough to the market as product leader, innovator or has reached a level of customer numbers that produces enough buzz and content regarding the company products. What most SMEs can do though is to listen to the voice of their target markets in general: what customers say about competitors, competitive products. They can also look for online information that identifies the need for new products or product modifications and act accordingly. The main sources of such information are outlined in the Table 1: Web logs

and online forums are the most important potential sources of such information followed by the content communities and social networks.

The investment required for engaging in such an activity is relatively limited. A well trained and experience person could find and evaluate the online information, some attention must be also given to the organizational issues related to the distribution and efficient utilization of such data. Some funds should also be made available for subscribing to commercial organizations like that can provide assistance in locating the customer voice.

c. Engage Social Media as Active Marketing tools

The degree that an SME will engage the social media as active marketing tools depends as in the previous case on the company size, market coverage and of course the marketing objectives. In principle all four categories of objectives (using Web 2.0 as PR and Direct Marketing tools, reaching the new Influencers, personalizing customer experience and tapping customer creativity) are presenting very interesting options to SMEs. The way of engaging the social media is similar to the way large corporations do that and described earlier. In the Table 1 the different applications and their suitability for each objective are illustrated. This types of activity require however a higher level of firm commitment in the form of financial means and human resources and probably some degree of organizational transformation. This because the firm in this case becomes also active contributor of Web 2.0 content. For example personalizing the customer experience means that the firm must create and make available online tools that will allow the user to customize his experience; tapping consumer creativity means actively reaching the customer and offering tools that will allow the customer to express his/her creativity either in advertising copies or design of new products. Next to this he firm must follow up by evaluating the customer generated content and in cases of interesting ideas to integrate them into the mainstream marketing program.

The active engagement of Social Media is therefore depended on the management commitment and ambition and also on the capacity of the firm to create the necessary organizational infrastructure necessary for utilizing these technologies in the proper way. As to the most likely candidates to make use of such media among SMEs, the size and

market position / reputation of the firm are important criteria for this. An extensive costs - benefits analysis is needed in order to evaluate the value of these media versus traditional marketing tools for achieving the above mentioned objectives. The newness of the subject means however that there is still not enough knowledge or reliable metrics of the effects of Web 2.0 applications as marketing tools versus traditional marketing tactics.

Conclusion

The vast interest and endorsement of the Social Media by the online public presents corporations with threats but also with many opportunities to improve their marketing strategies in novel and effective ways. Large corporations are so far the pioneers in this area engaging different types of Web 2.0 applications in order to get in touch with their markets, communicate their message or simply listen to the customer voice. In that respect social media can play a variety of roles as marketing tools; advertising, public relations and direct marketing but also as sources of market information and trends signaling. They can also improve customer relations by personalizing the customer experience and utilizing the customer creativity. A new task of marketers is to understand the degree of influence the social media exercise on customer behavior and decision making and try to establish contacts with the centers of market influencers.

Although the results of such activities have not yet properly studied, initial experience indicates that there is an important hidden potential here. SMEs could learn from the experiences of larger corporations and engage selectively the social media as part of their marketing strategies. The larger and the more successful SMEs are the ones more likely to try first. Management commitment, willingness to invest and willingness to transform the organizational structures and culture are conditions that should underpin any such effort.

Finally from the academic point of view more research is needed in analyzing this new phenomenon and measuring its effects. This will provide a clear picture as to the advantages of Web 2.0 as marketing tool versus the traditional marketing approaches.

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Clustering and the Internationalisation of High Technology Small Firms in Film and Television.

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Abstract

This paper draws together three strands of literature, that on clustering, entrepreneurship and international business, examining the relationship between these three in promoting firm formation and growth within clusters. The evidence drawn on includes econometric models based on the unique International Trade in Services Film and Television dataset, an in-depth interview survey and questionnaire survey. The key conclusions are firstly that strong clusters promote entrepreneurship, which in turn promotes cluster strength in a self-reinforcing dynamic. Secondly, some firms are better able than others to benefit from cluster location due to superior firm competencies and absorptive capacity. Thirdly, cluster strength and internationalization are mutually reinforcing. Cluster strength contributes to the ability of entrepreneurial firms to expand overseas via export sales, licensing and FDI. Evidence is presented which indicates firms have greater intensity of export and import activity if they have resource-strengths, some of which are derived from their membership of a strong cluster. Strong clusters also attract multinationals and in the case of the London media cluster, although those multinationals appear somewhat less embedded than non-MNEs, they are nevertheless quite strongly embedded. This means that there is a second important feedback loop as spillovers from MNEs to local firms enhances cluster strength which attracts further multinationals. The acquisition of high performing firms by overseas MNEs does not appear to have reduced either their performance or their embeddedness in the cluster. Fourthly, the nature of internationalization strategies are conditioned by firm and industry characteristics. In particular, the extent to which tacit knowledge is embodied in a product emerges as being influential in terms of the decision of which internationalisation mode to use. Finally, the resource-based view of the firm emerges as a useful integrative framework for understanding the interplay between clusters, entrepreneurship and internationalisation strategies.

Keywords: clusters, broadcasting, entrepreneurship, internationalization strategies

JEL classification codes: F29, L26, L82, O18, R11

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Clustering and the Internationalisation of High Technology Small Firms in Film and Television.

1. Introduction.

Geographical clustering is a major characteristic of industrial growth and has recently become the subject of intense interest in academic (Fujita, Krugman and Venables, 1999; Porter, 1998; Saxenian, 1994; Swann *et al*., 1998) business practitioner (*The Economist*, 1999; Owen, 1999) and government policy (DTI White Paper, 1998) circles. Porter (1990, 2000), in common with much of the literature in economic geography, has identified two key trends which are powerfully shaping the context for corporate strategy in the 21st century: on the one hand the manifest rise in importance of **local** concentrations of economic activity and excellence; and on the other a fast-paced increase in the globalization of business. There has been a burgeoning of literature within the field of Economic Geography which has centred on the nature of dynamic local concentrations of economic activity. The intense interest among geographers, including relevance for corporate strategy (Clark *et al.*, 2000; Scott, 2000), stands in contrast to the relatively more muted impact within the management, strategy and international business fields (Buckley & Ghauri, 2004). Akin to the recent awakening of interest among International Business scholars in clusters, so too Entrepreneurship scholars are increasingly bringing cluster-based analysis more centre stage. This paper provides evidence in support of the analysis of the relationship between clusters and both international business and entrepreneurship and further makes some connections between the latter two fields.

The UK media industry provides an important case study for examining these interlinkages. Firstly, the emergence of a cluster of entrepreneurial SMEs is of comparatively recent origin, as a result of two events which transformed the broadcasting industry. The first was the establishment of Channel 4 in 1982 as a broadcaster without its own in-house production capability. Almost immediately a comparatively large number of independent production companies emerged, many locating in the vicinity of Channel 4's headquarters in central London. The second major change was the Broadcasting Act 1990 which brought in competitive tendering for Independent Television (ITV) network contracts and obliged the BBC and ITV companies to commission 25% of most types of new programmes externally. A small number of the hundreds of independent firms which have sprung up over the past 25 years have grown and internationalized rapidly. What this paper will demonstrate is that the region in which the firm is located is one of the fundamental influences on both the prospects for firm formation and growth and for internationalization. It will further demonstrate that the mode of internationalization differs according to the economic and technological characteristics of the particular line of activity the firm is engaged in.

2. Literature Review

2.1. Clusters and Competitive Advantage

The majority of the literature acknowledges and builds on the classic insights of Marshall (1927) into the sources of superior performance in clusters (industrial districts in Marshall's terms): labour market pooling; the emergence of specialised input suppliers; and technological spillovers. A distinction has long been made in the literature (Hoover, 1948) between two potential sources of (urban) dynamism: urbanization economies, which refer to the benefits of size and diversity within a city; and localization economies which refer to the benefits of large scale *in a particular industry* in a particular location, essentially related to the classic Marshallian externalities.

Cultural industries are highly concentrated in urban locations (Hall, 2000; Power, 2002). Scott & Storper (2003) suggest that the superior economic dynamism of cities rests on the coexistence of four key factors: economies of scale in capital intensive infrastructure; dynamic forward and backward linkages among firms, which promote information flows regarding business opportunities, resource availability and labour market conditions, among other things; dense local labour markets; and localised relational assets or social capital promoting learning, efficient coordination in production and innovation (Scott, 1996; Storper & Scott, 1995). Scott and Storper's list is not exhaustive. Rivalry may be important to stimulate innovation and productive efficiency (Jacobs 1972, 1985; Malmberg & Maskell, 2002; Porter, 1990). The volume and sophistication of demand within the city may be critical (Kitson *et al.,* 2004; Porter, 1990), especially in driving quality standards and innovation (von Hippel, 1988). The existence of concentrated demand for specialized services also provides an incentive for workers to invest in specialized skills and competencies (Scott & Storper, 2003), which is another dynamic of cumulative causation.

A challenge to cluster theory is to account for why some firms appear to benefit more than others from membership of a particular cluster. In recent articles (Pinch *et al.*, 2003; Tallman *et al.*, 2004) an important and bold attempt has been made to meld insights from strategic management and economic geography to argue how membership of key clusters can be the foundation for sustained competitive advantage, which appeals in part to the Resource-Based View (RBV) (Barney 1991; Wernerfelt 1984, 1995). While not gainsaying the importance of other types of resource, these authors place particular emphasis on knowledge-based resources. They lay importance on the firm's *absorptive capacity* to assimilate and make use of new knowledge (Cohen & Levinthal, 1989). The link with spatial clusters is made by arguing that there exist cluster-level knowledge systems, which some firms are better able to exploit than others. This account of the differential ability of firms to benefit from cluster membership is in principle applicable to entrepreneurial SMEs.

2.2. Clusters and Entrepreneurship

Entrepreneurship is important to regional prosperity (Camagni, 2002; Chinitz, 1961; Coe & Townsend, 1998; Scott, 2006). Small firms have long been viewed as an integral part

of dynamic industrial districts or clusters (Best, 1990; Piore and Sabel, 1984; Scott, 1988), yet entrepreneurs have been conspicuous by their absence in much of the literature on clusters (Acs & Varga, 2005). A growing literature is examining the ways in which dynamic clusters themselves may promote entrepreneurship (Capello, 2002; Folta *et al.*, 2006; Rocha & Sternberg, 2005; Scott, 2006). Scott explicitly argues that as a cluster develops, so increasing agglomeration economies will emerge as more firms are formed and in turn form denser networks which will anchor firms to a particular location, thus there is a dynamic positive feedback between clusters and entrepreneurship. Scott also emphasizes that entrepreneurship is a social phenomenon, hence rich social institutions in clusters may be particularly supportive of entrepreneurship (DeMartino *et al.*, 2006; Elfring & Hulsink, 2003). In a more broadly related way, seeing examples of successful entrepreneurship may in turn encourage others to try and follow suit, possibly learning from the mistakes of others. Would-be entrepreneurs may also derive much practical support from the social capital within the cluster. As demand grows, so there may emerge a finer division of labour, allowing niches which entrepreneurs can exploit. More generally, dense urban agglomerations offer a wider array of resources such as money, premises and business services, which facilitate the survival of new firms (Scott, 2006).

2.3. Clusters and International Linkages

Whilst several authors have championed the region as the most important spatial scale over which clustering processes operate (Cooke & Morgan, 1998; Florida, 1996; Scott, 1996; Storper, 1997), processes operating at wider spatial scales are important. Jacobs' (1972, 1985) analysis lays considerable importance on the nature of external linkages a city has, especially import and export activity, a point also emphasised by Hall (2000) as a powerful contributor to periods of creative flourishing in cities. The significance of external connectivity for remaining at the forefront of innovation has been widely acknowledged in the literature (Boggs & Rantisi, 2003; Cumbers & McKinnon, 2004; Pred, 1977; Rocha & Sternberg, 2005), important as it provides a constant stream of fresh ideas and helps prevent insularity and homogenization.

Bathelt *et al*. (2004) suggest that multinationals (MNEs) provide important "pipelines" within which tacit knowledge (among other types) can flow between locations in a way which would be less easy between third parties at equivalent distance. Whilst it is clear that there is a considerable amount of MNE Foreign Direct Investment (FDI) in clusters (Kozul-Wright & Rowthorn, 1998), and that this activity is increasing (Nachum, 2003a, 2003b), the body of research on this interface is small (Birkinshaw & Solvell, 2000). There is a large literature that attempts to generally explain MNE FDI in terms of the benefits that certain locations provide for investing MNEs (Dunning, 1993). More recently, he has drawn from economic geography (Dunning, 1998) to elaborate the location element of his 'OLI' framework by incorporating clusters thinking. Although this literature encourages us to think of MNEs 'taking' from clusters, we should guard against such a conclusion. Studies by Head *et al*., (1995), Nachum (2000) and Wheeler & Moody (1992) show that MNEs can play a major role in cluster development and evolution.

There has been debate in the literature regarding the implications of takeovers of small firms by overseas multinationals. The fastest growing and most innovative firms are the most likely to attract bids and such acquisitions have been common in the UK among high technology firms (Mason & Harrison, 2006). It is plausible that these acquisitions may benefit the SME by providing the resources needed to exploit its innovations more fully, as well as benefiting the acquirer by providing access to a stream of new innovations. Mason & Harrison report the consensus in the literature that the short-run effect on the target firm is generally positive. On the other hand there is evidence that longer term the influence may not be so benign with a loss of autonomy, lower levels of engagement with local networks and not infrequently the closure of the acquired firm ensuing.

Thus the literature of economic geography sees international linkages of firms in the cluster as being important influences on cluster success and dynamism. Moreover, there is an important dynamic feedback loop in so far as strong clusters promote international linkages, exemplified by their attraction to MNEs, which in turn yield positive spillovers reinforcing cluster strength.

2.4. Internationalization Strategies of Small Firms

The literature on internationalization of SMEs has evolved with three distinct strands. In brief, these are the stages model of the Uppsala School (hereafter referred to as UM) (Johanson & Vahlne, 1977, 1990), the International New Venture (INV) school (Oviatt & McDougall, 1994) and the business network approach (Coviello, 2006; Johanson & Vahlne, 2003). Each of these approaches will now be reviewed to distill the key features which they suggest will influence the prospect, mode and extent of internationalization. Some reflections will also be made on how each of these approaches might interface with insights derived from the clustering literature.

The UM is a behavioural model predicated on fundamental assumptions that risk-averse agents pursue profit under bounded rationality and imperfect information. This leads to the central proposition that firms, especially SMEs, internationalise in an incremental fashion, acquiring learning in an experiential fashion, albeit that large firms may have the resources to internationalise in a non-incremental way. The UM thus predicts both age and size will be influences on internationalization. From a clusters perspective, rapid learning can take place within rich circuits of information within highly networked and dense agglomerations, which may support internationalization.

The Uppsala model has long been prone to the basic objection that not all firms internationalize in small steps and that the sequential model is too mechanistic (Melin, 1992). This basic thought has been effectively crystallized in the theory of international new ventures (INV) set out by Oviatt & McDougall (1994), motivated in part by evidence that firms are increasingly establishing international relationships and operation from a very early stage. One of the four key elements which constitute the necessary conditions for the emergence of international new ventures is that the firm must have unique resources as a basis for being competitive in international markets. The ability to exploit previous experience in international business has been one of the reasons advanced in the INV approach to explain how rapid internationalization is possible.

What clusters theory contributes is the idea that such experience is more abundantly available in some locations than others both because in stronger clusters there will be more firms which have international experience and also because the labour markets, particularly in major global nodes, are highly international in scope.

All firms are embedded to a greater or lesser degree in networks comprising suppliers, customers and peers. To the extent that firms are embedded in networks which are international in scope, this may smooth the path of internationalization (Coviello & Munro, 1997). From a clustering perspective, networking skills, which are important in international business, may be effectively developed in a dense cluster typified by high levels of networking, and a global node in Amin & Thrift's (1992) sense will provide important connections to highly internationalized networks.

One important piece of received wisdom in the literature is that small firms are at a relative disadvantage to large firms in terms of any form of internationalization, but above all foreign direct investment (FDI) (Buckley, 1997; Hollenstein, 2005). Nevertheless, there is evidence that the amount of FDI attributable to small firms has been growing rapidly in recent years, albeit from a small base, such that the share of small firms in FDI has been rising (Acs & Preston, 1997). Buckley, drawing on Dunning's (1993) OLI framework, suggests reasons why the extent of small firm FDI might be industry specific. In some industries efficient scale is large relative to market size and in such cases small firms will struggle to survive unless they can find a defensible niche. By contrast, he argues small firms will be better placed where scale is less important and local skills and rapid information processing are more to the fore.

In summary, the extant literature on SME internationalization is consistent with clusters providing a conducive environment for the accumulation of knowledge, resources and access to networks which the leading theories indicate will be important influences on successful engagement with international business. What is more, the important OLI framework provides analytical insights into the firm and industry-specific factors which may influence choice of internationalization mode.

2.5. Conclusion.

Four propositions emerge from the above discussion that will be explored in the evidence to be presented below.

Proposition 1. There is as symbiotic relationship between dynamic clusters and entrepreneurship

Proposition 2. International connectivity is both a symptom of and cause of cluster dynamism

Proposition 3. Internationalization strategies depend on the economic characteristics of the industry a firm belongs to and the strength and nature of the firm's distinctive competencies (ownership advantages).

Proposition 4. Firms which internationalise or are acquired by overseas MNEs will become less embedded in the cluster.

3. Formation and Growth of Entrepreneurial SMEs.

3.1. Clusters and the Formation and Growth of Firms

This section will provide an overview of the programme production, post-production and equipment supply sectors and place them in the context of the contribution which they make to broader clustering dynamics in the British broadcasting industry. These three sectors provide the bulk of the entrepreneurial and internationalizing small firms.

The British broadcasting industry is highly clustered, with an estimated 70% of employment in film and television concentrated in London. Within this, there is a very strong concentration on an area of approximately one square mile in Soho. The post-production sector has around 70% of its firms located in London which account for 91% of total revenues (Film Council 2003). Post-production companies are generally very small, with a median size of 15 employees. The exception to the generally atomistic structure of post-production is the BBC which is far larger than any other post production facility. Programme production is also dominated by the BBC which is responsible for around 36% of programme production. The independent television broadcasters account for around another 25%. Another 25-30% of the market is accounted for by about 50 medium-sized, mainly London-based independent production companies (many of which are owned by larger media concerns) and the remaining 10% is accounted for by around 500 very small companies. Independent production companies are very small, with a median size of 5 employees.

Equipment supply firms manufacture and/or supply the hardware and software which is not only used by the post-production companies but also the broadcasters and production companies, some of whom also have in-house post-production sections. The median size of the equipment manufacturers is 39, but there are some firms which are much larger. Some important multinational companies such as Sony, Panasonic and Philips have UK subsidiaries. These companies are based mainly to the South and East of London, particularly in the Thames Valley area and down into Hampshire.

Recent econometric research conducted on the British broadcasting industry (Cook *et al.* 2001) has yielded results which indicate that the dynamics of industrial clustering are subject to positive externalities of colocation. Two types of model were estimated. The first, a growth model, estimated the extent to which cluster strength, measured in terms of employment in both the firm's own line of activity (own employment) and in related lines of activity (other employment), either impeded or enhanced the growth rate of firms located within the cluster. In almost every case, cluster strength in the firm's own line of activity *enhanced* the firm's growth rate, whereas strength in related lines of activity *diminished* firm growth, suggesting a congestion effect. The second type of model was based on firm entry and investigated the extent to which cluster strength in sub-sectors within each industry either appeared to attract or repel entry of firms into each sub-sector. Entry into a given sub-sector is almost always *deterred* by existing cluster strength in that sub-sector and entry attraction typically emanates from *other* sub-sectors.

In terms of growth dynamics, the strongest positive effects of cluster strength in a firm's own line of activity appear in programme production, manufacture of broadcasting systems and post production. The centrality of programme production and post

production in cluster dynamics is reinforced by entry dynamics. Programme production is the only sub-sector in broadcasting where cluster strength within the sub-sector attracts entry of like firms. Programme production and post production also exert strong positive entry attraction on each other. Thus there is a powerful virtuous circle where cluster strength in each of these sub-sectors not only attracts entry but also leads to faster growth. Both of these sub-sectors attract entry from firms in other sub-sectors within the industry. Both attract entry from specialist equipment suppliers, natural given the extent to which each relies on specialist equipment which they are likely to want to update, develop and keep in good repair.

3.2. Entrepreneurial Growth Processes within the Clusters.

The crude econometrics point to the fact that clusters promote entrepreneurship in terms of the formation and growth of new businesses. Some brief remarks will now be addressed to the nature of the cluster processes which underpin these relationships. The main evidence supporting these comments was gathered from a semi-structured interview survey encompassing 75 forms and industry experts in London, Bristol and Glasgow between 2000 and 2005 and a questionnaire survey of 204 companies in London conducted in 2004.

The importance of social capital is very manifest in the post production and production sectors. The interview evidence and reading of the trade literature does reveal that substantial support can be forthcoming for entrepreneurs starting new businesses. Spin-offs with backgrounds in the major broadcasters are imbued with knowledge about their organizational routines and so are easier for the major broadcasters to work with. Many have also received considerable support and advice from their former parent. In post production it is not unusual for new firms to be given space in an existing facility in return for an agreement to pay in kind by doing work as requested for the host company. In some cases funds are advanced to help the new firm become established. The full extent and nature of support in cash, kind and by way of advice is beyond the scope of this paper to answer. Nevertheless, there are sufficient straws in the wind to indicate that collectively they are an important support to entrepreneurship.

An important section of the questionnaire asked about why it was important to have close proximity to other firms in London. These factors achieved the highest ratings, with prime importance being placed on face-to-face contact, ability to foster trust and interpersonal relationships, providing three of the top ten benefits of a London location. These are important for three reasons. Firstly, the high semiotic content of television programmes, films and advertisements requires rich communication for a team to arrive at the desired end product. Secondly, any weakness in the finished product can badly undermine the desired effect, therefore a high degree of assurance is required of the ability of individuals. Thirdly, projects are typically undertaken to very tight deadlines with considerable sums of money at stake, therefore it is essential that the team brought together for the project can gel quickly and that consummate effort can be relied upon. In the event of problems, it is essential that they be resolved quickly in a frank and constructive manner.

Allied to the above points regarding social capital, aspects of the labour market emerge as being especially important, especially the ability to recruit high quality labour and the ability of highly skilled labour to contribute to innovation. Social institutions are highly important in the labour market, where socialization into the norms of both a particular craft and the industry more generally are important in the rites of passage to becoming a credible professional. They are also essential in supporting short-term project work where disparate skills must be combined under severe time pressure. The density of demand means that people are willing to specialize to a high degree and invest in highly idiosyncratic human capital. What is more, the labour market in London has global reach, acting as a magnet to the best talent. This is an important self-reinforcing dynamic of cluster success.

Finally, relationships with other firms emerged as being a highly important advantage of proximity within the dominant London cluster. Above all, both suppliers and customers were identified as providing important support for innovation. Customers may demand innovation, a spur for both broadcast production and post production companies competing for business against strong rivals. Moreover, customers may themselves be important innovators who are able to guide their suppliers to innovative solutions. London is also the focus of a high volume of national and international demand. Both questionnaire and interviews established that people talk to peers in other firms and that there is a substantial degree of mutual support and advice.

In summary, the London cluster, above all, provides a very fertile environment in which entrepreneurs can thrive. There is both highly concentrated demand and a rich and specialized supply infrastructure into which they can embed their businesses, exploiting rich personal and business networks. Resources of all kinds, especially skilled labour, are abundant. The econometric evidence indicates that there are powerful feedback effects whereby cluster strength promotes business formation and growth, which further strengthens the cluster.

4. Clusters and International Linkages: Evidence

4.1. Influences on Import and Export Activity.

The basic dataset on which this analysis was conducted is the UK's Annual Survey of International Trade in Film and Television Services (FTV). The survey examines sources of export and import revenues by country. The data analyzed in this paper is from the 2003 Survey, the most recent for which complete data are available for both positive and nil returns. In order to produce meaningful analysis of the pattern and extent of export and import activity, the FTV data was merged with a variety of additional databases maintained by the UK's Office for National Statistics, the Annual Respondents' Database and the Business Data Library.

Analysis in the regression models was based on those firms with fewer than 600 employees, which was a natural break in the firm size distribution and broadly consistent with a conventional cut-off for SMEs of 500 employees. The models estimated were logistic regressions based on a 1,0 dependent variable depending on whether or not the firm was engaged in international activity, exporting or importing, or not. The basic model had the form:

$L_i = \beta_1 Size_i + \beta_2 Overseas_i + \beta_3 Age_i + \beta_4 MP_i + \beta_5 OthMP_i + \beta_6 TV_i + \beta_7 Locquo_i + \beta_8 Totemp_i$

where L_i is the log of the odds ratio $Ln\left(\frac{P_i}{1-P_i}\right)$ and P_i is the probability that the firm either exports or imports respectively. The coefficients reported for the logistic regression show the change in the log-odds ratio for a one unit change in the independent variable, therefore a coefficient less than 1 indicates an increase in the independent variable made, respectively, importing or exporting less likely and *vice versa* where the coefficient exceeded one.

- Size was measured by numbers of employees, measured in natural logs due to the strong positive skew. In both the import and export equations this is *a priori* expected to be positive as it crudely proxies resource strength.
- Overseas was a 1, 0 dummy variable taking the value 1 where the firm had a code indicating it was ultimately owned by an overseas corporation. This is *a priori* expected to have a positive sign.
- Age is the age in years of the firm since first registration, sign expected positive.
- MP is a 1, 0 dummy indicating that the firm was classified to SIC92111, motion picture production, which is expected to take a negative coefficient due to the lower propensity to engage in trade relative to the default category SIC 92120, motion picture and video distribution.
- OthMP is a 1, 0 dummy variable indicating that the firm was classified to SIC 92119, other motion picture and video production. As for MP, the sign is expected to be negative.
- TV is a 1, 0 dummy indicating the firm belongs to SIC 92202, television activities. The expected sign is negative as the majority of independent programme production companies are very small and serve the domestic market.
- Locquo is the location quotient of the region in which the firm is located. The location quotient is constructed as the ratio of total media employment in the region to that of all media employment in Britain divided by the ratio of total employment in the region to all employment in Britain. The location quotient thus represents the extent of clustering in the region. A quotient above 1 indicates that the region has a disproportionate share of media employment relative to its total employment. The prior expectation is that the coefficient will be positive representing the positive effect of stronger clusters which will manifest itself, in part, in stronger export performance.
- Totemp is total employment in the region. This crudely represents the extent of urbanization economies in the region. Again the prior expectation is that this variable will have a positive sign.

The strongest influence on propensity to engage in either export or import activity is firm size, which may be given a crude interpretation as indicating the importance of resource strength. Firms with resource strength would be expected to grow larger, controlling for age, and also to accumulate resources through the process of growth. Age has a negative influence, although not significant and virtually indistinguishable from 0 in the export equation. This is consistent with the INV literature, which argues that it is

resource strength rather than age which is the principal influence on whether or not a firm will engage in international activity. A somewhat speculative interpretation of the larger (negative) coefficient on age in the import equation may be that as firms mature, they become better able to produce internally goods and services they previously imported. Penetrating export markets is more demanding of resources, and also experience and contacts accumulated over time, therefore one would not expect export activity to diminish with age in the same way. The location quotient has a positive coefficient and is highly significant in both equations implying that firms located in stronger clusters are more likely to be engaged in importing and exporting. This is capturing the centrality of London, which has by far the largest location quotient and around 75% of all firms involved in international trade (compared to around 60% of all firms in the sample). Total regional employment has a barely positive effect and is quite far from conventional significance, indicating that it is regional strength in media employment which is the principal source of the positive influences. As would be expected, being a subsidiary of an overseas firm is positively associated with the likelihood of being engaged in import or export activity. The generally negative coefficients on the industry dummies are consistent with expectation.

Table 1 Logistic regression for probability of engaging in importing and exporting

	Import model				Export model			
Variable	coefficient	z	Marginal effect		coefficient	z	Marginal effect	
Size	1.7201	6.27	0.05220	***	1.5785	6.01	0.06645	***
Age	0.9739	-1.46	-0.00254		0.9997	-0.02	-0.00004	
Overseas	1.4094	1.01	0.03540		1.4057	1.21	0.05239	
MP	0.3868	-1.92	-0.07453	*	0.8706	-0.35	-0.01970	
OthMP	0.5845	-1.34	-0.04820		1.1457	0.39	0.02011	
TV	0.8121	-0.56	-0.01949		0.9553	-0.14	-0.00662	
Location quotient	1.2666	2.36	0.02275	**	1.2300	2.43	0.03014	**
Total regional employment	1.0001	0.29	0.00001		1.0002	0.81	0.00003	
N observations	597				597			
Wald χ^2	103.16***				89.87***			
Pseudo-R^2	0.22				0.17			

*** significant at 1% ** significant at 5% * significant at 10%

A set of models were run to examine the principal influences on export/import intensity. This was measured as exports/imports per employee due to the fact that only a small number (64) of firms had turnover data available, therefore using employment lead to a much larger number of uncensored observations. The Heckman (1979) two-step procedure is required as we have censored observations of export and import activity. Failing to take into account the fact that firms have made a prior choice to either import or export through the selection equation would lead to biased estimates in the

export/import intensity equations. The export/import intensity equations were as follows, with a full and a restricted model being separately estimated. The selection equation in each case (not reported for brevity as it is highly similar to the logistic regressions reported above) was as follows:

$$Y_i = \beta_1 Size_i + \beta_2 Overseas_i + \beta_3 Age_i + \beta_4 MP_i + \beta_5 OthMP_i + \beta_6 TV_i + \beta_7 Memp_i$$

Where Memp is total media employment in the sector

Restricted model

$$Y_i = \beta_1 Size_i + \beta_2 Overseas_i + \beta_3 Age_i + \beta_4 MP_i + \beta_5 OthMP_i + \beta_6 TV_i + \beta_7 Locquo_i + \beta_8 Totemp_i$$

Full model

A more extensive model was estimated in cases where additional financial information for a sub-set of firms was available, in order to capture more firm-specific effects.

$$Y_i = \beta_1 Size_i + \beta_2 Overseas_i + \beta_3 Age_i + \beta_4 MP_i + \beta_5 OthMP_i + \beta_6 TV_i + \beta_7 Locquo_i + \beta_8 Totemp_i + \beta_9 Productiity_i + \beta_{10} Advertising/sales_i + \beta_{11} R\&D/sales_i + \beta_{12} Meanwage_i + \beta_{13} Investment\ intensity_i$$

- Productivity is measured as gross value-added per head. The expected sign is positive as greater productivity implies greater cost competitiveness.
- Advertising/sales is a standard proxy for a resource strength in product differentiation. The expected sign is positive.
- R&D/sales is a standard proxy for resource strength in innovation. The expected sign is positive.
- Mean salary. The expected sign here is ambiguous. A high value might imply a resource strength in terms of a labour force skewed towards more highly skilled employees. Alternatively it may represent a disadvantage of relatively high costs.
- Investment intensity is measured as net capital expenditure/sales. The expected sign is positive as a high investment intensity implies a progressive company.

Considering first the restricted export and import models, size and being under foreign ownership take positive signs as expected, although the coefficients are far from conventional significance. Age is positive in the export equation but negative in the import equation. The negative sign on age in the import equation is consistent with the logistic regressions of the probability of being engaged in exporting or importing. Again, importing may be easier for younger firms compared to exporting and younger firms may be more reliant on importing, lacking resources. There is an interesting contrast in the behaviour of the regional variables in the export and import models. The coefficient on the location quotient becomes barely distinguishable from 0. The coefficient on total employment remains positive and is close to significance in both equations, implying that

as far as export and import intensity go, urbanization economies may be more important than localization economies. Sectoral dummies behave much as expected, the positive coefficient on TV in the export model probably reflecting the small core staff in television production companies which inflates the ratio.

Table 2 Heckman two-step model of export intensity second step results

	Restricted model			Full model		
Variable	coefficient	Z		coefficient	z	
Size	248.5235	0.45		0.5943	0.22	
Age	0.4494	0.03		6.1479	0.45	
Overseas	289.0943	0.59		203.1317	0.71	
MP	-115.2359	-0.28		350.1079	0.95	
OthMP	-1.2121	-0.00		206.3557	0.58	
TV	56.8050	0.17		394.4886	1.17	
Location quotient	97.8228	0.35		4.2176	0.05	
Total regional employment	0.2870	1.38		0.0548	0.28	
Productivity				0.8236	1.50	
Advertising/sales				1636.98	1.26	
R&D/sales				6858.712	0.21	
Mean wage				0.4275	0.12	
Investment intensity				27.3772	0.07	
Rho	1.0000			0.5630		
Sigma	1559.6933			273.7773		
Lambda	1559.6933			154.1408		
N observations	597			493		
Censored obs.	464			464		
Uncensored obs.	133			29		
Wald χ^2	83.06***			58.06***		

*** significant at 1% ** significant at 5% * significant at 10%

The results from the full model clearly need to be treated with caution as they have a very small number of uncensored observations. Nevertheless, there are a few pertinent observations. As expected, the inclusion of a greater array of firm specific variables generally moderates the influence of the variables included in the restricted model. The impact of the regional variables, in particular total regional employment, is clearly weakened, and the coefficient on the location quotient becomes negative in the import equation, implying that for the larger firms remaining in the restricted model, for whom a greater array of financial data is available, firm resources play a greater role in supporting international activity relative to regional externalities. In both equations productivity, advertising intensity and investment intensity have the expected positive

sign, with advertising intensity being significant in the import model. The negative coefficient on R&D intensity in the import equation is hard to rationalize. The negative and highly insignificant coefficient on mean wage reflects the ambiguous *a priori* influence of this variable.

Table 3 Heckman two-step model of import intensity second step results

	Restricted model			Full model		
Variable	coefficient	Z		coefficient	z	
Size	47.750	0.15		1.1749	0.67	
Age	-8.5736	-0.49		-1.5401	-0.31	
Overseas	264.604	1.00		137.1647	0.97	
MP	-366.2376	-0.64				
OthMP	-431.0996	-1.23		328.366	1.78	*
TV	-175.8165	-0.86		517.9682	2.31	**
Location quotient	27.8352	0.19		-28.4118	-0.62	
Total regional employment	0.1558	1.53		0.0086	0.15	
Productivity				0.5628	1.60	
Advertising/sales				4206.981	3.37	***
R&D/sales				-87745.15	-0.66	
Mean wage				-1.2367	-0.61	
Investment intensity				545.2009	0.29	
Rho	0.8792			0.8436		
Sigma	666.8622			183.0189		
Lambda	586.2995			154.3889		
N observations	587			520		
Censored obs.	498			498		
Uncensored obs.	99			22		
Wald χ^2	96.11***			56.03***		

*** significant at 1% ** significant at 5% * significant at 10%

Around 30% of post production revenues are derived from overseas (Film Council, 2003). International sales in film, advertising and broadcast television post production are for high value-added work. This is above all the case for high-end special effects on Hollywood blockbuster movies. This export-based activity is an important part of the dynamics of the London cluster, since work on these projects both develops skills and allows the latest technology to be invested in. It also adds to the reputation of the cluster and specific firms within it. Only a limited number of companies in London have the scale and capability to compete for high-end film work, the most significant being CFC Framestore, the Mill, MPC, Double Negative and Cinesite (non-UK). There is evidence that there is a "trickle down" effect to other local companies of the techniques and

technology used in the most cutting edge work (Oxford Economic Forecasting, 2005). Programme production companies tendering for original productions overseas also benefit from meeting demanding requirements. What is more, the incremental revenues which export activity brings is an important source of financial resources. This is particularly significant for export revenues in programme production, where the incremental cost is extremely low for sales of programmes which have already been made, and export revenues are a highly important source of cash flows. Those firms able to generate such revenue streams also find it easier to raise additional finance, supporting their growth strategies.

In summary, there is evidence that strong clusters promote internationalization and that there is a positive feedback loop through both accumulation of experience and financial resources which strengthens both individual firms and the cluster. In terms of cluster-based advantages.

4.2. The Role of Multinational Enterprises

This section reports analysis based on the questionnaire survey, which asked about a broad range of possible advantages and disadvantages of having a location in central London, rated on a five-point Lickert scale. There were 187 usable replies from companies, of which 150 were non-MNEs and 37 were MNEs.

The evidence on the degree of embeddedness of the multinationals in the local cluster indicates that there is quite a high level of embeddedness in terms of dependence on local interaction, but that this generally has lower importance to MNEs than to non-MNEs. In the main, there were no substantial differences between MNEs and non-MNEs in terms of the perceived advantages of being located in the London cluster. This is consistent with MNEs being attracted by a range of positive externalities in strong clusters. The greater importance of complementary expertise as an advantage of proximity to other firms in the cluster to non-MNEs ($\chi^2(4) = 6.79$, $p=0.147$) does indicate that MNEs have internal capabilities which make them less reliant on such spillovers. It is, however, important to point out that MNEs do often rate this factor as important and are not more likely to rate it as unimportant compared to non-MNEs. This is underscored by the slightly greater importance to MNEs of the ability to have face to face contact due to close proximity ($\chi^2(1) = 1.34$, $p=0.246$). The evidence on the importance of contact with other firms is also similar.

The symbiotic relationship between MNEs and the local cluster is exemplified by the relationship between the post production and equipment supply sectors. Both have a significant presence of MNEs, both indigenous and overseas. Not only do they benefit from cluster spillovers within their respective lines of activity, but there is also significant interaction between them in the development of new equipment. Post production companies in London are important lead users (von Hippel, 1988) who are demanding and directly contribute to the development of technological solutions. This contributes both to the South East being a foremost research node in the equipment industry but also to London maintaining it global pre-eminence in post production as the availability of the latest equipment attracts the best talent.

What have been the effects of the takeover of domestic firms by overseas multinationals? The most spectacular entry has been that of US-based Ascent Media which in the space of roughly two years in the early 2000s acquired a significant proportion of London's highest quality post production capacity, causing considerable consternation in the post production community. The important companies acquired over this period were Rushes, the Soho Group, Todd-AO (itself a US-based company),Telecine, SVC, TVI, St. Anne's and One Post. A common view prevailing at the time was that it would not be successful as top creative labour would not want to work for a large multinational and that a more bureaucratic firm would not be capable of providing sufficiently flexible and bespoke service to clients. The evidence to date is that these early predictions of failure have not been born out. It appears that the subsidiaries have been given reasonable autonomy. It is also the case that Ascent has brought considerable financial and management resources to the service of the acquired companies. The most recent beneficiary has been Rushes which has seen a substantial expansion backed by significant investment in recent months. Equally, in the programme production sector, the acquisition of Bazal and Brighter Pictures by Endemol and of Talkback, Alomo, Thames Television and Witzend by Bertelsmann appears to have had beneficial effects as these multinationals have had the resources to exploit more fully the intellectual property of it acquisitions more fully than they might have done themselves.

5. Internationalization Strategies

Internationalization strategies in post production are essentially export based. There are a small number of notable examples of companies which have made FDI moves, three leading examples being the creation of New York offices by CFC Framestore, The Mill and Smoke and Mirrors in advertising post production. The experience of internationalization in post production bears out some, but not all, of Buckley's hypotheses. Post production does exhibit the technological characteristics which are identified by Buckley as being favourable to FDI by small firms. Although quite capital intensive, and more capital intensive than programme production, technology is small scale in post production compared to typical manufacturing industries. An average-sized post house would require a capital investment of a few million pounds, rather than hundreds of millions of pounds. Labour is a key resource and access to the right type of labour is critical. Finally, it is a highly knowledge intensive business where creativity, ability to use advanced technology and the ability to interpret the clients' creative vision and requirements is all.

In film post production, scale is more important as the magnitude of the work required for the effects on a "blockbuster" movie is significant. Compared to setting up an advertising post house, the attendant risk is greater given the higher costs and how "lumpy" demand is, with just a few high budget projects becoming available each year. These factors help explain why major film post production companies such as Moving Picture Company and indeed the Mill and CFC Framestore have not made FDI moves into Hollywood. Hollywood studios are willing to come to London to source this high value-added work because the knowledge and human capital which is sought is embedded in the cluster. Moreover, it is sufficiently valuable relative to the alternatives

to warrant the time and money costs of periodic trips between Los Angeles and London to manage projects. Again in line with Buckley, there are some examples of small, niche firms, such as Uli Meyer Animation, which have found it worthwhile to set up overseas operations in Hollywood. Here the balance of highly idiosyncratic tacit knowledge and small scale combine to tilt the balance in favour of FDI.

FDI has not been a major feature of the independent programme production. Some of the major production companies have established sales offices overseas, mainly in the USA, however this is a comparatively limited form of FDI. Firms may earn export revenues through direct programme sales to a broadcaster, where the UK is the world's second largest exporter of TV programmes, albeit a distant second to the USA, or from sales of videos or DVDs of programmes. Format sales, where the basic programme idea is sold with the programme itself being reworked and remade to suit it to a different national audience, are an increasingly important source of revenues. Programme production does not lend itself as easily to FDI and also has a range of means of exploiting its intellectual property which mean that overseas location is not as important. These factors can be related to Dunning's OLI framework. Post production is a service which it is typically advantageous to deliver in close proximity to the customer to ensure the end product meets the creative vision. In terms of exploiting intellectual property overseas in programme production, then such a market seeking advantage for overseas location is less important. The product is easy to export. Transport costs are negligible in the case of direct programme sales and very low for videos and DVDs, the production of which can in any event be easily subcontracted. Format sales are now a reasonably well established and successful contractual mode of exploiting the intellectual property in programme ideas and there are no internalization advantages which warrant overseas production. The key tacit knowledge required to make a programme acceptable to an overseas audience resides in local firms and the intellectual property in the idea itself is reasonably easily transferred under the licensing agreement.

6. Conclusions

This paper has presented a few strands of evidence relating to the question of the interconnections between clusters, entrepreneurship, and international expansion. Regarding proposition 1, the econometric evidence revealed that strong clusters do promote higher rates of surviving new firm start-ups and firm growth rates, providing evidence of a self-reinforcing dynamic between clusters and entrepreneurship. Underpinning these crude statistical relationships are classic processes identified in the literature. There is close cooperation and exchange of tacit knowledge underpinned by rich social capital, flexible specialization and dynamic linkages between firms. Labour markets are deep, flexible, specialized and a draw on the best talent. Moreover, socialization of labour, for which physical propinquity is necessary, is highly important. These processes and the abundance of resources, especially in London, support entrepreneurship and entrepreneurship drives innovation and cluster strength.

Proposition 2 is also supported. The logistic regression showed that both export and import activity are more likely in stronger clusters. Those firms which have seen the greatest success in terms of international expansion have been almost all London based.

This accords with Requena-Silvente (2005)'s finding that geographic spillovers promote SME exports. Moreover, London's status as a major global node in the media industries attracts powerful multinationals which interact with and benefit local firms, not least via the innovation system in equipment supply. One exception to the supremacy of London is Bristol, which has a unique position as the world's most important centre in a genre of programme making highly suited to international sales, natural history. The ability to compete for export revenues overseas and to serve demanding customers there draws knowledge, labour and financial resources into the cluster in a further positive feedback loop. The regressions, however, also indicate that firm-specific factors may be more important than locational factors in promoting internationalization.

There is general support for proposition 3. Industry characteristics were shown to explain in part the pattern of internationalization across different segments of the industry. Advertising post production and niche elements of film post production lend themselves to FDI being generally small scale and highly (tacit) knowledge intensive. Programme production is product rather than service based and there is a less compelling reason for an overseas location, therefore as Dunning's OLI framework would suggest, exports are the most common strategy. Only limited evidence has been presented in respect of proposition 4. Whilst in general MNEs appear slightly less embedded than domestic firms, there evidence to date is that the benefits to the cluster of the presence of overseas MNEs and the expansion overseas by both exports and FDI of domestic firms has had a net positive influence on cluster dynamics.

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Taking technological opportunities to the market: the role of university-based business plan competitions in supporting high technology commercialisation

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Abstract

Encouraging technology-based entrepreneurship is central to the policy agendas of governmental and non-governmental economic development agencies in many industrialised and newly-industrialising countries. Entrepreneurs are central to venture creation and evidence indicates that, following secondary and, typically, tertiary education, most work for one or more employers prior to establishing a technology-based venture on their own or with others. As a result of this "entrepreneurial apprenticeship" many technology entrepreneurs establish businesses in their mid- to late thirties. Developing a thorough understanding of product/service markets and devising strategies to access, serve and support customers are major challenges for founders of technology-based businesses. Ventures established by individuals or groups with relevant commercial experience benefit from the know-how and networks of their founders. This paper explores the role of university business plan competitions in stimulating entrepreneurial activity and technology transfer from two universities in Northern Ireland by focusing on entrants in the 2007 £25k Enterprise Award Scheme business planning competition. Such initiatives tend to attract students/recent graduates and members of university staff which raises the question as to how such teams develop commercially-robust ventures, given that, on the face of it, most have little or no commercial experience. Based upon analysis of the business plans of the top ten ventures from the 2007 competition this paper explores characteristics of the entrepreneurial teams, their choice of product/service offerings and aspects of the markets they target.

Introduction

Increasing levels of technology-based entrepreneurship is central to policy agendas of economic development agencies in many industrialised and newly-industrialising countries (Oakey, 1995; Cooper, 1998). Entrepreneurs are central to venture creation and evidence indicates that, following secondary and, typically, tertiary education, most work for one or more employers prior to establishing a technology-based venture on their own/with others (Cooper, 2006; Harrison et al., 2004). As a result of this "entrepreneurial apprenticeship", during which they develop knowledge, skills, networks and confidence to identify and exploit commercial opportunities, many technology entrepreneurs establish businesses in their mid- to late thirties (Cooper 2006; Harrison et al., 2004; Majid, 2006). Developing a thorough understanding of

product/service markets and devising suitable strategies to access, serve and support their customers are major challenges for founders of technology-based businesses; ventures which are established by individuals or groups with relevant commercial experience benefit from the know-how and networks of their founders (Aldrich and Zimmer, 1986; Chandler and Jansen, 1992; Cooper, 2006; Harrison et al., 2004).

Universities have been identified as having a role to play in providing students and staff with knowledge regarding the commercialisation process and support to help them pursue viable opportunities (Cooper, 2001; Galloway and Brown, 2002). One activity which is viewed as having the effect of priming the formation of potential new venture teams are university-centred, business plan competitions. Little research has been conducted into the impact of such competitions and beyond anecdotal reports of new venture teams which have won such competitions and used the money or other prizes to help build their business, there is a paucity of data about the types of businesses which are formed, the characteristics of the teams behind the ventures and the markets which they target. On-going, exploratory research, early findings of which are reported here, is investigating the impact of a university-based, business plan competition in Northern Ireland. The £25k Enterprise Awards Scheme (EAS) is co-run by the Northern Ireland Centre for Entrepreneurship (NICENT) and involves students and staff from the University of Ulster and Queen's University, Belfast. Given comments above regarding technology markets and strategy the paper focuses on the product/service marketing strategy adopted by the most successful entrants to the competition.

Following a brief discussion of technology-based entrepreneurship and the objectives behind university business plan competitions, the paper explores NICENT's £25k EAS which culminates in the selection of ten teams for the final round. The empirical section of the paper draws upon findings of systematic, text-based analysis undertaken on the full business plans submitted by the top ten teams from the 2007 competition. Content regarding the entrepreneurial teams and product/service market issues is analysed and discussed. Discussion focuses upon exploration of the expertise and commercial background of team members and how this relates to the business opportunity and marketing strategy.

The aim is to develop a better understanding of some of the short- and longer-term contributions of enterprise competitions within a university setting, Discussion, therefore, focuses on the potential for competitions to facilitate venture start-up and technology transfer, pointing to the types of venture likely to be generated and their potential to contribute to local economic development. It also considers their potential impact on those who will not engage in venturing directly after university, where experience gained of new venture planning may encourage participants to seek employment in small enterprises and seed longer-term entrepreneurial aspirations. Implications of the research for theory, policy and practice are explored in the conclusion to the paper.

Technology-based venture creation

If numbers of technology-based businesses are to rise, it is necessary to increase the flow of entrepreneurial talent from within science, engineering and technology (SET) seeking to commercialise technological opportunities through venturing (Cooper et al., 2007). The formation of a new venture is the most visible evidence of entrepreneurial action and in the majority of cases the entrepreneur spins-off from the organisation where they worked previously to establish the new business (Cooper,

1973; Cooper, 1996; Cooper and Park, 2008; Harrison et al., 2004; Oakey and Cooper, 1991; Oakey, 2005). There is evidence that propensity to spin-off can be influenced by the peers with whom individuals work; peers who have past experience of venture creation act as sources of vicarious learning for would-be entrepreneurs (Nanada and Sorensen 2007). More generally, firms which are located in environments where high levels of spin-off activity occurs will tend to see higher numbers of spin-offs (Cooper 1973), as would-be entrepreneurs are encouraged to take the entrepreneurial step themselves as a result of observing role models who demonstrate the feasibility of pursuing an entrepreneurial career pathway. In the case of technology entrepreneurship, the employer which the individual leaves to start his/her own venture is typically a commercial, private sector business, although research has shown that public sector research establishments and universities act as the "incubator" for around 10% of electronics and software start-up and 20% of biotechnology new starts (Cooper, 1998; Cooper and Park, 2008; Harrison et al., 2004; Oakey et al., 1990).

Studies of entrepreneurial activity in technology-based sectors also suggest that the majority of ventures are founded by entrepreneurs in their mid- to late thirties (Cooper, 2006; Harrison et al., 2004) although work based upon inter-sectoral comparisons suggest that start-ups by younger entrepreneurs are more common in some sectors than others (Cooper, 2006). For example, start-ups by younger entrepreneurs are more common in the software sector than they are in the electronics industry. Arguably, it is easier for people in the software sector to become entrepreneurs at an earlier stage as it is a relatively new and rapidly developing sector where maturity does not offer significant benefits over youth. Those with appropriate knowledge and skills are able to identify opportunities which require relatively modest levels of financial resource to enter the market. Maturity is a double-edged sword in terms of its influence on entrepreneurship; mature people may benefit from a greater wealth of knowledge, experience and networks but may be less flexible in their thinking as a result of being more fixed in their ways. Younger people, with fewer preconceptions may be better-placed to identify new opportunities. When a person decides to take that entrepreneurial step they can be influenced by a range of factors. The technological sector may facilitate start-up or impose constraints, such as the level of experience and skills required to establish a venture and length of time required to gain it. Credibility and track record may also prove important in establishing a new venture; brokering relationships with various agents which include suppliers, customers and financiers may be easier the greater the level of experience, which is often a function of age.

Team-based entrepreneurship is the typical technology start-up mode as around only one in four or five technology firms is established by a lone entrepreneur (Cooper, 2006; Oakey, 1995; Roberts, 1991). Team-based venturing provides the opportunity to pool complementary knowledge, experience, skills and resources, so that firms benefit from the collective weight of their individual team members' contributions. Most technology entrepreneurs are educated to degree level and for many this means a degree in a technical domain (Cooper 2006; Harrison et al., 2004). Following their education, most work for other employers for a number of years, in some cases fifteen to twenty, before they set up their own venture. During this period of employment many would-be entrepreneurs meet those with whom they subsequently start new ventures; they also have the opportunity to enhance market awareness and knowledge, and establish relationships with customers, suppliers and other agents (Chandler and

Jansen 1992). Vitally, this period, which can be thought of as an entrepreneurial apprenticeship, also provides the chance to identify opportunities which frequently form the basis of the new venture (Harrison et al., 2004). It is not surprising, therefore, that many technology entrepreneurs establish ventures in sectors in which they have worked before (Chandler 1996; Cooper 2006; Harrison et al., 2004).

Thus, the career path of many technology entrepreneurs is characterised by a journey which comprises several years at university and ten to fifteen years in employment before the step up to entrepreneurship; few make the transition to entrepreneurship before the age of thirty. The establishment of the National Council for Graduate Entrepreneurship in the United Kingdom has raised expectations that increasing numbers of students will start businesses whilst at university, on graduation or soon thereafter. If the present reality is that most entrepreneurs are not that young when they start, this raises the questions about what can be done to bring the entrepreneurial future forward. Entrepreneurship education and related enterprise activities, stimulated and supported via government programmes and other institutional initiatives, have the potential to influence the future entrepreneurial career path of many individuals (Cooper and Lucas, 2006).

Bringing the entrepreneurial future forward

Universities are recognised by policymakers and university managers as having the potential to play a multifaceted role in enhancing levels of entrepreneurial activity by stimulating and supporting the development of students and staff as entrepreneurs (Cooper, 2001; Cooper and Hetherington 2005). The focus of universities on technology-based enterprise has been fuelled by programmes such as Science Enterprise Challenge, the United Kingdom government-sponsored initiative targeted at promoting entrepreneurship within SET disciplines in higher education (Hartshorn and Hannon 2005). Such initiatives have led to the introduction of activities ranging from taught modules in enterprise to business plan competitions aimed at encouraging SET students and staff to engage in enterprising behaviour and commercialise university-generated know-how (McGowan and Cooper 2008). Students entering business plan competitions need to understand a range of functional areas and resource requirements, some of which can be developed through taught modules or extracurricular workshops. Given earlier comments regarding the importance of markets/marketing strategy to technology ventures, a major issue for many students entering business plan competitions is that they have little/no direct experience of markets they seek to enter. Some students form teams with university staff, increasing numbers of whom have commercial awareness/direct experience, from working in industry before entering academia or through collaboration with companies on near-market research.

There has been a proliferation of business plan competitions, with anecdotal evidence of teams using their winnings to bootstrap their start-up; however, little research has explored the impact of competitions in terms of the entrepreneurial teams and businesses which emerge (McGowan and Cooper 2008). Hence, little is known about the backgrounds of those who found the ventures and how they overcome the apparent lack of experience which is important to the success of so many entrepreneurial ventures.

Research focus, method and empirical findings

Focus

In order to help address this knowledge gap the authors of this paper are undertaking exploratory research which focuses on the outcomes of a cross-institutional business plan competition in Northern Ireland. The data discussed in this paper were gathered through analysis of the business plans developed by the top ten ventures which won a place to compete in the final of NICENT's £25k EAS in 2007. NICENT has managed the EAS across two higher education institutions in Northern Ireland, the University of Ulster and Queen's University of Belfast, since 2000 when the competition was initiated. The competition, based upon MIT's $50k Enterprise Award Competition, is designed to encourage student engagement in enterprise through the exploitation of technology-based opportunities and the stimulation of technology transfer within universities in Northern Ireland. The EAS is open to undergraduates, postgraduates and staff from any discipline at all the University of Ulster campuses and at Queen's University, Belfast. Entrants are required to develop a business plan for commercialisation of a specific piece of technology.

As a results of the extent to which academic staff were becoming involved in the competition the rules regarding team composition were amended in 2003 to require teams to be made up of students or a mix of students and academic staff, as long as the number of staff did not exceed that of the students. This rule was introduced in order to encourage greater involvement of members of the student body, to encourage increased levels of collaboration between research active staff and their research students and to avoid the emergence of venture teams which were comprised of exclusively university staff seeking a commercial outlet for outcomes of their research activity. An impact of this change, reflected here, has been the emergence of teams directly involved with the development of the business plans, and likely to develop the new ventures, which are made up largely or exclusively of students. What is also evident is the innovative and strategically sound development and use of secondary, informal teams of advisors. These bodies while engaged indirectly, are viewed by the founding teams as a crucial resource for the emerging ventures, acting as an advisory board, or informal adjunct to the management board, providing guidance, occasionally resources and access to key networks. In five of the ten cases there was evidence of a wider supporting team; further consideration is given to this wider team in the discussion which follows.

The competition is run over two stages which extend over a six-month period. All entrants are required to submit a short business plan for their technology-based opportunity which is evaluated by a team of experts (made up of entrepreneurial practitioners, business angels and business professionals): based on the short business proposition the top ten ventures are selected to compete in the final. Those proposing ventures which win through to the final have access to specialist workshops and are matched with a mentor who provides supports to shape the opportunity/proposition. Individual or teams of entrepreneurs then develop a full business plan and present to a panel of external experts. Success of the competition has enabled significant private-sector support to be attracted as well as that of the development agency Invest Northern Ireland. In total 40 plans were submitted to the 2007 competition sizeable numbers of teams coming from business and from engineering; cross disciplinary teams were very rare. The empirical section of this paper explores the top ten teams and their technology-based opportunities.

Methodology and sample

Nearly 100 individuals/teams registered their interest in participating in the 2007 EAS competition. The eventual number of entrants in the first round of the competition totalled 40, from across the two institutions. From this group the top ten business propositions were selected to participate in the final round. In the 2007 competition five ventures from each university were represented in the final ten, all of which had been developed by teams. The business plans of these top ten teams provide the data which are analysed and discussed in this paper. Given the current lack of evidence regarding the outcomes of business plan competitions this exploratory and case-based research seeks to help address this gap. The ten plans varied in length from 26 to 59 pages. Analysis of the plans was undertaken by the two members of the research team. A framework of topics to guide analysis was drawn up and agreed by the research team, based upon literature on entrepreneurial teams, the background of entrepreneurs and aspects of market development, so that the plans could be analysed and relevant information extracted. The researchers jointly coded up the data from three of the plans before dividing the remaining plans for individual coding. The researchers then exchanged their findings for verification and corroboration to ensure that the analysis was systematic and rigorous.

Findings

The company location and its "product": The product ideas of the top ten ventures were described, variously, as "innovative", or "revolutionary", meeting definite and clearly identified and defined customers needs. They comprised a computer security software product (Company A, Belfast), a bespoke insurance claim service (Company B, Londonderry), a media resource and education service (Company C, Londonderry), a sports accessory good (Company D, Belfast), an on-line stress management resource (Company E, Belfast), a school transition software product for post-primary school children (Company F, Belfast), a toileting product for older and infirm people (Company G, Belfast), an innovative refrigeration technology and service (Company H, Antrim), an innovative bed management product for use in hospital wards (Company I, Belfast), and a new search and query technology for internet searches (Company J, Belfast). Notwithstanding the claim of "innovativeness", only two of the ten teams had Intellectual Property (IP) protection in place for their ideas and two others were in the process of applying for protection of their innovations.

The actual or proposed locations of the businesses was in some cases influenced by the desire to maintain links with academics or research groups within the students' or staff members' university. A number of the plans made explicit mention of the desire to be located in close proximity; other firms were more footloose and less tied to specific locations. There was evidence of some of these young start-ups using university incubator facilities which offered low-cost, flexible terms.

The team - size, gender, age and "status": The average number of members of the venture teams was four; this number comprised those who were directly involved in development of the business plan and would be responsible for the initial development of the venture. The teams, however, varied markedly in size; one had just two members while the two largest teams comprised six and seven members. For this cohort entrepreneurial new venturing appeared to be an activity attracting men, primarily, since of the 42 individuals involved in these top ten teams, 36 were male and only six were female. This finding reflects those in research on the gender

balance evident in technology sectors (Cooper at al., 2007; Hampton et al., 2007), but contrasts with findings of research which focused on earlier years of this competition, which showed that it attracted large numbers of female participants (McGowan and Cooper 2008).

The age of team members directly involved in the development of the ventures ranged from early-twenties to mid-fifties. Some teams combined youth and maturity as students had teamed up with staff or others from outside the university, so that students were able to draw upon the expertise of those with commercial or greater technical experience. The average age of venture team members was mid-twenties, which is significantly different from that observed in non-business plan ventures discussed earlier.

As alluded to earlier, all but eight of the participants are categorised as current "students", reflecting the degree to which students dominated the make-up of team membership in this cohort; of the others, four were identified as academic staff members. The lead entrepreneur in nine of the ten cases was a student. Those "staff" team members on venture teams brought specific technical expertise and experience to their respective teams, in computer technology, organisational behaviour, education and technology transfer.

Education, knowledge and experience: Team members came from varied educational backgrounds. All of those engaged directly with the development of the enterprise had completed or were completing a university degree programme, undergraduate or postgraduate taught/research degree. The majority of these team members (36 out of a total of 42) were about to be awarded or held a Masters degree obtained through taught enhanced undergraduate or postgraduate programmes, and a minority, 8, held or were working to complete postgraduate research qualifications or PhDs. The academic disciplines of team members varied widely, and, as is discussed below, were significant in informing the types of businesses developed by their respective teams. Subjects ranged from English, Creative Writing, Sociology, Mathematics, Sports Studies, Education, Business, Law and Social Science to Engineering, Construction, Electrical, and Mechanical, Product Design, Graphic and Web Design, and Computer Science. More than half of those involved in the teams were from an Engineering, Design or Computer Science background.

Those directly involved in the enterprise drew upon their education, technical knowledge and business experience as sources for their business ideas. For example, in developing its computer security software product Company A reflected the technical expertise and experience of two of its four team members, one of whom had an undergraduate degree in Computer Science whilst the other held a PhD in the subject, was highly experienced in computer security and had an extensive network of industry contacts. Company D had developed a sports-related product; one of Company D's four team members had an undergraduate degree in Sports Science, a taught postgraduate Masters degree in Marketing and was undertaking research for a PhD. The other team members had undergraduate degrees in Mathematics, Sociology and English and Creative Writing, with this last team member also having a Masters degree in Fine Art. All were accomplished sports people, with extensive professional experience, and two were involved in sports on a professional basis.

A good example of how diverse skills and knowledge were brought together to support venture development is seen in Company F. The four members of this team,

which developed transition software for children moving to post-primary school level, brought a balanced mix of software development knowledge and educational qualifications, as well as substantial experience, of and in the education sector. Three members of the team held undergraduate and taught Masters degrees in Computer Science, while the final team member was a qualified teacher with nearly thirty years of experience within the education sector and specialist knowledge of special needs education. A final example is that of Company J, which offers a new internet search and query technology based upon a particular and highly innovative technology. The four members in this team held undergraduate and postgraduate degrees in Computer Science and Computer Engineering. One helds a PhD in artificial intelligent systems and another was about to complete his PhD in this area. All had substantial experience in the field and had developed significant networks within the sector, both nationally and internationally.

The number of years of relevant experience amongst the new venture team members ranged from zero to, in one case, over thirty years. Leaving these extreme examples aside, the average number of years of experience was five, with some teams bringing together individuals with widely divergent levels of experience, which was the case where teams comprised both staff and students or students and others not connected to the university. The majority of undergraduate engineering students within the new venture teams had spent a period of up to one year in industry as part of their degree programme and so much of their experience was derived from this placement. All of those who had completed or were about to complete taught postgraduate programmes had gained relevant, full-time experience either between their undergraduate and postgraduate studies or following completion of their masters degree. For those whose experience was very limited, it raises questions as to the depth and breadth of that experience, and the extent to which is provides adequate preparation for venture start-up.

Beyond the team - extended networks: Not withstanding levels of education and high levels of technical knowledge and qualifications, in light of the limited experience and access to key networks of many team members, half of the teams saw the need to enhance their team's capability and access to resources. In developing their business plans five of the ten teams saw the need to report upon an extensive network of contacts on whom they would draw to support them in the launch and development of their venture.

Those indirectly involved in the development of the new ventures, who were key members of networks of those directly involved, appeared highly qualified and with significant experience in the sectors within which the new ventures were situated; thus, they would be able to provide guidance and access to resources, including to other networks. They clearly demonstrated specific technical as well as business experience, supportive of the idea being developed. For example, members of Company B drew heavily upon the parents of one of the team, who were experienced business people with their own company, and the services of a qualified accountant. Similarly, Company D listed an extensive network of quality contacts, including a professor of business, a qualified attorney and IP specialist, all with over 25 years of highly relevant experience, and a venture capitalist with over twenty years of experience. Also included were several others with varying expertise and experience in the sports industry, both nationally and internationally. A further example is Company E which listed an "indirect" team comprising five individuals who brought

extensive experience of the management development sector in which the new venture was positioned, and who made available to the core team, access to their extensive network of contacts.

The remaining five teams did not specifically cite a wider network of contacts as a key entrepreneurial resource. Three of them did, however, reflect the breath and depth of their experience as well as their level of qualifications. Company F, for example, presented team experience of, on average fifteen years, with one member having almost thirty years of relevant business expertise. Another example is Company J, whose members had, on average, eight years of experience, with one member having 28 years of pertinent business experience.

Markets and customers: The extent to which the different venture teams identified the value of their project and defined a strategy to exploit that value was a key part of the business plans. All appeared to be clear who their different customers were and to be able to define appropriate segments to target. Company A, for example, in seeking to provide a computer security product, identified the commercial banking sector and its customers as its key target group. Its potential market was global and it appeared to have identified one key United States (US)-based competitor to its plans. It was clear about the growth potential of its market, worldwide and how much it estimated it would need to invest in order to establish the venture. The team was also clear about how it would approach the market, utilising licence deals and augmenting its marketing promotions efforts by personal contacts, professional endorsements and the development of its web-site. Interestingly, all ten companies had established a website as a part of their promotions programme, and eight appeared to be particularly sophisticated, facilitating feedback from customers as well as providing information on the venture, the venture team and its products. Company C offered a particularly good example, given the venture's focus on providing access to media education and resources. This venture team had a clear vision of who its customers were, individuals who wanted to be able to manipulate film media. Competitors were identified in the US but none was seen to pose a direct challenge, particularly given the new venture's focus on the UK and Ireland markets. However, detail as to the size of the level and sustainability of demand in these markets for the venture's product offering appeared limited. The web was identified as the route to market, hence the emphasis on the development of the company's website.

A further example of how the individual venture teams identified the value of its project and defined a strategy to exploit that value as a key part of the business plans is Company G. This team of engineering students developed a toileting assistance product that resolved many of the difficulties experienced by the elderly and infirm in using the toilet, whilst retaining personal dignity. A further benefit of the product was to reduce the risk of back injury by carers seeking to assist those who need help. The team had identified its target customers, defined its market place as being the UK and Ireland, had researched its likely competitors but was convinced that its product offered greater benefits than products available in the market. While short on detail it had identified the potential of the market in terms of its size and who the key players were as far as those likely to adopt the company's product, largely hospital trusts. Although with little by way of a profile in the market, Company C had decided that its best approach to the market should be through personal selling. One final example in this regard was Company H. This team was made up of seven students, all with undergraduate Masters degrees in Mechanical and Manufacturing Engineering.

Reflecting the academic background of its members the venture focused on developing a market for a refrigeration technology based upon the use of air rather than chemical refrigerants. Seeking to exploit current trends in terms of the green agenda the team set out to target industrial refrigeration and had identified the growth potential of its market. Only one direct competitor, from Japan, was identified by the team, although other competitors using traditional chemical methods were identified. The basic product appeared to exist already but the team had developed enhancements to this which it was taking steps to protect through IP channels. Despite little or no profile in the market the team planned to promote its product through demonstrations and personal selling. The island of Ireland was identified as the first key target market, with the UK next, after a period of three years.

Probably the most sophisticated example out of the ten for identifying the value of its product and defining a strategy to exploit its value was that of Company J. The customer group for this venture's, IP-protected, new search and query technology had already identified themselves as large companies within the media sector. Another new emerging sector was companies within the international pharmaceutical sector which have a need for on-line search technology. Eight competitors were identified and the markets which they served, and research suggested a substantial global market for the venture's product. The team had, however, decided to establish its position within the UK and Ireland before seeking, within three years, to gain entry into the US market. Along with the company website, attendances at conferences and personal selling were identified as key approaches to promote the company and its products, assisted by the team members' extensive network of contacts and high profile in the venture's target market.

Discussion and conclusions

A number of valuable insights emerge from the research discussed in this paper. The NICENT £25k EAS seeks to encourage a greater engagement of students and staff, from within higher education institutions, in practical aspects of entrepreneurial venturing. From the earliest stages of the competition, the Centre puts the emphasis on the concept of "near-to-market " projects and, as entrants develop their business plans, they are encouraged to think seriously about the commercial potential of their ideas as the basis for a new venture, and as possible alternative career choices for themselves. This strategy is in contrast with other business planning competitions managed by the Centre, targeting largely undergraduate students, where the emphasis is much more on learning about the entrepreneurial process and any expectation of venture start-up is significantly lower. The types of opportunities discussed here suggest that the competition is stimulating and helping to drive forward ventures which are identifying technologies with real market potential.

The Centre's strategy to emphasise the expectation that new ventures may well emerge from engagement with the £25k competition has clearly had an impact on the composition of the entrepreneurial teams which it has attracted. The teams have really focused on how their technical knowledge has influenced the identification of business opportunities which capitalise upon their know-how and commercial experience, their access to relevant expertise beyond the immediate venturing team, and the development of robust marketing strategies for their products. That these ten finalists have all started-up in business is an interesting and valuable outcome.

What appears clearly from the analysis of the top ten venturses is that team members draw upon their own specialist knowledge and expertise in their chosen subject area,

mostly research-based, to identify the product idea around which they propose to develop an entrepreneurial venture. An important driver in the development of a venture proposal is a key individual within the team who is particularly knowledgeable about the area, largely as a consequence of research undertaken, and is aware of an opportunity that s/he considers is ripe for exploitation. A second key driver appears to be that individual's personal and professional experience within the area, which, combined with specialist knowledge, helps them to identify a specific problem or gap in the market which they perceive that they can address. Furthermore, for at least five of the teams the professional expertise and experience of significant others was especially crucial in identifying and seeking to establish the potential of the opportunity for which they saw the "window of opportunity" opening, and upon which they considered that they could build a sustainable commercial enterprise. Issues of personal confidence and self-belief are evident amongst team members in each of the companies, but particularly within teams where some members bring to the venture a record of long and varied business experience and have, or at the very least, access to such people through their network of personal contacts, often generated during previous employment. Even for Company H, with it seven student team members, who had each spent just a year in industry during their degrees, it could be seen how it pulled upon that experience and for one member it had provided the opportunity to identify a commercial problem which Company H was seeking to address.

Analysis of these top ten companies indicates how all of the teams, the members of which came from non-business backgrounds as far as their primary subject areas of research were concerned, responded to the opportunity that engagement in the £25k EAS afforded. It clearly provided an opportunity to explore the commercial potential lodged within their research activity and to develop appropriate competencies in venture management which they might not otherwise have gained. This raises the question as to how many of them would have become as deeply involved in entrepreneurial venturing at this stage in their careers had it not been for the competition; the most likely answer is very few, if levels of new venturing activity by similar students prior to inception of the competition is an appropriate measure by which to judge. What is evident is that most of the 42 individuals who are involved in the ten teams come from a university environment where they are studying or are undertaking cutting-edge research in a technology-based discipline which has provided the technological basis for their new venture to exploit diverse opportunities.

From an institutional and disciplinary point, all student and staff venture team members came from Science, Engineering, Technology and/or the Creative Media, (SET/CM), and none were from Business and Management. Most of the engineering students had gained industry experience during their degree; this had helped them to develop commercial awareness and, in some cases, had helped them to identify an opportunity. The competition is open to staff and students from all faculties which raises questions about the type of ventures that are likely to be generated from enterprise competitions within a university setting; the evidence presented here suggests that they are most likely to come from within the SET/CM constituency. This raises further interesting questions about the rationale for lodging the entrepreneurship agenda within Business and Management faculties which are the traditional "home" for "entrepreneurship", the value of migrating the agenda out of Business and Management and into SET/CM faculties, and the need to nurture much

greater cross-disciplinary activity. Future research will give consideration to these issues.

At this point it is not possible to judge the long-term economic contribution of these ten ventures. If all of the individuals are ultimately engaged in the new ventures this will amount to 42 direct "jobs", before any employment of others, which is the short- or long- objective of most teams. All the ventures are located in Northern Ireland which represents a small but valuable contribution to the stock of local businesses, and while most teams are focusing, initially, on domestic markets, more than half are planning to build their presence in international markets, which will bring longer-term export trade benefits to the wider economy. Retaining technical talent within Northern Ireland is important. Many students leave Northern Ireland to attend university across the Irish Sea, and secure employment on the mainland when they graduate; many never return, or at least not until later in their career. Finding ways to retain technical talent in the shape of students educated in Northern Ireland's universities and staff who are working within Northern Ireland's higher education institutions is vital if the economy is to remain vibrant and dynamic. University technology transfer, along the lines discussed here, may represent another string to Northern Ireland's bow in terms of ways in which to retain entrepreneurial talent, supported by more experienced entrepreneurs, university technology transfer offices and the university research community, which was identified as an important continuing resource for a number of the businesses.

A little less than one year on from the competition all of the companies have a web presence and are operating, some more actively than others. Only time will tell which of the ventures will thrive and which will perish; the aim is to track the development of the ten ventures over the next three years to develop a greater understanding of the evolution of ventures with a university origin. Even if not all of the ventures continue, experience gained by their founders will enable individuals to become valuable employees working for other organisations, and at some future juncture some might be stimulated to pursue other entrepreneurial opportunities, alone or with others, perhaps fellow work colleagues.

Taking a wider perspective on business plan competitions, most participants will not engage in venturing directly after university, however, as has been observed here, some will. Experience gained of new venture planning may encourage some participants to think positively about employment within small enterprises, and seed longer-term entrepreneurial aspirations. Those who never start a venture should be better-placed to contribute to innovation as an employee, whatever type of organisation they join.

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Continuous High Technology Business Incubation

Cross-sectoral comparison of approaches to high technology business incubation

Abstract

This paper addresses the question of how organisations can foster high technology businesses in an incubation-type environment. We compare the approaches taken by a large private firm with a successful University entrepreneurial program to outline successful elements in creating a successful high tech business incubation environment. By outlining similarities and differences of the two cases, this paper provides practical insights how to foster high technology businesses.

Keywords: fostering high technology small businesses, incubation, creation of a supporting environment

1. Introduction

The concept of business incubation is not a new one (Joseph et. al., 2005), but its major importance has only be acknowledged more recently. In the rapidly changing global economy (Bayhan, 2006), the development of entrepreneurship as well as the creation and development of small and medium-sized enterprises (SMEs) are increasingly recognised as a driving force for economic development (Szabó, 2006), since these SMEs are flexible and therefore able to supply the need for immediate adoption of market changes (Szerb, 2003). In this context, business incubators contribute to local, regional and national growth and competitiveness, create jobs as well as wealth for the society (e.g. Bayhan, 2006, Szabó, 2006).

However, even if the business incubation concept is not new, there is no universally valid definition (Hamdani, 2006) nor a coherent approach toward its practical implementation (compare e.g. the overviews on the different national approaches in United Nations, 2001 and Szabó, 2006). Business incubation can be understood as a business supporting process designed to encourage entrepreneurs to start their own businesses and help them to survive and grow on a long-term sustainable basis (e.g. Bayhan, 2006, United Nations, 2001). By providing a supportive environment (Klok, 2001) with resources and services such as tools, information, education, contacts/networks, office space and capital (e.g. Bayhan, 2006), business incubators aim to "accelerate the growth and success of entrepreneurial companies" (American National Business Incubation Association cited through Bøllingtoft & Ulhøi, 2005, p. 269) until these companies can leave the incubators financially viable and free-standing. Following this definition, the business incubation concept is closely linked (but not identical) with other concepts providing an environment that fosters entrepreneurship (e.g. Science/Technology Parks or the Corporate Entrepreneurship concept).

This paper is intended to contribute to the challenge faced by many organisations: How to foster high technology businesses in an incubation-type environment? We take an existing model towards innovation management as a starting point and compare the successful business incubation approaches of a large, worldwide professional services firm (Deloitte Australia) and of a entrepreneurial university (University Twente, Netherlands). Outlining similarities and differences of the two cases, the paper provides valuable insights how organisations can successfully approach high technology business incubations.

2. Research Framework

The research framework for this study is the 'House of Innovation' model developed by A.T. Kearney (2008). Since innovation performance is not only depending on one indicator, the model takes a holistic approach of innovation management covering a wide range of aspects towards innovation such as innovation strategy, innovation culture, innovation life cycle-management as well as enabling factors (A.T. Kearney, 2008).

The 'House of Innovation' model is currently being applied in a European-wide project called 'IMP^{3}prove' aiming to enhance the innovation capabilities of SMEs. Part of the Europe INNOVA Initiative and supported by the European Commission, the project allows companies to benchmark their innovation performance and helps these organisations to improve their innovation management through personalised consulting services (IMP3rove, 2008).

Figure 1 shows the mentioned 'House of Innovation' model graphically.

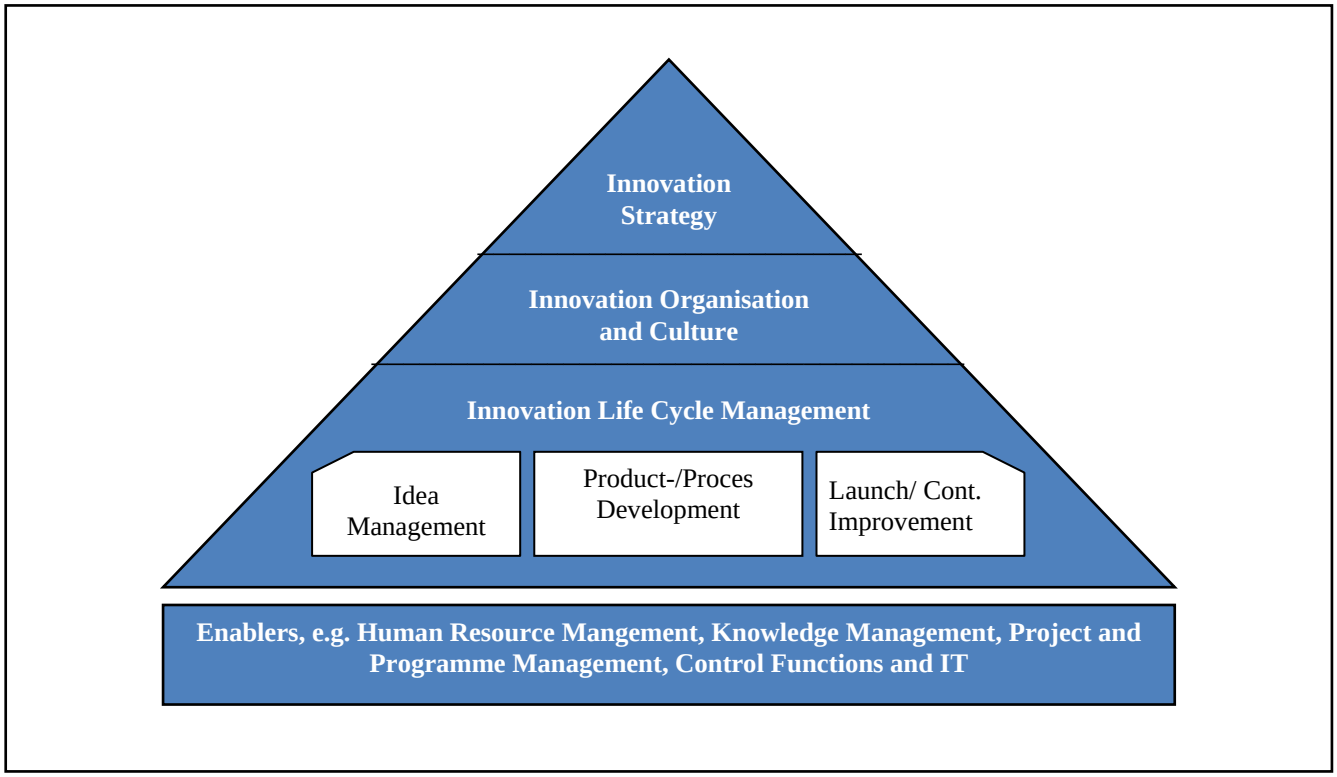


Figure 1: The 'House of Innovation' model (following IAGO, 2008)

We will now take a closer look how University Twente and Deloitte Australia have developed a entrepreneurial environment with specific mechanisms to support high technology business incubation. In the conclusion, using the four building blocks Innovation Strategy, Innovation Organisation and Culture, Innovation Life Cycle Management, and Enablers, we will then compare the two programs to understand some common success factors.

3. Fostering high technology small business at University of Twente

Founded in 1961, the University of Twente (UT) offers an environment in which the academic and personal development as well as the entrepreneurial senses of the UT-students are actively stimulated and facilitated. The University currently has some 7.700 students with almost 2.000 first-year students arriving in 2005. There are 2388 Full Time staff, of which 1400 (FTE) are scientific personnel. Not included in this number are 732 PhD students, active in various research areas.

UT has a world-wide reputation for the creation of a best-practise entrepreneurial process and a solid history of producing high technology start ups and is regularly sited in literature reviews on the topic of entrepreneurship (Clark, 1997, Clark 2003). Their well developed Entrepreneur and innovation program provides a model for European learning and research institutions, whilst 'UT has realised the most spin-offs of all Dutch universities. The number two in the list has generated only half the spin-offs.' (Diffuse, 2006)

Whilst the idea that Universities can play a major role in economic development by becoming entrepreneurial may not be new (Mian, 2006), the move to increase the profile of entrepreneurship activities within University Twente actually began in the early 1980's. Knowledge valorisation and the stimulation of academic entrepreneurship are key features of UT's policy and they have developed a holistic approach to Knowledge Exchange and Transfer using a mix of centralised and decentralised innovation management.

Framework

The structure for their program is as follows:

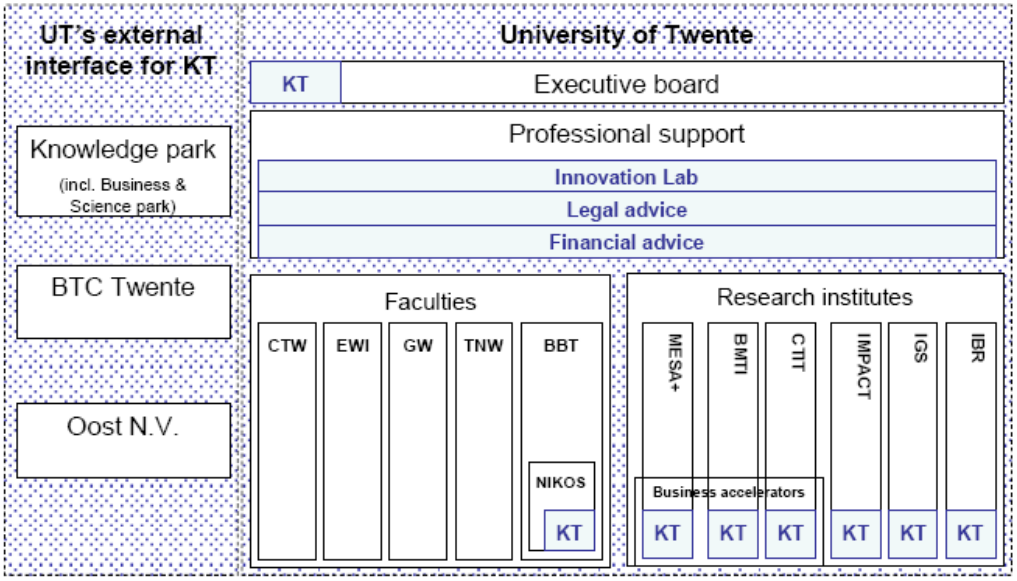


Figure 2: University Twente's Innovation Program Structure

The structure for University Twente's Entrepreneurship program primarily consists of the following:

1. *Executive board member* committed to valorisation of Knowledge transfer
2. A dedicated professional support group called the *Innovation Lab* that support entrepreneurial and innovative activities within the University
3. *Nikos - An expert centre on entrepreneurship* research, consultancy, projects and teaching, that works closely with the Innovation Lab and the research institutions
4. Each research institute has its own *Knowledge Transfer body* that interfaces with the market

5. Three research institutes have their own *Business Accelerators* to reduce the time to market for selected projects
6. Access to three dedicated *external Knowledge Transfer agencies* (BTC Twente, Knowledge Park, Oost. N.V)

Strategic Approach to the Entrepreneur Program at University Twente

Strategic Intention - The University has a designated Executive board member committed to the advancement of entrepreneurship within the university being assigned the Knowledge Valorisation portfolio.

Commitment to developing an 'entrepreneurial culture'

At all opportunities, UT brands and promotes itself as an 'entrepreneurial' university. University Twente has developed many different mechanisms to support this. These include:

- Stimulating entrepreneurship among researchers
- Regular meeting in the Faculty Club: entrepreneurs and research meet on a once per month basis to discuss mutually interesting topics
- Researchers and research institutes are also members of entrepreneur's associations
- TOP programme (managed by Nikos) matches every entrepreneur with a mentor from science
- Live-in entrepreneurs - over the years every research group has had at least one entrepreneur to mentor and "live" in the research group
- NIRIA Students Twente and the Student Union host the Twente Technology Week annually
- NIKOS, organizes the 16th annual High-Technology Small Firms Conference (HTSF) in Enschede
- BTC-Twente is a business incubator situated at the Business & Science Park Enschede. It is an incubator center with a target group of knowledge-intensive enterprises and enterprises that specialize in high-tech or high-quality business services

UT'S philosophy is that sustainable firms require four types of functions to develop their business in terms of types of capital (strategic, cultural, economic and social) up to a certain minimum; they must then be balanced.

Encouraging entrepreneurship

To support entrepreneurship education, Twente actively supports the entrepreneurial activities of students and facilitates through the Student Union and the USE taskforce (University Student Entrepreneurs). In addition students can rent office space at below market-rates, USE organises network activities and Nikos offers students various curricular and elective courses and workshops on

entrepreneurship and entrepreneurial skills, whilst all University student-facing services are managed and operated by students.

Education and training to support entrepreneurship

University Twente have created an agency, Nikos (Dutch Agency for Knowledge Intensive Entrepreneurship); dedicated to improving the understanding and education of entrepreneurship within the University. This ensures that the University continues to improve its processes, concepts and culture with the intention of staying ahead of the market.

Encouraging high technology small business

The University of Twente is heavily committed to development of high technology skills and business incubation through its many programs including Technology Week, the High Technology Small Firm Conference and the BTC incubator. The Business & Science Park is a leading location for high-tech companies and ICT service providers wishing to establish research contacts with the university or use the campus facilities.

Converting knowledge into business

- TOP program - during the one-year support the TOP entrepreneur receives office space and facilities, access to networks, a scientific and a business manager, and an interest- free loan.
- Knowledge Park – A collaboration between the province of Overijssel, the cities Enschede and Hengelo and the UT, supported by the Ontwikkelingsmaatschappij Oost NV. the structure has been created to efficiently support the content-related activities ensuing from the Technology Valley and to enable upscaling of successful practices to the national level.

Resources

University resources offered to new ventures (including high technology firms) include:

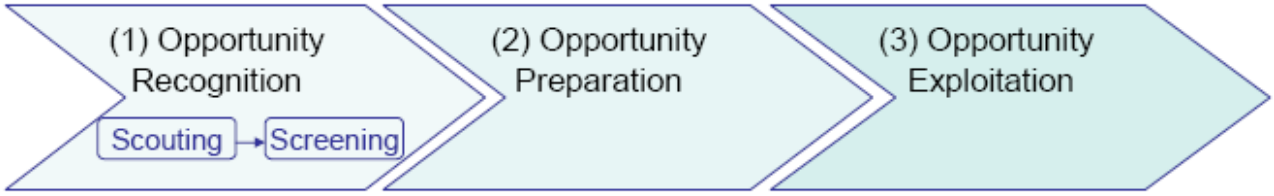
- Knowledge and networking support through Knowledge Park
- Financing and cheap office space though the TOP program
- Engagement with financiers - For the TOP-programme the UT has its own fund. TOP-companies are provided with a loan under favourable conditions (no interest and 4 year pay-back period). The UT is a shareholder in the PPM-Oost fund, which includes the former Innofund. Further, the research institutes and the Innovation Lab have industrial board with representatives financiers.
- University investments in companies - The University sometimes invests in its spin-off companies, especially those companies that are research spin-offs and close to the research capabilities of the university

- Zone of Opportunities – A database of opportunities coming from the university for use by students and SME's

Involvement of the program with regional and governmental agencies

The University facilitates this through Knowledge Park, with the local Government being part owners of the facility. The Ontwikkelingsmaatschappij Oost NV participates in projects and programmes stimulating regional development.

Process



Decentralised scouting of opportunities at the research institutional level	Ideas with 'high potential' on a research institutional level are worked on by business developers	Companies 'spun out' using University IP
Initiatives designed to stimulate entrepreneurial attitudes in researchers – including 'entrepreneurs in residence', Faculty Club and other initiatives	Mentors from science and business development officers are partnered with entrepreneurs	BTC Twente incubator
Zone of opportunities - Database of opportunities for students and SME's	TOP program supports would-be entrepeneurs	Knowledge Park supports new ventures
Teaching entrepreneurship at the undergraduate and graduate level	Knowledge Park supports new ventures	PPM-Oost fund provides funds for start-ups through the TOP program
Individuals are free to self select projects to advance and take ownership of the project	Business Plan competitions	Innovation Lab provides funds for investment in research spin-offs
Innovation lab coordinates and oversees all aspects of knowledge valorisation		
Innovation accelerators within three strategic research institutions to provide structured commercialisation with an emphasis on speed to market		
Nikos TOP Program provides resources through support services and access to finance		
Executive Board member oversees and represents the program at board level		

Figure 3: University Twente's innovation framework

4. Fostering high technology small business at Deloitte Australia

Deloitte Australia (hereafter Deloitte) is a member of Deloitte Touche Tohmatsu, one of the world's leading professional services organisations, with revenue of over US$20 billion and more than 135,000 people in over 140 countries. Providing services in the areas of audit, assurance and advisory, tax, corporate finance and consulting mainly to Australia's large and middle sized corporate and government organisations, Deloitte has sustained double digit growth for the past four years..

Just a few years ago, Deloitte recognized the importance of creating and sustaining innovation and environment in order to archive its ambitious growth plans. Regarding this, Deloitte's biggest challenge was to transform the vague concept of innovation into a solid activity for its partners and employees. Apart from communicating the significance of innovation regarding Deloitte's overall business and growth strategy, it was seen as crucial to create a sustainable work environment which encourages partners and employees to actively participate in and contribute to innovation.

Since 2003, Deloitte is addressing this challenge with its national Innovation Program, which transformed the work environment at the deepest level. Due to its basic premise that everyone is an innovator, Deloitte promotes partners and employees to "play in the innovation space". The Innovation Program educates and supports partners and employees who then generate and develop ideas on how to improve internal processes or service delivery to clients, as well as new products and services to bring to market. As a structured and comprehensive business process covering targets, funding, resources and accountability, the program covers the whole innovation process from helping people to generate ideas to the successful launch of disruptive and breakthrough innovations.

In 2002, Deloitte's most significant step into high technology business incubation, was in the strategic acquisition of Eclipse, at the time a small web software development company. The group has growth considerably within Deloitte as a essentially a business unit. Since that time, and through the innovation program, they have supported many high technology business ideas, with some being funded ventures that are in the process of being taken to market. The technologies range from a double authentication internet security device designed to prevent phishing and identity fraud, to a new search technology. The high technology expertise that Deloitte possesses through Eclipse, allows it to provide in-house technical support, however when required, Deloitte are willing to either recruit-in or seek advise from domain experts to assist development. The Innovation Acceleration Team looks specifically at high technology ideas and seeks to fast-track their past to market.

Deloitte's strategic approach is based on the framework presented in figure 4:

Figure 4: Deloitte's innovation framework

Innovation Strategy: The heart of Deloitte's framework is the innovation strategy. Defining the role of innovation within the organisation, the innovation strategy provides the context and guiding principles for the design, implementation and operation of the Innovation Program in alignment to the overall business or growth strategy. By determining the program's goals and objectives, its boundaries, and its measures of success, the innovation strategy enables organisations to clarify the vague and intangible concept of innovation. Most importantly, the innovation strategy is aligned to Deloitte's overall business strategy and has a strong commitment by the CEO / board.

Culture: The Innovation Program aims to create an innovative culture, and to embed and continually improve an innovation capability of an organisation. The objective is to educate employees (ability), and, most notably, to encourage and maintain their interest and engagement in the long run (willingness). Winning over the hearts and minds is seen as a key to drive the quantity as well as quality of ideas, and finally to extract value from the program. In order to do so, Deloitte uses strong communication, networking activities, a Reward & Recognition program and relates the Innovation Program to the company's business culture, which is shaped by Deloitte's award winning 7 signals campaign.

Innovation Zone: The Innovation Zone™ is a web based idea management solution providing the primary contact point for employees to interact with the innovation program and with each other. The centrepiece of the zone is the ability to collaboratively improve submitted ideas in order to extract the maximal value at the end. However, the interaction is not limited to employees; rather the Innovation Zone™ is aligned with the other building blocks of the framework and supports the whole innovation process, including idea generation, idea capture, idea review by an innovation council, idea development and launch. To align the Innovation Zone to existing and future market needs, the software also allows campaigns to be started around particular themes (e.g. a "Sustainability Week" was launched in 2007, where 500 new ideas relating to sustainability were submitted to the zone in one week).

Funding & Governance: Effective governance is vital to achieve the defined goals and objectives, and to manage funding in an appropriative manner. Deloitte has employed a multi-tiered governance structure, including an Innovation Executive to direct the program at the strategic level, and two Innovation Councils, which perform the more tactical role of filtering ideas. Financial and other resources have to be identified, approved and tracked to set up and manage a program respectively to develop and implement ideas. Furthermore, long-term oriented management and operating structures need to be developed as the backbone of the program.

Value: In order to reach the program's objectives, and to ensure that the program contributes to the overall business and growth strategy, specific tangible and intangible targets have to be defined. These targets, working as both goals and measures, ensure in conjunction with costs and benefits tracking, a target-oriented execution of the program.

Innovation Acceleration Team (IAT): To ensure that business as usual does not get in the way of high potential ideas with a crucial speed to market, a specialised team accelerates the development and implementation of time-critical ideas. This team, focused on maximizing and capturing value of an idea, has expertise in Intellectual Property (IP) management, rapid prototyping, business case development and go to market strategies.

Pipeline Management: The program's pipeline management component defines criteria, tools and templates to provide a structured process for moving an idea from its generation to launch. Different stage gates (raw idea, active concept, funded prototype, and market expansion) ensure to drive the quality through the program, and hence to extract the maximal value of an idea.

Today, about 80% of Deloitte's employees participate actively in the Innovation Program. The development of Deloitte's innovation and growth capabilities resulted in a number of new businesses and services, which generate close to 8% of the firm's revenue. With a return on investment of over 250%, the Innovation Program is regarded as highly profitable. Due to its internal success, Deloitte took the strategic approach of its Innovation Program to market and has successfully applied the program to a number of clients across varied industries, e.g. the third largest bank in Australia, a leading general insurer in Australia, one of the world's leading commercial real estate services and money management firms, and one of the worlds largest news media companies.

5. Comparison & discussion

In order to compare the approaches taken by Deloitte Australia and the University of Twente, the 'House of Innovation' model introduced in the introduction will be used.

	Deloitte Australia	University of Twente
Major objective	• New revenue	• Education & economic development
Innovation Strategy • Is the innovation strategy clearly linked to the business strategy?	• Defines the role of innovation • provides the context and guiding principles for the design, implementation and operation of the Innovation Program • determining the program's goals and objectives, its boundaries, and its measures of success, • ensures the innovation strategy is aligned to Deloitte's overall business strategy • strong commitment by the CEO / board • Alignment to business culture (7 signals)	• Top-level commitment • designated Executive board member committed to the advancement of entrepreneurship within the university being assigned the Knowledge Valorisation portfolio • A dedicated professional support group called the Innovation Lab that support entrepreneurial and innovative activities within the University
Innovation Organisation and Culture • How does the company's readiness for innovation rate?	• Well developed structure for management of innovation through a concept 'pipeline' • Innovation promoted to all employees through regular promotions, competitions and performance review • 'Innovation Week' remains the focus for the program's promotion • Reward & Recognition tied to innovation	• Promotes itself as an 'entrepreneurial' university • Promotes entrepreneurial activity with Professors and researchers • Well established and proven structure for development of new technology
Innovation Life Cycle Management • What is the average time-to-market for the most important products/services?	Mechanism to facilitate path to market of high technology: • Innovation Zone • Innovation Acceleration Team (IAT) • Network activities (e.g. Breakthrough Cafes) Collaboration of projects facilitated through the innovation zone • Innovation Council reviews and assist improvement of ideas • Use of Innovation Zone to manage and funnel ideas	Mechanism to facilitate path to market of high technology: • Top Program • Knowledge Park • NIKOS • TOP program mentors from science and industry assist the development of the technology and the technology business
Enablers • What percentage of the innovation projects have you completed within the defined time, budget and quality?	• Pipeline management / stage-gate process • Focus on value creation / targets / measures	• Structures innovation process • 2 channels of development of technology depending on who 'owns' the IP

Table 1: Comparison

As table 1 shows, the two approaches are similar. The primary difference between the two organisations is their interaction with ideas and the market. At one end is Deloitte whose day-to-day business puts them in constant contact with the market. This provides an outstanding opportunity to experience and assess the needs of the market in great detail. University Twente, as is the nature of Universities, are constantly exploring new ideas, concepts and ways of thinking whilst also being constantly involved in the development of new research or technologies. UT has the perfect opportunity (time, space and resources) to develop new concepts. It would seem an interlinking of the two innovation paths, that is a professional services firm with a University who has a well developed research pathway especially together with a well developed entrepreneurial educational and developmental pathway, as an ideal vehicle for the development of robust market-tested and research backed new ventures.

Specific high technology experience, capability and supporting mechanisms are crucial in developing an 'incubation' environment for high technology business, whilst resources and networking capabilities are also crucial. Both Deloitte Australia and UT have developed this specific capability.

A further point of difference is the facilitation of the innovation program within Deloitte using the Innovation Zone. Acting as a means for the capture and improvement of ideas, the software provides a central point of focus for the innovation program.

The key concepts from the two programs include:

1. Long term top-level buy-in
2. Building the entrepreneurial culture/spirit – workshops and promotions to encourage participation in entrepreneurial / innovation programs
3. Process - creating a process that is flexible to the technology, market and resources, but aims to make the process of turning ideas into value repeatable
4. Resources – creation of an infrastructure that provides resources (including funding, support and / or access to infrastructure) to advance new business concepts
5. Opportunity evaluation - Evaluation of opportunities designed not to stifle the development progress or time to market for the opportunity. This includes having 'concept acceleration'
6. Development – development of the opportunity using a lab (cross-discipline environment where people come together to improve the concept) or a 'virtual-lab' as used by Deloitte though its Innovation Zone™ software (allows Deloitte employees from across all disciplines to improve the idea)
7. Instruments – Creation of instruments that facilitate interaction with the market
8. Empowerment – Empowering the idea owner to develop the concept
9. Coordination – A group coordinating the innovation entrepreneurship program

10. Communication – Internal and external communication to interest the right agencies and partners to work with the organisation to extract value
11. Specific support and expertise for high technology including accelerators for fast to market technologies

Tools used:

- Fast-prototyping of concepts
- Concept accelerators
- Idea capture with the mentality of ‘it doesn’t matter where it comes from but what we can do with it’
- Recognition of the idea generator
- Use of ‘horizon’ models to determine how and through which channels a concept is developed depending on either where the IP lies or on its fit with the organisations capabilities
- Use of ‘entrepreneurs in residence’ to assist and focus the development of concepts

6. Conclusion

The examples of Deloitte’s Innovation Program and the University of Twente’s Entrepreneurial Program have outlined how organisations can foster the creation of high technology business by creating a sustainable ‘incubation’ environment with specific support for high technology development. The comparison of these two approaches also showed that - even if the organisations are different in its nature - the similarities outweigh the differences. Giving practical implications for successful establishing an environment to exploit growth from currently undiscovered sources, this paper also brings up some areas for further research. Future research should be undertaken to further investigate innovation approaches of research and business organisations. Key questions to be answered include how compatible these approaches are and how to bring together the approaches in order to create a successful high technology business incubation environment.

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CONFIGURATIONS DRIVING NPD PERFORMANCE FIT WITH MARKET DEMANDS AND TIME CONSTRAINTS

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ABSTRACT

The research reported in this paper is aimed at developing knowledge on organizing NPD systems to optimize their contribution to performance. To this end, a systems approach to fit is used to explain the context-structure-performance relationships for NPD performance, specifically in terms of fit with market demands of the product concept and fit with time constraints of the development process. From a sample of 164 US firms, the top 15 % performers in terms of *both fit with market demands and fit with time constraints* have been identified. An optimized 'Ideal Profile' for the organization of NPD systems, formed by a consistent pattern of: NPD Process, NPD Project Structure and Management, Innovation Climate, and NPD Goal Setting and Portfolio Management, followed from the analysis of the NPD configuration of these top performers. For the calibration sample (the other 85%) significant deviation from the ideal profile on all elements of the configuration was found, the correlations between NPD Performance Fit with Market Demands and Fit with Time Constraints and total Euclidean distance are also significant. Overall, these results provide evidence for the proposition that (1) new product success is a function of a set of NPD development system decisions and (2) to truly understand the impact of those decisions, they must be considered as a holistic system.

The contribution of this research is in the empirical validation of the internal consistency of an ideal organizational profile for NPD systems achieving both a high NPD performance in terms of market acceptance of their new products as well in terms of the satisfactory level of the development times of those products. By also examining ideal profiles for each of these NPD performance dimensions separately, the conflicting demands created by multiple performance metrics are highlighted as well as the organizational trade-offs necessary for optimal performance. In terms of managerial implications, this also gives direction for organizational redesign to firms either wanting to maximize their product concept (Fit with Market Demands) or development process (Fit with Time Constraints) performance.

INTRODUCTION

A variety of studies have explored the factors that drive successful new product development (e.g., Brown and Eisenhardt 1995; Cooper and Kleinschmidt 1995; Ernst 2002; Griffin 1997; Griffin and Page 1993; 1996, Kahn *et al*. 2006; Montoya-Weiss and Calantone 1994). These studies have tended to focus on the relations between *single* success factors and performance. Drazin and Van de Ven (1985) have argued that this type of analysis assumes that the "anatomy of an organization" is "decomposable into elements that can be examined independently. The knowledge gained from each element can then be aggregated to understand the whole organizational system" (Drazin and Van de Ven 1985, p. 519). In contrast, the systems approach advocated by Miller (1981) and Van de Ven and Drazin (1985) emphasizes the search for patterns of contextual and structural variables that influence performance. They assert that the understanding of context-structure-performance relationships can only advance by addressing simultaneously the many contingencies, structural alternatives, and performance criteria that must be considered holistically to understand organizational design. The systems approach emphasizes the need to adopt multivariate analysis to examine patterns of consistency among dimensions of

organizational context, structure and performance. The consistency analysis in the systems approach uses the central concept of 'Fit' as being the "internal consistency of multiple contingencies and multiple structural characteristics, it affects performance characteristics" (Drazin and Van de Ven, 1985, p. 515). In this study performance will be intermediately measured by determining fit. Already in their 1995 study Brown and Eisenhardt by contrasting the impact of both product concept effectiveness as well as process performance on financial performance, highlighted the importance of multiple performance dimensions. In this study we pick up this challenge by focusing on two sets of NPD performance dimensions that are potentially conflicting and need balancing. Brown and Eisenhardt (1995) did further decompose their product concept and development process performance constructs into various forms of fit, pointing at market acceptance of the new product (labeled 'Fit with Market Demands) versus development times of the NPD process ('Fit with Time Constraints').

Our research is guided by the following central question: What is the relationship between an organization's profile of NPD practices and NPD performance in terms of (1) market acceptance of their new products (Fit with Market Demands), as well in terms of (2) the satisfactory level of the development times of those products (Fit with Time Constraints)? To answer this question, we begin in the next section by reviewing the literature to define a set of best practices in organizing NPD, and we further operationalize the concepts of Fit with Market Demands and Fit with Time Constraints. Using data collected from 164 firms, we then identify the highest-performing firms on *both* performance dimensions and use their data to define an ideal NPD profile, following the systems approach advocated by Miller (1981) and Drazin and Van de Ven (1985). We establish the deviation from the ideal profile for the calibration sample to determine whether this is significant. We also examine how the ideal profile varies depending on the performance metric used to identify high-performing firms. Methodology, results, discussion and conclusions are presented in consecutive sections below.

LITERATURE REVIEW

NPD Configuration

A review of the literature indicates that an ideal NPD system has the following characteristics:

1. A formally documented, staged *process* with overlapping fluid stages and 'fuzzy' stage decisions (Griffin and Page 1996; Griffin 1997);
2. A multifunctional 'heavy weight' *team structure* with a *project manager* having primary responsibility or even full control over resources (Clark and Wheelwright 1993; Brown and Eisenhardt 1995; Hobday 2000);
3. An *innovative climate* with emotional involvement, freedom to define one's own work, time & support to develop unplanned new ideas (Glick 1985; Ekvall 1996; Isaksen & Lauer 2002);
4. A formal *NPD strategy* and project portfolios aligned with *business strategy* (March 1991; O'Reilly and Tushman 2004), Cooper *et al*. 2004); and
5. A clearly articulated role of NPD in achieving business *goals* combined with systematic project *portfolio management* (Cooper and Kleinschmidt 1995; Cooper *et al*. 2004)

NPD Performance

The peculiarities of NPD success and performance assessment is a recurring theme in NPD literature. NPD performance literature lacks standard definitions of constructs (Blindenbach-Driessen et al, 2005). An increasing number of authors have referred to and make use of the constructs proposed by Brown and Eisenhardt (1995) in their meta review. Brown and Eisenhardt distinguish between 'product concept effectiveness' and 'process performance'. As an important indicator for product concept effectiveness they identify 'Fit with Market Demands', which points

at the degree of market acceptance of the new product. Process performance is on the other hand largely influenced by 'lead-time' or speed, which can be labeled as 'Fit with Time Constraints'. Measuring NPD performance in terms of these constructs or performance dimensions, does justice to tensions occurring in new product development, such as between the quality or novelty of a product (fit with market demands) and the speed/throughput time of the development process. Pursuing both simultaneously poses conflicting demands upon the organizational structure and (inter)actions for innovation in which NPD projects are being embedded (Van Looy, Debackere and Bowen, 2002).

In general, high performance of the NPD function – as a consequence of Fit with Market Demands – should be reflected in higher sales and profits (financial performance, De Brentano and Kleinschmidt, 2004), but also customer satisfaction, timeliness (time to market), product price and quality (Chiesa et al, 1996). Griffin and Page (1993) regard the speed of decision making, and the commitment to these decisions as measure for the speed of the development process, which is crucial for Fit with Time Constraints. Kessler and Barely (2002) point at the relevance of assessing speed relative to schedule.

Hypothesis

We define the ideal NPD profile as the profile of the highest-performing firms in our sample. We define a firm's "ideal profile fit" as the degree to which a firm's actual profile of NPD practices approximate the ideal profile as outlined above. We then examine the impact of "ideal profile fit" on the two NPD performance dimensions. Our primary research hypothesis addresses the impact of deviation from the ideal profile on performance, and is formulated as follows:

> H1: The more a firm's NPD profile resembles the ideal profile, (1) the higher the level of market acceptance for the firm's new products (Fit with Market Demands) and (2) the more satisfactory are the development times of those products (Fit with Time Constraints).

METHODOLOGY

Data Collection

Our sampling frame consists of 500 randomly selected firms from all nonservice firms listed in the *World Business Directory*. We sent a pre-survey letter to all 500 firms requesting pre-approval of participation. A total of 186 firms agreed to participate and provided a contact person, while 36 companies declined to participate, 42 letters were returned due to invalid contact person or addresses, and 236 companies did not respond.

In administering the final survey, we followed the total design method for survey research (Dillman 1978). The first mailing packet included a personalized letter, the survey, a priority postage-paid envelope with an individually-typed return-address label, and a list of research reports available to participants. The package was sent by priority mail to 422 firms (186 firms agreeing to participate and 236 non-responding firms from the pre-survey). We asked the contact person (president, division manager, strategic business manager, new business program manager, or R&D director) to distribute the questionnaire to a manager involved in developing new products in their organization or having knowledge of overall new product programs in their organization.

To increase the response rate, we sent four follow-up mailings to the companies. One week after the mailing, we sent a follow-up letter. Two weeks after the first follow-up, we sent a second package with same content as the first package to all non-responding companies. After two additional follow-up letters, we received usable questionnaires from 164 firms, representing a response rate of 39% (164/422).

The industries represented in the final samples are: Chemicals and Related Products; Electronic and Electrical Equipment; Pharmaceutical, Drugs, & Medicines; Industrial Machinery & Equipment ; Telecommunications Equipment; Semiconductors & Computer Related Products; and

Instruments and Related Products. The annual sales of respondent firms ranged from $500,000 to $461 million and the total number of employees in the business unit ranged from 11 people to 1,017 people.

Variables

The Appendix contains the scales used to measure the different dimensions of the NPD profile. Fit with Market Demands involves the degree of market acceptance, the degree to which the products generated by a NPD program are valued by the market. Our measures of market acceptance are based on the innovation scorecards developed by Chiesa *et al*. (1996), and scales developed by De Brentani and Kleinschmidt (2004). Fit with Time Constraints involving the satisfaction level of new product development process times we used scales based on the work of Kessler and Bierly (2002) and Griffin and Page (1993).

Descriptive Statistics

Table 1 contains the descriptive statistics for the variables in our study.

Table 1
Descriptive Statistics: Means and Standard Deviations (N=164)

	Mean	Standard Deviation	Reliability (Cronbach alpha)
NPD PROCESS	4.73	1.35	n/a
GOALS & PORTFOLIO	4.42	1.41	0.99
NPD STRATEGY	4.54	1.38	0.99
INNOVATIVE CLIMATE	4.65	1.19	0.85
FIT WITH MARKET DEMANDS	5.09	1.33	0.90
FIT WITH TIME CONSTRAINTS	3.70	1.75	0.96

RESULTS

High Fit with Market demands AND High Fit with Time Constraints

In this section we first present the results of our data analysis testing our main hypothesis (H1), which consisted of three steps. First, we identified the top 15% of the firms in our sample that exhibited high performance on both the "Fit with Market Demands" and "Fit with Time Constraints" NPD Performance dimensions. Second, we calculated differences between the profile of individual firms and the ideal profile using the Euclidian distance metric. Third, we correlated the calculated distances with our two performance measures.

The first two numerical columns in Table 2 describe the NPD profile of the 15% of sample exhibiting high performance on both NPD Performance metrics. We will refer to this sub-sample as the "Ideal Profile" sample. Each of the firms in this sample were in the top 33% of firms ranked by market acceptance, and also in the top 29% of firms ranked by new product development process time. (The two percentages are not equal because of ties in the rankings).

The adjacent two columns describe the NPD profile of the remaining firms in our sample (which we will refer to as the calibration sample). The last two columns describe the degree to which the calibration sample firms deviate from the ideal profile sample. Notice that none of the Euclidean distances for the individual NPD dimensions are significantly different from zero (in all four cases, the mean divided by the standard deviation is less than one). However, the total Euclidean distance is significantly different from zero ((2.83/1.28) = 2.21). Thus a "one at a time" analysis of the four NPD profile variables in Table 2 suggests that the two samples do not differ, but a holistic analysis of the pattern of relationships reveals that the two samples differ significantly.

Table 2
Comparison between top 15 % and calibration sample
(in both Fit with Market Demands and Time constraints)

	Top 15 % 'Ideal Profile' (n=26)		Calibration Sample (n=138)		Euclidian distance	
Construct	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
NPD PROCESS	5.58	0.76	4.57	1.38	-1.01	1.38
GOALS & PORTFOLIO	5.00	1.48	4.32	1.38	-0.68	1.38
NPD STRATEGY	4.90	1.24	4.47	1.39	-0.43	1.39
INNOVATIVE CLIMATE	5.34	1.12	4.52	1.17	-0.82	1.17
			Total Euclidian distance		2.83	1.28

Table 3 reports the correlation between performance and the total Euclidean distances of the firms in the Calibration sample. Both correlations are negative and significant, suggesting that our main hypothesis is confirmed.

Table 3
Correlations between Performance and Total Euclidean Distance

	Total Euclidean Distance
Market Acceptance/Fit with Market Demands	-0.36
NPD Process Time/Fit with Time Constraints	-0.45

Table 4 reports the number of firms using each of four different types of Project Structure Management (these are defined in the Appendix). Notice that half of the firms in the ideal sample used so-called tiger teams, in which the project manager has *full control* over resources. In contrast, in the calibration sample the spread over all for types was almost even, with the number of tiger teams being the lowest. A chi-square analysis indicates that the between-sample difference in the number of tiger teams is significant ($\chi^2 = 11.83$, $p < 0.01$).

Table 4
Most Common Team Structure

	Top 15% 'Ideal Profile' (n=26)		Calibration Sample (n=138)	
TEAM STRUCTURE	Frequency	Percent	Frequency	Percent
Functional	3	11.54	36	26.09
Light-weight	3	11.54	39	28.26
Heavy-weight	7	26.92	37	26.81
Tiger	13	50.00	26	18.84

High Fit with Market Demands

We already mentioned that we focus in our study on two performance dimensions that are potentially conflicting and need balancing, viz. 'Fit with Market Demands' and 'Fit with Time Constraints'. Although it seems from the above results that indeed an optimized Ideal Profile has been identified, it would be very interesting to know exactly which trade-offs have been made in the organization design to accommodate the balanced performance fit. For this reason we also performed the patterns analysis procedures for the top 15% NPD systems excelling purely in Fit

with Market Demands (focusing on market acceptance). Results as can be seen in Table 5 are especially interesting when looking at the role of the NPD process, and NPD strategy (with a significantly higher mean and lower standard deviation).

Table 5
Comparison between top 15% and calibration sample
(Fit with Market Demands)

	Top 15% 'Ideal Profile' (n=25)		**Calibration Sample (n=139)**		**Euclidian distance**	
Construct	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
NPD PROCESS	5.80	0.50	4.53	1.37	-1.27	1.37
GOALS & PORTFOLIO	4.78	1.44	4.36	1.40	-0.42	1.40
NPD STRATEGY	5.44	1.23	4.38	1.34	-1.06	1.34
INNOVATIVE CLIMATE	5.25	1.14	4.54	1.18	-0.71	1.18
FIT WITH MARKET DEMANDS	6.83	0.16	4.77	1.20	-1.27	1.37
FIT WITH TIME CONSTRAINTS	5.40	0.94	3.39	1.69	-0.42	1.40

Table 6
Most Common Team Structure
(Fit with Market Demands)

	Top 15% 'Ideal Profile' (n=25)		**Calibration Sample (n=139)**	
TEAM STRUCTURE	Frequency	Percent	Frequency	Percent
Functional	6	24.00	33	23.74
Light-weight	2	8.00	40	28.78
Heavy-weight	8	32.00	36	25.90
Tiger	9	36.00	30	21.58

High Fit with Time Constraints

Also significant differences were found between the Ideal Profile and the organizational profile of NPD systems excelling mainly in Fit with Time Constraints, (focusing on NPD Process Time), see table 7. Here, the relative higher importance of innovative climate is remarkable, as is the lower score for the role of the NPD process. Also, in the top 15 % the 'tiger team' comes back as the most often used NPD project Structure and Management form.

Table 7
Comparison between top 15% and calibration sample
(Fit with Time Constraints)

	Top 15% 'Ideal Profile ' (n=24)		Calibration Sample (n=140)		Euclidian distance	
Construct	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
NPD PROCESS	5.29	1.20	4.63	1.36	-0.66	1.36
GOALS & PORTFOLIO	5.10	1.55	4.31	1.36	-0.79	1.36
NPD STRATEGY	5.06	1.17	4.45	1.39	-0.61	1.39
INNOVATIVE CLIMATE	5.44	1.11	4.51	1.16	-0.93	1.16
FIT WITH MARKET DEMANDS	6.16	0.67	4.90	1.33	-0.66	1.36
FIT WITH TIME CONSTRAINTS	6.31	0.45	3.25	1.48	-0.79	1.36

Table 8
Most Common Team Structure
(Fit with Time Constraints)

	Top 15% "Ideal" Profile (n=24)		Calibration Sample (n=140)	
TEAM STRUCTURE	Frequency	Percent	Frequency	Percent
Functional	5	20.83	34	24.29
Light-weight	3	12.50	39	27.86
Heavy-weight	6	25.00	38	27.14
Tiger	10	41.67	29	20.71

DISCUSSION AND CONCLUSION

The contribution of this research is in the empirical validation of the internal consistency of an ideal organizational profile for NPD systems achieving both a high level of market acceptance for the firms' new products as well as a satisfactory level of the development times of those products. By also examining ideal profiles for each of these NPD performance dimensions separately, the conflicting demands created by multiple performance metrics are highlighted as well as the organizational trade-offs necessary for optimal performance. In terms of managerial implications, this also gives direction for organizational redesign to firms either wanting to maximize their product concept (Fit with Market Demands) or development process (Fit with Time Constraints) performance.

However, NPD systems are not just confronted by contradictory demands reflecting in their *current* performance. NPD systems striving for *sustained* innovation and longer-term competitive advantage are in the organization of their NPD efforts confronted with additional balancing issues, viz. short versus long term perspectives. This for example is reflected in organizational choices with regard to the combination of radical and incremental innovation, or exploration versus exploitation. Researching ideal profiles for this type of balancing is subject for further research.

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Appendix A
Measurement of the constructs
NPD PROCESS:

Please check the box that most closely describes your business unit's development processes. Please tick one answer.

- ☐ No standard approach to new product development.
- ☐ While no formally-documented process is followed, we have a clearly understood path of the tasks to be completed in product development.
- ☐ We have a formally-documented process where one function completes a set of tasks, then passes the results on to the next function which completes another set of tasks.
- ☐ We have a formally-documented process where a cross-functional team completes a set of tasks; management reviews the result and gives the go-ahead for the team to complete the next set of cross-functional tasks.
- ☐ We have a formally-documented process where a facilitating "process owner" helps cross-functional teams move through stages and management reviews.
- ☐ We have a formally-documented process where a cross-functional team uses a staged process with overlapping, fluid stages and "fuzzy" or conditional stage decisions.

NPD GOALS & PORTFOLIO:

In this section please indicate your level of agreement with each statement

	Strongly disagree						Strongly agree	Don't know
The role of NPD in achieving business goals is clearly articulated.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
Systematic project portfolio management is in place.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

NPD STRATEGY:

In this section please indicate your level of agreement with each statement

	Strongly disagree						Strongly agree	Don't know
There is a formally stated NPD strategy.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
The project portfolios are aligned with the business strategy.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

INNOVATIVE CLIMATE:

In this section please indicate your level of agreement with each statement regarding your overall innovative climate

	Strongly disagree						Strongly agree	Don't know
People are emotionally involved in goals set.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
People have freedom to define their own work.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
There is a high level of trust between people.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
There is time for people to develop unplanned new ideas.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
There is a high level of conflict.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
There is a strong support for further development of new ideas.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

MARKET ACCEPTANCE:

Please indicate your level of achievement on following objectives:

	Not at all achieved						Very well achieved	Don't know
Our new products meet customer requirements.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
Our new products are delivered on time.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
The cost of our new products is satisfactory.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
The quality of our products is good.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
The impact of our NPD program on our sales level is positive.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

NEW PRODUCT DEVELOPMENT TIME:

Please indicate your level of achievement on following objectives:

	Not at all achieved						Very well achieved	Don't know
Our new products are launched on schedule.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

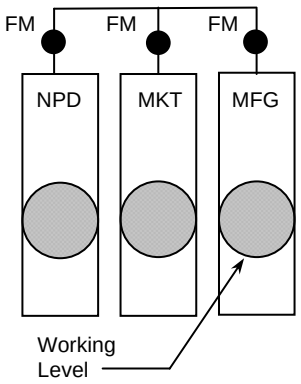
Scheduled time is in line with total development time (TT).	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
Our Development Time (DT) is satisfactory.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
Our Concept to Customer Time (CTC) is satisfactory.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐
Our Total Time (TT) is satisfactory.	1 ☐	2 ☐	3 ☐	4 ☐	5 ☐	6 ☐	7 ☐	☐

TEAM STRUCTURE[1]:

Please indicate which of the structures pictured and described in the next figure is the most common NPD structure within your business unit. Tick one option.

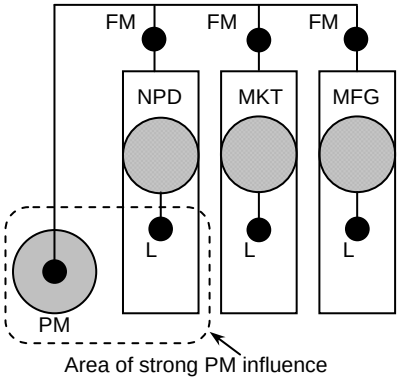
[1] **Relating team structures to literature** (this note was not included in questionnaire):
Team structure A: functional team structure *without* overall project manager
Team structure B: light-weight team structure with project *coordinator*
Team structure C: heavy-weight team structure with *overall responsible* project manager
Team structure D: tiger teams with project manager with *full control* over resources

Team Structure A1



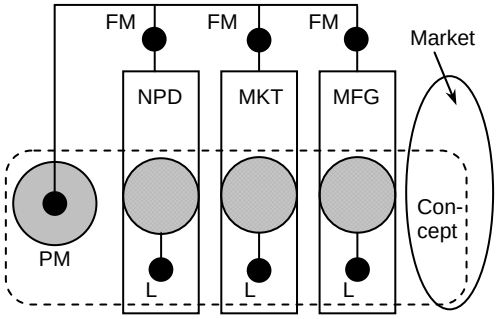
1. People are grouped principally by functional areas.
2. They work under the direction of a Functional Manager (FM).
3. Over time, primary responsibility for the project passes sequently from one function to the next.

Team Structure B



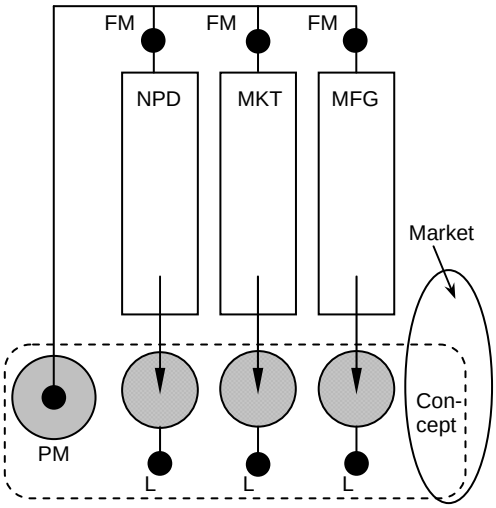
1. Like structure A, those assigned to the team reside physically in their functional areas
2. However, they designate a Liaison person (L) to "represent" it on a coordinating committee.
3. A Project Manager (PM) coordinates the different functions' activities. The Project Manager does not have power to reassign people or reallocate resources.

Team Structure C



1. Liaisons from the functions still reside in the team.
2. In contrast to structure B, the Project Manager (PM) has primary responsibility for the work of all those involved in the project.
3. However, team members are not assigned to a team on a permanent basis as is the case in structure D.

Team Structure D



1. Individuals from the different functional areas are formally assigned, dedicated, and co-located to the project team.
2. The Project Manager (PM) is given full control over the resources contributed by the different functional groups.
3. Team members are assigned permanently and the team will be held fully accountable for the results of the project.

The Impact of the Voice-of-the-Consumer in the Start up Process for Knowledge Intensive Entrepreneurial Firms

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Abstract

Many high tech knowledge intensive entrepreneurial firms tend to focus on their technological capabilities and to develop products that are typically taken to the market using a "push" strategy. In doing so, the firm and its downstream value-chain members push their technology into the marketplace with scarcely a thought of the consumer until after the product is in the hands of the user (Workman, 1994). The need to bring the voice of the consumer (VOC) into the start up firm has seldom been discussed. A true VOC orientation involves integrating a consumer-orientation throughout the firm (regardless of the firm's position in the value chain). Innovation should be viewed as a continuous process that operated in response to emerging consumer needs so that the firm leads rather than follows the industry (e.g., Sheth, Sisodia and Sharma, 2000). High tech knowledge intensive entrepreneurial firms who listen to the VOC throughout the startup process should be more successful since they are more able to (1) understand how their technical capabilities translate into consumer benefits, (2) develop products that reflect this understanding and (3) better align their value chains to deliver these benefits.

As noted by Morris, Schindehutte and LaForge (2002), a consumer orientation in an entrepreneurial context should involve marketing efforts that emphasize three dimensions: Customer Equity, Visceral Relationships and Emotional Experience. Customer equity reflects the firm's attitude toward the consumer and refers to the view that the primary value of a customer[1] to the firm is across the lifetime, not situated in a single transaction. A customer equity perspective requires that the firm develop a knowledge base of changing consumer preferences, which helps the firm to anticipate and respond to changes in its current customer base and potentially to expand to new consumer segments. Visceral Relationships reflect the depth of connection, at fundamental level of identity, between the firm and the customer (e.g., many users have a strong personal bond with myspace.com and the online community it serves). A hallmark of a strong visceral relationship is that it is highly interactive. The final dimension is the nature and intensity of the emotional experience (see also Fournier [1998] for a discussion of the quality of emotional experience and consumer bonding with brands). The firm and the customer have a deeply felt sense of purpose and conviction reflecting a different level of commitment and resulting in a sense of authenticity that underlies the customer experience (e.g., Second Life, paperbackswap.com).

This paper explores the role of the VOC in the start up process for high tech knowledge intensive firms. We examine the following research questions, (1) what kind insight into consumer behavior is needed at which stage of entrepreneurial development, (2) what methods are best suited to developing these insights and (3) what benefits accrue to firms that successfully integrate the VOC into their innovation processes. First, we will provide a review of the literature VOC and knowledge intensive entrepreneurship. Then using survey data, business plan analysis and annual reports from a random sample of firms started in the last five years of the TOP program at the University of Twente, we highlight different techniques and tools for capturing the VOC and the impact on the startup process and firm performance. Our goal is to focus on how startups with limited experience and

[1] Throughout, we make the following distinctions: consumer is used to refer to the end user in the market whether or not this person or entity has purchased a product from the firm. Customer is used to refer to individuals or entities who have purchased products or services from the firm.

available resources are able to integrate the VOC into the firm's systems and processes and to thereby develop more effective product offerings. Finally, we propose a research agenda and offer some practical suggestions for start up firms.

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Transitional Governance in External Technology Sourcing Trajectories: Connecting Pre-Acquisition Collaboration to Post-Acquisition Integration

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Transitional Governance in External Technology Sourcing Trajectories: Connecting Pre-Acquisition Collaboration to Post-Acquisition Integration

ABSTRACT

Collaboration and acquisition have traditionally been observed as two alternative strategies to get access to external technologies. However, real option scholars have recently argued that firms can also engage in transitional technology sourcing trajectories where collaboration and acquisition are used as complementary strategies. While these real option scholars have identified factors that influence *when* partners are likely to shift from collaboration to acquisition, they remain silent on *how* such a transition can be effectively managed. Based on a multiple case-study of four transitional technology sourcing trajectories between one entrepreneurial and one established firm, this study therefore explores how the pre-acquisition collaboration stage and the post-acquisition integration are related to each other. Our findings suggest that entrepreneurial companies may use the pre-acquisition collaboration stage as a period to evaluate the goodwill of the established partner. In addition, we point to the presence of pre-acquisition integration efforts and the extent of strategic convergence during the pre-acquisition collaboration stage as factors that substantially influence the success of the post-acquisition integration process in transitional governance trajectories.

Transitional Governance in External Technology Sourcing Trajectories: Connecting Pre-Acquisition Collaboration to Post-Acquisition Integration

INTRODUCTION

In the last two decades, we have witnessed a shift from a closed innovation model, where established companies focused on internal development of new technologies, to an open innovation model, where established companies increasingly relied on interactions with entrepreneurial companies to get access to new technologies (Chesbrough, 2003; Hagedoorn, 2002). In line with this evolution, scholars (e.g. Hagedoorn & Duysters, 2002; Pisano, 1990; Williamson, 1991) have sought to understand whether established firms should source technologies through collaborations or integrate technologies through acquisitions. While this external technology sourcing literature initially framed collaborations and acquisitions as two alternative strategies, it is increasingly realized that these two external technology sourcing strategies are complementary. In particular, real option scholars (e.g. Folta, 1998; Folta & Miller, 2002; Kogut, 1991; McGrath, 1997) show that acquisitions of firms are frequently preceded by more collaborative approaches. Moreover, these studies provide evidence that factors such as uncertainty of the target technology and valuation of the target company determine the timing of a shift from a collaborative to an integrative approach.

While existing studies on external technology sourcing provide valuable insights in *when* companies are likely to shift from collaboration to acquisition, they remain relatively silent on *how* this transition is actually managed. The existing literature on technology acquisitions – i.e. acquisitions of small technology-based firms by large, established firms (Puranam, 2001) - however, emphasizes that successfully acquiring entrepreneurial firms is not a straightforward task. In particular, they argue that the management of technology acquisitions triggers a fundamental organizational dilemma (Birkinshaw, Bresnman & Hakanson, 2000; Grimpe, 2007; Puranam, Singh & Zollo, 2006; Ranft & Lord, 2002). While preservation of the acquired firm's main technological capabilities asks for substantial autonomy of the acquired firm, the synergistic exploitation of these technological capabilities demands substantial integration of the acquired firm (Ranft & Lord, 2002). According to these acquisition scholars, the most feasible option to deal with this dilemma is to apply a gradual post-acquisition integration trajectory, where the acquired firm initially maintains substantial autonomy and becomes more integrated later on (Bannert & Tschirky, 2004; Birkinshaw et al., 2000; Haspeslagh & Jemison, 1991). However, it needs to be stressed these existing studies on the post-acquisition integration process apply a quite atomistic perspective on acquisitions, neglecting the possibility that acquired firm and acquiring firm share a history of prior collaboration. Actually, these studies seem to implicitly assume that the involved firms did not collaborate before the acquisition. A systematic analysis of how pre-acquisition collaboration and post-acquisition integration are related therefore seems to be necessary.

The purpose of this research is to build theory on how the pre-acquisition collaboration process influences the post-acquisition integration process. In order to do so, we conducted a multiple-case study of 4 technology sourcing trajectories between one entrepreneurial and one established company in which a shift from a collaborative to an integrative approach was realized. For each case, we conducted interviews with managers and engineers of both involved companies and executed a systematic archival analysis of public as well as private documents.

From a theoretical perspective, our findings contribute to a richer understanding of transitional governance in external technology sourcing trajectories. While real option scholars stress that established firms can rely on pre-acquisition collaboration in technological sourcing trajectories to assess the feasibility of the technological *competencies* of the entrepreneurial firm, we argue that entrepreneurial firms can apply this collaborative stage in the technology sourcing trajectory to evaluate the *goodwill* of the established partner. In addition, we point to the presence of pre-acquisition integration efforts and the extent of strategic convergence during the pre-acquisition collaboration stage as factors that can substantially influence the success of the post-acquisition integration process in transitional governance trajectories. From a managerial perspective, our findings suggest an alternative acquisition integration trajectory that allows addressing the dilemma between preserving value and realizing operational synergies in technology acquisitions.

METHODOLOGY

Research Design

The purpose of this paper is to explore how pre-acquisition collaboration influences post-acquisition integration. Although case studies have remained rather rare within the technology sourcing literature, this design is appropriate for our study because it allows us to 1) answer 'how' questions about a contemporary set of events over which the investigator has little or no control (Yin, 1984), 2) mobilize multiple observations on complex relational processes such as collaboration and integration (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Parkhe, 1993), and 3) draw in the significance of various interconnected levels of analysis such as the operational and managerial level (Faems, Janssens, Madhok & Van Looy, In Press; Hall, 2006; Pettigrew, 1990).

As we wanted to inductively build theory on the shift from collaboration to acquisition in external technology sourcing trajectories, our objective was to study a small number of external technology sourcing trajectories in great detail (Birkinshaw et al., 2000). We limited our study to high-tech settings (i.e. advanced material industry) to minimize extraneous variation (Eisenhardt, 1989) that might be derived from differences between technology intensive settings and settings where technology is less dominant. In the end, we managed to get access to 4 external technology sourcing trajectories, situated in the Advanced Materials industry. Table I summarizes the major characteristics of the selected cases. The names of companies, products, and individuals are disguised to ensure confidentiality.

----- Insert Table I about here -----

Data Collection and Analysis

Data on the four external technology sourcing trajectories were collected in a retrospective way, allowing for a much more focused data gathering process (Leonard-Barton, 1990; Poole et al., 2002). At the same time, unconsciously accepting respondent bias might occur in retrospective studies, leading to confusion about cause and effect relationships (Leonard-Barton, 1990). We therefore triangulated our data, applying multiple data collection techniques, including interviews and archival review of documents (see Table II). Applying the suggestions of Pettigrew (1990) and Pentland (1999), we made an explicit distinction between three different stages in our theory building process, representing an evolution of surface levels to deeper levels of data collection and analysis.

For each external technology sourcing trajectory, we first conducted unstructured interviews with two key informants (i.e. senior managers) and studied relevant documents (i.e. contracts, reports of managerial and operational meetings,

and publicly available data). Based on this information we constructed a graphical representation of the chronology of the major events that had taken place within each trajectory.

In the second stage, we conducted semi-structured interviews (Kvale, 1996) for each case with both managers and engineers of the involved organizations. We interviewed in total 32 persons (see Table II). Interviews were conducted individually, face-to-face, and in the native language of the interviewee to maximize the informant's ability to express its thoughts, feelings, and opinions. The interviews were structured along the chronology of the major events, asking the respondents to describe these events and the kind of interactions these events triggered between the partners. The average length of the interviews was between one and two hours. The transcribed interviews were sent back to the interviewees to give them the opportunity to hand over additional comments. At this stage, we also reexamined the available documents to verify whether the content of the interviews was consistent with the content of the documents. When discrepancies between these two data sources were observed, we again contacted respondents to ask for additional comments. After semi-structured interviews were completed, a case study report was written for each external technology sourcing trajectory. In these reports, we made extensive use of citations from interviews as well as documents, achieving a high level of accuracy (Langley, 1999). We discussed these case study reports with managers of the involved firms in order to assure that they provided a realistic representation of the history of the alliance. These discussions provided additional data, which allowed us to fine-tune the case study reports.

----- Insert Table II about here -----

The purpose of the third stage was to interpret the narrative, developed in the previous stage in order to answer our research questions. In this stage, we used an inductive approach, relying on an iterative process that coupled within-case analysis with between-case analysis (Eisenhardt, 1989; Yin, 1984). We started with conducting a within-case analysis for each observed trajectory. We re-assessed each case, focusing on the shift from collaboration to acquisition. In specific, we searched for linkages between the process of collaboration during the pre-acquisition stage and the process of integration during the post-acquisition stage. After the completion of these within-case analyses, we compared the findings across the three cases. Based on the identification of similarities and differences across cases, new iterations of within-case and across-case analysis were subsequently initiated. This procedure was repeated until dominant findings emerged.

RESULTS

Pre-Acquisition Collaboration

Pre-acquisition collaboration to evaluate goodwill of the established partner. Real option scholars (e.g. Folta & Leiblein, 1994; Folta & Miller, 2002) argued that, in external technology trajectories, established partners can rely on pre-acquisition collaboration to evaluate the value of the entrepreneurial partner's technology without having the obligation to make irreversible commitments. Two of our cases (i.e. Combustion Burner Trajectory and Substrate Polishing Trajectory) were in line with this real option argument. In these cases a collaborative strategy was seen as the ideal option to get acquainted with the technology of the entrepreneurial partner without having to make substantial investments. The following statement of one MAT manager regarding MAT's decision to buy an equity stake of 51% in GBURN is an illustrative example in this respect:

> ‘GBURN’s burner technology perfectly fitted in our strategy of forward integration… [However], our board was not ready to radically invest in this technology as it was not really linked to our core activities… [Therefore], we decided to first buy 51% and also negotiate an option to move to 100% later on.’ (MAT manager)

In the two other cases (i.e. Coating Trajectory and Optical Glass Trajectory), however, we observed that the established partner actually wanted to immediately acquire the entrepreneurial partner as the technology of the entrepreneurial partner was of high strategic importance for the established company. In these cases, it was the entrepreneurial partner that insisted on engaging in a pre-acquisition collaboration stage in order to evaluate the good intentions of the established partner. In particular, the entrepreneurial partner wanted to use pre-acquisition collaboration as a stage to find out whether the established partner was really committed to further apply and develop their technology. The Coating Trajectory is an illustrative example in this respect. After scanning the coating industry, MAT identified FRCOAT as a company that possessed an Advanced DLC technology. MAT was very interested in this technology as it could help MAT in improving its existing DLC/DLX technology. MAT therefore wanted to acquire FRCOAT in order to get access to this technology. Although the CEO of FRCOAT was interested in closer collaboration with MAT as this could trigger important technological, commercial and operational synergies, he did not want to immediately sell his company to MAT. In November 2001, MAT and FRCOAT therefore signed a collaborative agreement, allowing MAT to buy 49% of FRCOAT’s shares. This agreement was called a ‘marriage d’essai’ (i.e. an attempt to marry) and stipulated that FRCOAT had the right to stop the collaboration after two years and buy back MAT’s shares. The CEO of FRCOAT explicitly stressed that the intention of this collaborative agreement was to test the reliability of MAT:

> ‘I wanted to collaborate but I also wanted to have the opportunity to end the collaboration in two years when I would feel that the collaboration did not work out. The purpose of the marriage d’essai was not to limit the collaboration. I believed that this agreement would force each party to conduct the necessary efforts to get to know the other partner and to really think about the different opportunities to work together. (FRCOAT manager)’

In sum, while real option scholars emphasize that established partners can use pre-acquisition collaboration to assess the technological competencies of the entrepreneurial partner, our data indicate that entrepreneurial partners can rely on pre-acquisition collaboration to evaluate the good intentions of the established partner.

Pre-Acquisition integration efforts. Acquisition scholars refer to integration efforts as ‘the making of changes in the functional activity arrangements, organizational structures and systems, and cultures of combining organizations to facilitate their consolidation into a functioning whole’ (Pablo, 1994: 806). While the existing acquisition literature has focused on integration efforts during the post-acquisition stage, we observed that, in our cases, integration efforts were already initiated during the pre-acquisition stage (see Table III).

In the Coating Trajectory, for instance, partners initiated pre-acquisition integration efforts to consolidate their technology platforms. As already mentioned, MAT wanted to apply FRCOAT’s Advanced DLC technology in order to improve its existing DLC/DLX technology. However, interviewees emphasized that, during the first six months of their collaboration, transfer of knowledge between engineers of

MAT and FRCOAT advanced with difficulty. Although engineers of both partners were motivated to exchange knowledge, interviewees indicated that they were not able to arrive at a common understanding of their respective technologies. After six months, managers of both companies therefore decided to conduct efforts in order to create a joint technology platform. In particular, it was decided to install each other's coating systems: a FRCOAT coating system was installed at MAT, while a MAT coating system was installed at FRCOAT. In addition, joint training sessions for MAT and FRCOAT engineers were organized to support this exchange of technology equipment. As one FRCOAT engineer expressed, it was the installation of each other's technological equipment that allowed getting a fine-grained understanding of the partner's technology:

> 'It is a very interesting step because you first think that the partner's technology is very good. However, by using the machines you start experiencing problems. In a similar vein, MAT people experience problems with using our FRCOAT coaters. In this way, it becomes possible to list the strong and weak characteristics of both coating systems. For me this was the fundamental step in the collaboration which really meant that both parties started working with each others technology (FRCOAT engineer)'

In the Combustion Burner Trajectory and the Substrate Polishing Trajectory, similar kinds of integration efforts were conducted to consolidate partners' technology platforms. During the pre-acquisition collaboration stage of the Burner Combustion Trajectory, one GBURN engineer regularly visited the MAT facilities in order to come to a common platform for media that could be used for combustion burner applications. In the Substrate Polishing Trajectory, one GCOMP engineer visited POLIISH to learn about the entrepreneurial partner's capabilities in polishing silicon substrates. Next, this transferred knowledge was applied within GCOMP to develop capabilities for polishing anonium substrates. These anonium substrate polishing capabilities were subsequently transferred back to POLISH. In this way, a common technology platform emerged that allowed GCOMP and POLISH to conduct similar anonium substrate polishing activities for the same customer.

We did not only identify pre-acquisition efforts to come to a consolidated technology platform, but we also observed that, during the collaborative stage of the Optical Glass Trajectory and the Substrate Polishing Trajectory, partners made efforts in consolidating their operational production system. In the Optical Glass Trajectory, for instance, GCOMP and OPTICS had agreed at the start of their collaboration to jointly industrialize OPTICS' Optical Glass technology for commercial applications in the automotive industry. In order to do so, the OPTICS team, consisting of three people (i.e. CEO and two engineers), had to start developing industrial prototypes of the optical glass technology, while the GCOMP was responsible for the worldwide promotion of OPTICS' optical glass technology. However, during the first year of their collaboration, it quickly became clear that the OPTICS team, which had been very experienced in conducting explorative activities such as fundamental research and conducting laboratory experiments, did not really have the motivation and ability to conduct exploitative activities (i.e. standardization, upscaling, and fine-tuning), which were necessary to industrialize the Optical Glass technology:

> 'The people at OPTICS really were still R&D people… They were not used to do process engineering. Their reasoning was: 'let's try something; if it works we have a process.' (GCOMP engineer)'

> ‘GCOMP wanted to commercialize as quickly as possible… [However], we were specialists. We first wanted to achieve perfect quality before initiating production. (OPTICS engineer)’

Moreover, the existing facilities of OPTICS did not really allow for high-quality production, which clearly hampered the ability to move to large-scale industrialization of the technology:

> ‘They were not used to do production. They were working in a laboratory… You had to put things into the oven; then you had to wait for a while; next you had to open the oven, remove a lid and again put it into the oven. This was not a process. This would not be possible on an industrial scale.’ (GCOMP engineer)’

While OPTICS was struggling in developing industrial prototypes, GCOMP made progress in marketing the optical glass technology on an international scale. One year after the start of their collaborative endeavor, GCOMP had succeeded in attracting the interest of several potential customers. However, as OPTICS had achieved little progress in exploiting its technology for large-scale applications, it was impossible to hand over industrial prototypes of optical lenses to these potential customers. GCOMP therefore decided that interventions at OPTICS were necessary in order to adjust their production system. GCOMP therefore decided to send, on a regular basis, one process engineer to OPTICS for several days in order to find out which operational problems were encountered at OPTICS and how GCOMP could contribute to solve these problems. During his visits this process engineer tried to make interventions that ‘could make the life of the OPTICS engineers easier’ (GCOMP engineer). For instance, he arranged that OPTICS engineers got free access to equipment of GCOMP, which could be used for improving OPTICS’ existing production process. In addition, he invited engineers of OPTICS to GCOMP to show them how GCOMP addressed some of the operational problems that OPTICS was facing. Gradually, this process engineer became a liaison person who helped OPTICS engineers contacting other GCOMP engineers for the solution of specific operational problems that OPTICS engineers faced in adjusting their production system. In addition to this human support, GCOMP also stimulated OPTICS to move to a new production facility. As OPTICS had limited financial resources, GCOMP provided financial support to build a new facility that would allow high-quality production of Optical Glass products. The human and financial support of GCOMP in adjusting the operational production system of OPTICS quickly started to pay off. In 2000, first industrial prototypes of optical glass lenses for large-scale optical applications were delivered to interested customers.

In the Substrate Polishing Trajectory, similar kinds of integration efforts were conducted to consolidate the production systems. Also in this case, the established partner (i.e. GCOMP) sent on a regular basis one engineer to the facilities of the entrepreneurial partner (i.e. POLISH) to adjust the existing production system and provided the necessary financial support, allowing the entrepreneurial partner to move to a new facility.

In sum, our cases provide evidence that, during the pre-acquisition collaboration stage of external technology sourcing trajectories, partners can already initiate integration efforts to consolidate 1) the technological platform of both partners and/or 2) the operational production systems of both partners. Regarding these pre-acquisition integration efforts, we have to make two important additional remarks.

First, we observed that, in most of the cases, it was the established company that took the initiative to initiate pre-acquisition integration efforts. At the same time, the established partner introduced these integration efforts in a very careful manner. Instead of imposing changes on the entrepreneurial partner, the integration efforts were launched as suggestions towards the entrepreneurial partner and they were introduced in a very gradual manner. The initiation of the pre-acquisition efforts in the Optical Glass trajectory is an illustrative example in this respect. As already mentioned, GCOMP decided to send on a regular basis a project engineer to OPTICS in order to improve their operational production system. Both GCOMP and OPTICS interviewees emphasized that this kind of operational support was carefully introduced at OPTICS. According to the GCOMP interviewees, this careful approach was necessary in order to avoid feelings of disruption at the entrepreneurial partner:

> 'You can not enter there and say: 'guys, from now on we do it our way'. I was of the opinion that I could not do that. They would no longer be behind the steering wheel and would lose direction. This needs to go step by step. In this way, you can build a good understanding… In this small entity, it did not make sense to implement heavy project management programs that explicitly stipulated what should be done. In this case they would look as if one has been poleaxed and they would fear that they had to spend half of their precious time on administration. (GCOMP engineer)'

At the same time, one GCOMP manager acknowledged that, as GCOMP only was a minority shareholder in OPTICS, they did not have the power position to impose changes on this entrepreneurial company:

> 'At the beginning we could not do much more than providing advice. During board meetings, I said what I thought about it, but they [OPTICS] were free to do with this information what they wanted. Because we only possessed 40% of the shares, we did not have any decisive power. (GCOMP project manager)'

A second important additional observation was that, in our cases, the pre-acquisition integration efforts seemed to contribute to the emergence of a solid relational foundation between the engineers of the involved companies. In the Coating Trajectory, for instance, interviewees referred to the exchange of the coating equipment and the joint training sessions as events that triggered positive relational dynamics on the operational level:

> 'In the beginning, people on the operational level have to get used to each other. After we had visited FRCOAT to learn about their technology and FRCOAT engineers had visited MAT to learn about our technology, the ice was broken though. People started to see each other as comrades. Consequently, when we experienced a problem with their coating system, they were always willing to give us assistance. (MAT engineer)'

In a similar vein, interviewees stressed that the pre-acquisition integration efforts in the Optical Glass Trajectory contributed to the emergence of a more trustful relationship:

> 'When you introduce such a project manager and you support the building of a new facility, you create a platform of trust on which you can continue to build the relationship.' (GCOMP manager)

Post-Acquisition Integration

Initiation of post-acquisition integration process. Real option scholars (e.g. Folta & Miller, 2002; Kogut, 1991) argue that, when the future value of the technology becomes less uncertain, partners are likely to shift from a collaborative to a more integrative governance approach. Our data affirm this reasoning. In the Optical Glass Trajectory, for instance, a shift from collaboration to acquisition was made after it had become clear that some customers were interested in buying substantial amounts of the Optical Glass product. In particular, the CEO of the entrepreneurial company (i.e. OPTICS) asked the established partner (i.e. GCOMP) whether they were willing to acquire the remaining shares and to take the lead in moving towards large-scale manufacturing of the Optical Glass product:

> 'OPTICS had to change into a higher gear to address the emerging market opportunities. The CEO of OPTICS realized that he would not be able to achieve this acceleration in growth by itself, neither from a financial perspective nor from an organizational point of view. He therefore asked GCOMP to take over 100% of the OPTICS shares. (GCOMP manager)'

In all cases, we also observed that, when a shift from collaboration to acquisition was realized, substantial additional integration efforts were made (see Table 4). Although integration already had taken off during the pre-acquisition collaboration, additional efforts in consolidating the technology platform and/or the operational production systems were conducted. In addition, while the entrepreneurial partner had maintained structural autonomy during the collaboration stage, structural integration of the entrepreneurial unit was initiated after the acquisition. In three cases (i.e. Coating Trajectory, Optical Glass Trajectory, Substrate Polishing Trajectory), structural absorption (Haspeslagh & Jemison, 1991) was observed, meaning that the entrepreneurial unit was integrated in the existing structures of the established company. In the Optical Glass Trajectory, for instance, the acquired OPTICS unit became structurally embedded in the existing optics business division of GCOMP. In one case (i.e. Combustion Burner Trajectory), structural symbiosis (Haspeslagh & Jemison, 1991) was observed, meaning that the structures of the entrepreneurial and established partner were merged together to create a new structure. In this case, the acquired GBURN unit was merged together with MAT's existing combustion burner division, triggering a new structure which was physically situated at the GBURN facilities. Interviewees referred to the changed power position of the established partner as the main explanation for these additional post-acquisition integration efforts. In particular, it was argued that, as the established partner now became the main shareholder, they wanted to get a 'full grip on the operational activities at the acquired firm' (GCOMP engineer).

While the established firms initiated substantial additional integration efforts after the acquisition, they continued to apply a quite careful approach regarding their relationship with the original management of the entrepreneurial partner. In all cases, the established partner tried to minimize the amount of management changes at the acquired firm (see Table IV). In the interviews, two reasons were mentioned to explain this careful approach. First, it was stressed that the former CEO of the acquired firm possessed critical technological knowledge and critical customer relationships, which needed to be preserved as much as possible. The Optical Glass Trajectory provides an illustrative example in this respect. During the pre-acquisition collaboration stage, it had become clear that there was some strategic divergence between the OPTICS CEO and the GCOMP management was not really the same.

While the GCOMP management wanted to focus all activities on commercializing the Optical Glass technology as fast as possible for large-scale applications, the CEO of OPTICS also wanted to look at the possibilities of the Optical Glass technology for blue-sky applications. After the acquisition, GCOMP therefore decided to appoint a new CEO at OPTICS who would be responsible for moving towards large-scale manufacturing. However, as the technological knowledge of the former CEO was perceived to be very important, they also decided to keep the former CEO within the company and to give him the title of CTO:

> 'We were dependent on his knowledge that was not codified… If he [=CEO of OPTICS] would leave the company, we would have bought an empty box.' (GCOMP manager)

A second reason to minimize management changes was to avoid instability at the operational level. In the Substrate Polishing Trajectory, for instance, the management team of the entrepreneurial partner (i.e. POLISH) turned out to be quite incompetent with respect to conducting large-scale manufacturing. After a while, GCOMP therefore decided to acquire POLISH and to make substantial additional investments in turning POLISH into a high-quality production unit. However, despite their proven incompetence, GCOMP decided to maintain the original management in order to give the operational people a feeling of stability:

> 'After the acquisition, we have left the management intact. We opted not to change the General Manager… We thought that we needed a transition stage to guarantee the survival of the group, to make sure that everything did not fall apart and give them a feeling of continuity.' (GCOMP manager)

Need for management changes during post-acquisitions process. While extensive additional integration efforts were planned in all observed cases, we also observed that, during the first year after the acquisition, the actual implementation of these integration efforts turned out to be difficult in most of the cases. In the Substrate Polishing Trajectory, for instance, the purpose of the additional post-acquisition integration efforts had been to further consolidate the production systems of GCOMP and POLISH in order to 'speak as one team toward the customer' (GCOMP manager). However, instead of reaching further consolidation, huge difficulties emerged with respect of the production activities of POLISH. Moreover, it turned out to be quite difficult for GCOMP to get a grip on these problems:

> 'Production of substrates reached a peak in 1997. At that moment, a number of critical events took place during which production was completely stopped at the SCOMP site and our customer refused to accept substrates. All at once, I was sent there to completely restart the production process. The problem was that, after I had returned to Belgium, the same problems emerged again. (GCOMP engineer)'

In the Combustion Burner trajectory and the Optical Glass trajectory, similar difficulties were observed. In the Combustion Burner trajectory, centralization of R&D activities and burner production activities at the facilities of GBURN triggered huge problems. In the Optical Glass trajectory, it turned out to be quite difficult to transform OPTICS into a production unit that was ready for large-scale manufacturing.

Interviewees referred to the management of the entrepreneurial firm as the main reason to explain these difficulties in achieving successful post-acquisition integration:

> First we naively thought: 'We let these people do it by themselves. We talk with them, we visit them. In this way, we will be able to motivate them to make their quality system more rigid and to provide their employees with the necessary training.' This however did not work out…It was very difficult to convince them [= management team of POLISH] to do it differently.' (GCOMP manager)
>
> 'The General Manager of GBURN tended to keep MAT at a distance, which made it difficult to integrate MAT's burner activities in the GBRURN activities.' (MAT manager)
>
> 'The former CEO of OPTICS had difficulties to renounce its former responsibilities. Tensions and conflicts between the old and new CEO consequently emerged. Rationally, he [= former CEO of OPTICS] knew that he no longer was the optimal guy to lead OPTICS, but emotionally he was not able to remain distant. In this way, a critical situation arose.' (GCOMP manager).

In each of the three cases, the original management of the entrepreneurial firm tended to disturb the additional integration efforts, triggering huge relational conflicts between the management of the acquired firm and the management of the acquiring firm. In the end, drastic management changes were made at the entrepreneurial unit in all three cases. In the Burner Combustion trajectory and the Optical Glass trajectory, the management team of the acquired firm was fired and replaced by a new management team. In the Substrate Polishing trajectory, one GCOMP manager was send to the POLISH unit to take charge of the integration activities. In all three cases, these drastic management changes quickly started paying off. We observed that swift progress was made in further consolidating the technology platforms and/or the operational production systems of the acquired and acquiring firm. In the Substrate Polishing trajectory, for instance, the GCOMP manager, who now was in charge of managing the POLISH unit, managed to implement a new quality system based on ISO-9002 principles and succeeded in streamlining the communication procedures within this entrepreneurial unit.

It needs to be stressed that, in contrast to the established firm's initial expectations, the execution of drastic management changes did not result in significant loss of technological knowledge or significant instability at the operational level. The Optical Glass Trajectory is an illustrative example in this respect. As already mentioned, GCOMP's management had initially feared that removing the former CEO of OPTICS would lead to substantial loss of fundamental knowledge. However, after GCOMP had fired the former CEO of OPTICS, it became clear that the two engineers, who had always worked with the former CEO, had been able to absorb most of the fundamental knowledge. Moreover, these two engineers turned out to be very motivated to stay involved within GCOMP. The build-up of a solid relational foundation during the pre-acquisition collaboration stage was mentioned as an important aspect to explain the willingness of the OPTICS engineers to stay involved within GCOMP:

> 'On the managerial level, tensions have emerged after the acquisition... [However], we had an excellent relationship with him and this relationship only intensified after the acquisition. On our level, there were no differences

of opinion. We wanted to become successful and GCOMP could support us in this objective.' (OPTICS engineer)

Finally, it needs to be emphasized that in the Coating Trajectory the post-acquisition integration proceeded more smoothly. The presence of a convergent strategic vision between the management of FRCOAT and the management of MAT seems to explain this smooth implementation of additional integration efforts. In contrast to the three other cases, a clear common strategic vision had emerged in the Coating Trajectory during the pre-acquisition collaboration stage. According to the interviews, this common strategic vision facilitated the post-acquisition integration process:

'There is common, shared strategy. MAT acknowledges the advantages of FRCOAT and FRCOAT sees the advantages of MAT. They speak the same knowledge. There is no discussion about what we will do in 2 or 3 years… [In this way], the FRCOAT people could be integrated in MAT.' (MAT manager)

DISCUSSION AND CONCLUSION

Previous studies (e.g. Folta, 1998; Folta & Miller, 2002; Kogut, 1991; McGrath, 1997) have pointed to the increased occurrence of transitional governance in external technology sourcing trajectories, where partners gradually shift from collaborative to more integrative approaches. In addition, these studies have identified a number of factors that influence *when* partners shift from collaboration to acquisition. However, much less is known about *how* this transition is made. Based on our findings, we present in this section a number of propositions that connect the pre-acquisition collaboration and the post-acquisition integration stages. Subsequently, we point to the main managerial implications of our study. Finally, we discuss the main limitation of our study and point to interesting avenues for future research.

Connecting Pre-Acquisition Collaboration and Post-Acquisition Integration

Real option scholars already provided evidence that greater technological uncertainty (i.e. uncertainty about the feasibility of the entrepreneurial partner's technology) increases the likelihood of transitional governance, where acquisition is preceded by a collaboration stage. In this way, the established partner can use the collaboration stage to evaluate the technology of the entrepreneurial partner. While we acknowledge the relevance of technological uncertainty as a factor that influences the choice for transitional governance, we also identify relational uncertainty as a second factor in this respect. In particular, we observed that, in some cases, the entrepreneurial partner preferred to first engage in a collaboration stage in order to evaluate the good intentions of the established partner. We therefore propose that:

Proposition 1: Greater relational uncertainty at the entrepreneurial partner (i.e. uncertainty about the good intentions of the established partner) increases the probability of the implementation of a collaboration stage before the acquisition.

While the acquisition literature has mainly focused on integration during the post-acquisition phase, we observed that firms can already engage in integration efforts during the pre-acquisition collaboration stage. In particular, we observed that, during the pre-acquisition collaboration stage, efforts were made to consolidate the technological platform and/or the operational production system of the involved companies. At the same time, it needs to be stressed that, during the pre-acquisition collaboration stage, the involved companies maintained structural autonomy and that

the pre-acquisition integration efforts were introduced in a very careful manner. We also found first indications that the presence of these pre-acquisition integration efforts influenced the post-acquisition integration process. In particular, our data suggest that the presence of pre-acquisition integration efforts might facilitate preserving fundamental knowledge during the post-acquisition integration stage. We observed that the initiation of these pre-acquisition integration efforts contributed to the emergence of a solid relational foundation on the operational level, which in-turn motivated key-technologists of the acquired firm to stay present after the acquisition, even when drastic management changes were made. We therefore propose that:

> *Proposition 2:* The presence of pre-acquisition integration efforts increases the ability to preserve critical knowledge during the post-acquisition integration stage.

Our findings also indicate that, when partners shift from a collaboration to an acquisition mode, substantial additional integration efforts are made. In all observed cases, the acquired firm was structurally integrated in the acquiring firm. In addition, additional efforts were made to further consolidate technology platforms and operational productions systems. At the same time, though, management changes at the acquired firm remained limited in order to avoid loss of knowledge and instability. In three of the observed cases, post-acquisition integration turned out to be difficult, resulting in relational conflict between the management of that acquired and acquiring firm. In these cases, integration only became successful after substantial management changes were made at the acquired firm. In the fourth case, however, post-acquisition integration proceeded much more smoothly. The extent of strategic convergence, realized during the pre-acquisition collaboration stage, seems to explain these observed differences. In the first three cases, strategic convergence had been limited. In these cases, a common strategic objective had not yet emerged. In the fourth case, however, strategic convergence was observed during the pre-acquisition collaboration stage. In this case, the collaboration firm had come to a common strategic objective (i.e. developing a joint technology platform in order to get access to the automotive industry). Our data indicate that such strategic convergence hugely facilitated the post-acquisition integration process. We therefore propose that:

> *Proposition 3:* The lower (higher) the strategic convergence between entrepreneurial and established firm during the pre-acquisition collaboration stage, the higher the need for substantial (limited) management changes at the acquired firm during the post-acquisition integration process.

Managerial Implications

Previous acquisition scholars have emphasized the relevance of implementing a gradual post-acquisition integration trajectory in order to address the tension between the need to preserve knowledge within the acquired firm and the need to realize synergies between the acquired and acquiring firm (see Figure 1). In particular, they suggest that, during the first years after the acquisition, focus should be on human integration or creation of positive attitudes towards the integration among employees on both sides' (Birkinshaw et al., 2000: 400). During this first stage, task integration or 'the identification and realization of operational synergies' (Birkinshaw et al., 2000: 400) should remain limited to initiating efforts to achieve acceptable performance in the individual operating units. When human integration is achieved and the performance of the individual operating units has reached an acceptable level, the second stage of the post-acquisition integration trajectory can be initiated. At this

stage, more substantial task integration efforts are initiated in order to allow for achieving operational synergies across the individual operating units. The shared identity and mutual respect that have emerged during the first stage, provide the relational foundation for such closer task integration.

Based on examining four external technology sourcing trajectories, in which the acquisition of entrepreneurial companies was preceded by a collaboration stage, we suggest an alternative integration trajectory (see Figure 1). While the integration trajectory of Birkinshaw et al. (2000) only starts after the actual acquisition, our alternative integration trajectory is already initiated during the pre-acquisition collaboration stage. In particular, we argue that, during the pre-acquisition collaboration stage, the entrepreneurial partner can carefully initiate some task integration efforts to create a joint technological platform and to improve the operational production system of the entrepreneurial partner. These carefully introduced integration efforts will not only contribute to acceptable performance at the entrepreneurial partner, but also facilitates human integration (i.e. emergence of solid relational foundation at the operational level). In this way, the established firm can immediately shift to more substantial task integration after the acquisition of the entrepreneurial partner. Again, we want to emphasize that, during this second stage of this integration trajectory, the original management of the acquired firm can only remain intact when strategic convergence between acquired and acquiring firm has been established.

Limitations and Future Research

As a final reflection, we point to the main limitations of this study. First, our findings are based on an in-depth examination of a limited number of external technology sourcing trajectories in the advanced materials industry. Although this research design allowed us to compare the four trajectories relationships with a minimum influence of extraneous variation, its findings are contextualized. Particular characteristics of the technological trajectory or the involved companies themselves may have influenced our findings. We acknowledge that the development of a more general theory on the linkages between pre-acquisition collaboration and post-acquisition integration requires additional case studies in other contexts.

A second limitation is related to our retrospective data-collection strategy. Despite our efforts to maximize the reliability of our data (i.e. multiple data collection techniques, feedback interviews with informants), our data-collection strategy restricted the ability to obtain a micro-level understanding of some essential processes and/or events. We therefore point to real-time research as a viable option to further elaborate on the findings that emerged from our study.

Despite these limitations, this study has managed to provide first insights in how pre-acquisition collaboration and post-acquisition integration are connected to each other in external technology sourcing trajectories. We hope that our findings may stimulate scholars to further examine the phenomenon of transitional governance in a wide variety of organizational settings. At the same time, we hope that our insights might help practitioners in further optimizing their technology sourcing and acquisition strategies.

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TABLE I: Overview of Cases

External Technology Sourcing Trajectory	*Involved Companies*	*Pre-acquisition relationship*	*Technology Acquisition*
Coating Trajectory	**MAT**: international company active in the domains of metal transformation and advanced materials **FRCOAT**: high tech SME, specialized in the development of advanced coatings	**2001 – 2003:** Equity relationship	**June 2003:** FRCOAT acquired by MAT
Combustion Burner Trajectory	**MAT**: international company active in the domains of metal transformation and advanced materials **GBURN:** high-tech SME, specialized in development and production of gas burners	**1999-2001:** Equity relationship	**February 2001**: GBURN acquired by MAT
Optical Glass Trajectory	**GCOMP**: international company active in the domains of materials and metals **OPTICS** : high-tech SME specialized in development of optical lenses	**1998 – 2001:** Equity relationship	**July 2001:** OPTICS acquired by GCOMP
Substrate Polishing Trajectory	**GCOMP**: international company active in the domains of materials and metals **POLISH:** high-tech SME specialized in processing Silicon substrates	**1994 – 1995:** Technology transfer agreement **1995 – 1996:** Collaborative production agreement	**September 1996:** POLISH acquired by GCOMP

TABLE II: Overview of interviews and documents

External Technology Sourcing Trajectory	*Number of interviews*	*Private documents*
Coating Trajectory	MAT: 8 interviews FRCOAT: 2 interviews	Contracts Minutes of board meetings Slides of board meeting presentations Minutes of technological meetings
Combustion Burner Trajectory	MAT: 5 interviews GBURN: 2 interviews	Contracts Minutes of board meetings Slides of board meeting presentations
Optical Glass Trajectory	GCOMP: 7 interviews OPTICS: 2 interviews	Contracts Minutes of board meetings
Substrate Polishing Trajectory	GCOMP: 3 interviews SCOMP: 3 interviews	Contracts Minutes of board meetings Fax correspondance

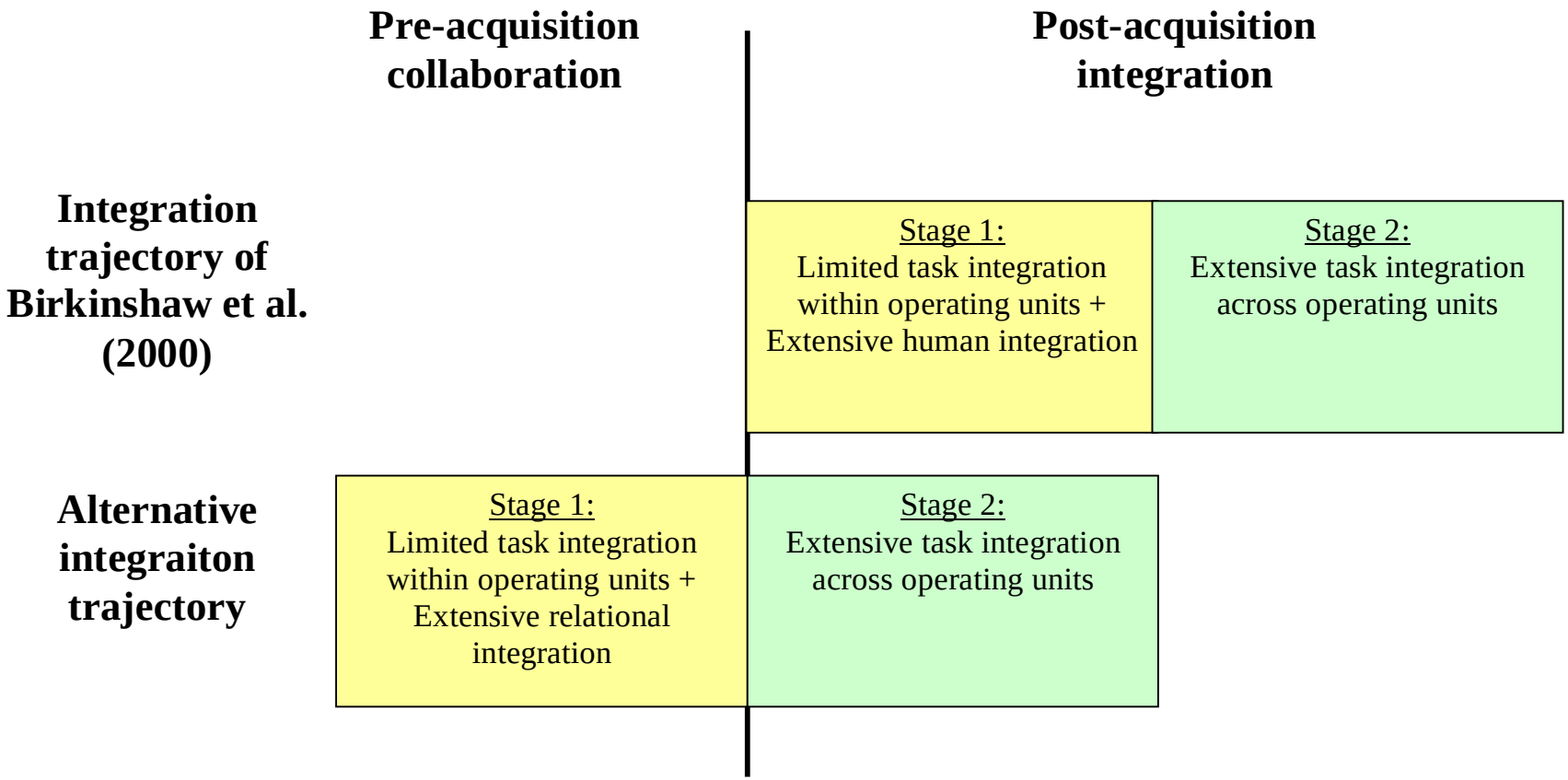
TABLE III: Overview of pre-acquisition integration efforts

Pre-Acquisition Integration Efforts	*Coating Trajectory (MAT and FRCOAT)*	*Combustion Burner Trajectory (MAT and GBURN)*	*Optical Glass Trajectory (GCOMP and OPTICS)*	*Substrate Polishing Trajectory (GCOMP and POLISH)*
Integration efforts to consolidate technology platforms	Transfer of FRCOAT's coating equipment to MAT Transfer of MAT's coating equipment to FRCOAT Joint training sessions for MAT and FRCOAT engineers	Regular visits of GBURN project manager at MAT facilities		Transfer of POLISH's silicon substrate polishing capabilities to GCOMP Transfer of GCOMP's anonium substrate polishing capabilities to POLISH
Integration efforts to consolidate operational production systems			Regular visits of GCOMP project manager at OPTICS facilities Building of new OPTICS production facility, financially supported by GCOMP	Regular visits of GCOMP project manager at POLISH facilities Moving to new POLISH production facility, financially supported by GCOMP

TABLE IV: Overview of post-acquisition integration efforts and management changes

	Coating Trajectory (MAT and FRCOAT)	*Combustion Burner Trajectory (MAT and GBURN)*	*Optical Glass Trajectory (GCOMP and OPTICS)*	*Substrate Polishing Trajectory (GCOMP and POLISH)*
Post-acquisition integration efforts				
Structural integration efforts	Structural absorption of FRCOAT in the MAT's Diamond Group	Structural symbiosis of GBURN and MAT's combustion burner division	Structural absorption of OPTICS in the Optics business division of GCOMP	Structural absorption of POLISH in the Amonium business division of GCOMP
Integration efforts to consolidate technological platform	Development of a technology matrix to stimulate exchange of technology between different members of the MAT Diamond Group Joint R&D team to develop new coating technology for automotive application	Centralization of R&D activities at GBURN facilities	Codification of OPTICS' Optical Glass technology and production process by GCOMP engineer	Joint exploration of new application domains for POLISH's silicon polishing capabilities
Integration efforts to consolidate operational production systems	Introduction of MAT's operational standards and systems at FRCOAT	Introduction of MAT's operational standards and systems at GBURN Centralization of burner production activities at GBURN facilities	Introduction of GCOMP's project management systems	Introduction of GCOMP's project management systems
Post-acquisition management changes	No management changes (Former FRCOAT CEO continues managing FRCOAT unit)	Former GBURN CEO leaves the company but appoints himself a successor to manage GBURN unit	Former OPTICS CEO becomes CTO of OPTICS unit. GCOMP appoints new CEO for OPTICS unit	No management changes (Former POLISH CEO continues managing POLISH unit)

FIGURE 1: Traditional and alternative integration trajectory



PRETORIA DENTAL LABORATORY'S UTILISATION OF ENTREPRENEURIAL PROCESSES AND CRITICAL CAPITALS: A SOUTH AFRICAN CASE

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Abstract

Pretoria Dental Laboratory (PDL), established in 1992, specialises in three disciplines, namely Crown and Bridge, Prosthodontics and Orthodontics. PDL represents an interesting entrepreneurial opportunity exploitation case because of its rapid expansion over a relatively short time span of 16 years moving from a stable but small laboratory to one of the biggest dental laboratories in the Tshwane Metropolitan area of South Africa. The purpose of this paper is to outline the theoretical framework and research methodology to be utilised in order to provide insight on how PDL interact with various stakeholders, respond to environmental changes, utilise various capitals (strategic, economic, cultural and social) through a process of business decision making to recognise, prepare and exploit business opportunities in the dental environment of South Africa. The outcome of the research is intended to enlighten entrepreneurialism and its application in a specific specialised environment of South Africa.

Introduction

Pretoria Dental Laboratory (PDL), an influential and successful dental laboratory in South Africa which was established in 1992 specialises in three dental disciplines, namely Crown and Bridge, Prosthodontics and Orthodontics. The goal achievements of PDL are largely determined by the reciprocal socio-economic environmental dynamics between PDL and its suppliers, clients and employees. This reciprocal socio-economic environmental dynamics requires a multi-dimensional and multi-varied research approach in studying entrepreneurship and entrepreneurial processes in PDL in a systematic manner. This view is supported by Groen (2005: 73), who stated that a systematic theoretical view is required in the studying of entrepreneurship for the sake of accommodating the analysis of multilevel networks of entrepreneurs, organizations and environments that could lead to changes in business practices and secondly, to avoid defining theoretical concepts too broadly.

Purpose

The purpose of this paper is to outline the theoretical framework and research methodology to be utilised in order to provide insight on how PDL interact with various stakeholders, respond to environmental changes, utilise various capitals (strategic, economic, cultural and social) through a process of business decision making to recognise, prepare and exploit business opportunities in the dental environment of South Africa. The outcome of the research is intended to enlighten entrepreneurialism and its application in a specific specialised environment of South Africa.

Scope

The paper is presented in three distinct phases namely:

- A general background of the business that will be researched is provided;

- The principal entrepreneurial theories from which an integrated theoretical framework is deducted is discussed;
- A research design aligned with the theoretical framework is presented; and
- A conclusion and implications for the study are synthesized.

Background to Pretoria Dental Laboratory

The business owner of Pretoria Dental Laboratory (PDL) qualified and completed in-service training as a Dental Technician in 1984 and worked as an employee at Tandtorium Dental Laboratory until 1988. In October 1988 the current business owner bought a 50% share in Sasseens Dental Laboratory in a partnership deal, specialising in prosthodontics and orthodontics. In 1990 it was decided to expand the current field of business to include Crown and Bridge and the first specialist ceramist was employed at PDL. The following three disciplines were performed in the laboratory:

- *Crown and Bridge* - the speciality that reproduces all of the same aspects of a natural tooth, and by using specific materials to reproduce an esthetic, hygienic and functional tooth while a bridge is a process of dental restoration that spans an area that has no teeth, and is connected to natural teeth at each end (Qualitydentistry, 2003).
- *Prosthodontic* - the dental speciality pertaining to the diagnoses, treatment planning, rehabilitation and maintenance of the oral function, comfort, appearance and health of patients with clinical conditions associated with missing or deficient teeth (Adafoundation, 2003).
- *Orthodontics* - the dental speciality that includes the diagnoses, prevention, interception, and correction of malocclusions (improper bites), which may be a result of tooth irregularity, disproportionate jaw relationships, or both (Wikepedia, 2008; Qualitydentistry, 2003).

In 1992 full ownership was obtained by buying the remaining 50% share of Sasseens Dental Laboratory and offering a full associateship regarding crown and bridge work to the specialist ceramist. The name of the laboratory was changed to Pretoria Dental Laboratory (PDL). A second acquisition was made in 2000 when Cradent Dental Laboratory was bought to broaden the client base of PDL whilst the field specialization remained the same.

During 2004 and 2005 another two laboratories were bought namely Tandtorium Dental Laboratory and J&D Dental Laboratory. The first laboratory specialises in Prosthodontics and Orthodontics whilst the second laboratory specialises in Chrome Cobalt.

The PDL entrepreneurial opportunity exploitation case, above the other dental laboratories explored for consideration in the study, is of particular interest because of firstly, its rapid expansion over a relatively short time span of 16 years moving from a stable but small laboratory to one of the biggest dental laboratories in the Tshwane Metropolitan area. Secondly, operating in a high technology, competitive specialist- and professional environment the expansion of services and the transfer of knowledge to build internal capacity and acquiring new technologies to prepare and position the laboratory for current and future challenges is worth analyzing. Lastly, the case could provide valuable information in the development of entrepreneurs in a

developing country like South Africa, as the venture was launched from a highly resource constraint base and due to the fact that the business owner not coming from a renowned entrepreneurial background. To this end, valuable knowledge could be gained for utilisation in entrepreneurial development programmes.

Literature review

In this section some of the principal entrepreneurial theories are briefly discussed to be utilised in the deduction of an appropriate research methodology to be applied in the analyzing and evaluation of PDL's utalisation of entrepreneurial processes and critical capitals.

Interaction or Relationship Theories

The interaction or relationships theories imply that inter-business relationships are relevant for business success. For the purpose of this study a relationship is considered to imply a *"mutually oriented interaction between two reciprocally committed parties implying mutual orientation and commitment over time"* (Håkansson & Snehota, 1995: 25). If this statement is assumed to be true, then it is important to relate these relationships and its effects on other important business constructs such as business opportunity recognition, preparation, exploitation and utilization of resources. In the next section various interaction or relationship theories are presented and its relationships with important business constructs are briefly explained.

- ***The Structural Network Theory***

The essence of the Structural Network Theory according to Groen (2005: 72) is that patterned relationships (networks) between actors such as individuals, groups or organizations are formed to create amongst others strategic alliances, joint ventures and formalized arrangements. Further, business networks could also be seen as voluntary arrangements between two or more business participants that involve durable exchange, sharing or co-development of products, services or technologies. The networks formed are inter-dependant relationship entities that could not be considered as isolated individual entities, but rather requires the maintenance of several relationships with various actors. Each relationship is therefore embedded and connected to some other relationships. This implies that any analysis of relationships needs to adopt a "relationship view" of the business market as a whole over a time span rather than focusing on a single relationship exchange episodes and transactions (Håkansson & Snehota, 1995). Taking a time span perspective allows a researcher to take into account and capture the forces shaping business relations in a social network.

Håkansson (1989) developed a structural network theoretical approach in which a business is considered part of a network characterized by any configuration that may vary between co-operation and conflict. According to this theory the business forms relationships with other businesses. Through established relationships business are linked into a network structure that prescribes a relationship framework in which every business should operate and adhere to. The motivation for establishing relationships is to handle or manage various kinds of inter dependencies that exist between the businesses generated by the co-existence of three mechanisms namely:

- Activities – the actions performed in this relationship model can be marked as either in-conflict or in-harmony with other businesses because of the simultaneous presence of conflicting or common interests between the actors in the various businesses. Optimising activities in the relationships is largely depended on the ability of the entrepreneurs in the various businesses to co-ordinate activities in terms of
    - Sequential dependencies (some activities must be carried out before others);
    - Shared dependencies (common activities); and
    - Mutually dependencies (achievements are used together).
- Resource structures – the resources represent a necessary but not sufficient condition for all business activities. In essence five types of resources could be identified namely, input goods, financial capital, technology, personnel and marketing. Van der Veen and Wakkee (2002) in similar fashion classify the resource base of a business in terms of strategic capital, economic capital, cultural capital and social capital. Resources are always controlled by business actors in terms of resource consumption and processing. Control over resources can be exercised in on of two ways, firstly, direct control over a resource in the sense that the business owns the resource or the right to use it or secondly, indirect control in the sense that the business has a close and stable relationship with a business which possesses that particular resource. The value of any resource in this theoretical framework is determined by how a particular resource combines with the other resources. Evolution and growth of the business is thus depended on optimising the configuration of the resources ; and
- Actors – the actors bring a dynamic element into the business network as they are responsible to generate change and business growth by altering actions or resource combinations directly or in directly. The actions of the individual business are based upon the businesses identity in the network. The resultant effect is that each entrepreneur in the network is faced with unique business demands and opportunities in the network.

The above explanation of the theory as explained by Håkansson (1989) could by summarized by figure 1.

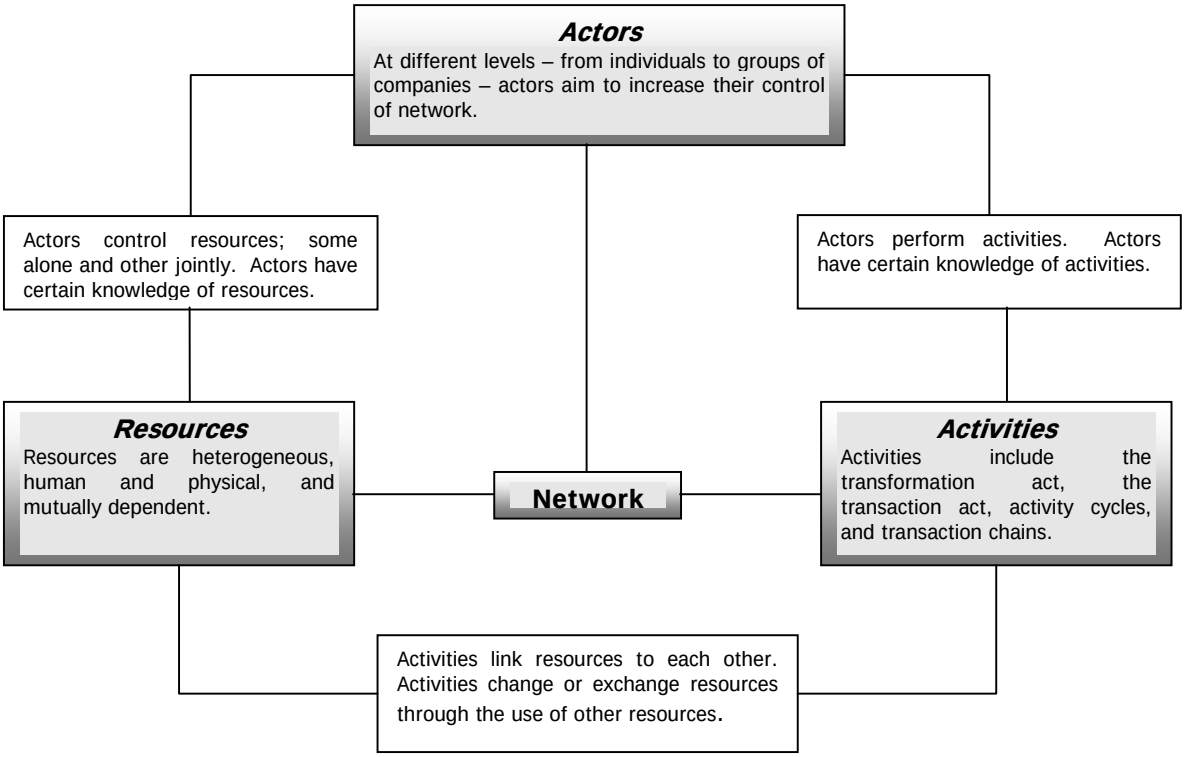

Figure 1 The Structural Network Model
(Source: Håkansson (1989)

Håkansson and Snehota (1995) have indicated four process concepts by which inter-relationships between businesses could be studied over time, namely:

- Adaptions – this concept relates to how business modify its products, routines and rules of conduct over time in order to function better with each other over time. It also includes adaptations in administrative and logistic activities.
- Cooperation and conflict – this concept relates to analysing the essence of what makes a relationship worthwhile for the parties involved and while it is worthwhile to seek constructive solutions when conflicts arises.
- Routinisation - this concept refers to institutionalised routines and implied rules of behaviour that a business maintains with its customers and suppliers.
- Social interaction – over and above business specific behaviour this concept also investigates the personal bonds and convictions engaged in the relationship.

- ***The Social Identity Theory***

Social Identity Theory, a sub-theory of social cognition, represents a theory of group membership and behaviour with a purpose of trying to understand how individuals make sense of themselves and others in a social environment. As such this theory is also applicable to understand behaviour in business organisations (Korte, 2007). Social Identity Theory suggests that an individual's self concept is made up of a personal identity as well as a social identity.

This implies that people in general defines themselves in terms of individual attributes and interpersonal relationships (things that relates to "I") as well as in terms of collective attributes of a group to which they belong (things that relates to "we"). A proportion of an individual's identity is derived from individual attributes whilst another proportion is derived from their memberships and interactions within (in-group) groups and amongst (inter-group) groups (Highhouse et.al., 2007; Korte, 2007; Van Knippenberg and Hogg, 2003; Brunetto, Y and Farr-Wharton, R, 2002).

This theory is of particular importance in understanding the business organization, its influence on the market and the benefits the business could received from the market. In this regard Highhouse et.al (2007) stated that social identity functions to facilitate attitudes to establish identities and to obtain social approval. In the business environment it implies the establishment of a business identity and obtainment of social approval of the business and its activities in the market place. It also implies that people in other businesses having relationships and identifying with a particular business do so as a means of expressing themselves and acquiring social approval. The above represents the foundation of proper self-presentation and a means for the business to put a "best face" forward (Highhouse et.al., 2007).

According to Highhouse et.al. (2007) establishing an identity and obtaining social approval are dependent on two need concerns namely:

- A social adjustment concern – this concern relates to ensuring that the business is regarded favourable with significant others. These concerns are often related to things that are popular, prestigious and successful in the eyes of significant others. The social adjustment concern focuses therefore on issues relating to "fit-in" with important groups or significant others. The effect of social adjustment is that the business obtains social stature in the market place; and
- A value expression concern – this concern relates to ensuring that the business projects an image of wholesomeness, in other words that the business is good, ethical, sincere and respectable. A concern for value expression has to do with the degree of importance places on working for or with a business appealing to pride.

Whilst the first concern (social adjustment) relates to impressing other stakeholders and the second concern (value expression) relates to expressing good values, thus clearly distinct behavioural orientations, one could also expect relationship between the two concerns. A relationship is expected because both dimensions are aimed at self presentation. However the motives behind the self presentations may differ. The more important issue is to determine which of the two concerns dominates in the life of the business.

- ***The Social Systems Theory***

According to Parsons (1964) a social system consists as a plurality of individual actors interacting with each other in a situation which has at least a physical or environmental aspect, actors who are motivated in terms of a tendency to the "optimization of gratification" and whose relation to their situations, including each other, is defined and mediated in terms of culturally structured and shared symbols.

Parsons et al. (1951) also indicates that a social system can be seen as a system of actions which contains the following characteristics:

- Processes of interaction that takes place between two or more actors;
- The situation towards which actors are orientated includes other actors;
- There is interdependence, and in part concerted action to form a function of collective goal orientation.

Primary problems that relates to social systems according to Parson et al. (1951) are indicated as:

- With relation to orientation, the question is asked whether or not the role's mutual relationships to other roles are based on cognitive or appreciative standards. If cognitive, then its chief characteristics do not derive from specific relations to other social objects, and its characteristics do not change so much when depending on interacting.
- In relation to the object side, the question is whether the role is related to other roles on the basis of performance or the quality characteristics of its incumbents.

- ***The Regulatory Focus Theory***

"Regulatory focus theory delineates how people engage in self-regulation, the process of bringing oneself into alignment with one's standards and goals" (Brockner et al, 2004) from a perspective of two components namely in terms of what one wants to be (ideal self) by focusing on things that may cause positive outcomes and secondly, what one ought to be that is tempered by what one should avoid not to create negative outcomes. Applied to a business one may assume that both the promotion (ideal business) and the protection (ought to be business) co-exist and if business processes and utilization of capitals are studied, it is important to analyze to what level alignment processes occurred because of exogenous changes (without changes caused by the marketplace) or because of endogenous changes (within alignment driven by the business itself) to promote positive outcomes and avoid negative outcomes for the business.

The Life Cycle Theory

The Encyclopedia of Small Business said that the organisational life cycle model proposes that over the course of time, businesses moves through a fairly predictable sequence of development stages. This model was a subject of substantial study over the years, and is linked to the study of business growth and development. This life cycle is based on a biological metaphor, that businesses remind you of living organisms because of the fact that they show a regular pattern of developmental processes. Businesses that went through an identifiable life cycle process are vitally impacted by external environmental conditions as well as internal factors (Encyclopedia of Small Business, 2008).

In Management Sciences (1983) Quinn and Cameron said that the models in general propose that changes that occur in businesses follow a predictable pattern that can be characterised by different developmental stages that are:

- Sequential in nature;
- Occur as a hierarchical progression;
- Is not easily reversed; and
- Involve a broad range of business activities and structures.

The number of life cycle stages has varied considerably over the years, but most models shown an organizational life cycle period in four (Robbins, 1994) or five stages (Kuratko & Hodgettis, 2004):

- Formation, birth, development or startup - this stage consists of activities associated with the initial formulation of the business and encompasses the foundation work needed for creating a formal business plan, searching for capital, carrying out marketing activities and developing an effective business team;
- Growth – this stage often requires major changes in the business strategy, businesses demonstrated significantly more concern for internal efficiency and installed more control mechanisms and processes;
- Business stabilization, maturity – this stage is a result of both market conditions and the business owner's efforts. During this stage a number of developments commonly occur, including increased competition, consumer indifferences to the business's goods and/or services;
- Decline – during this stage the business will because of its rapid growth and expansion, which was the result of initial successes, led to self-deception, inflexibility and shortsightedness that will lead to the final stage;
- Death or renewal – this stage indicate the business's foes through decline and will either die or enter a phase of renewal and development. If the business is able take drastic actions to rectify the situation, it may survive.

Planning is not homogeneous across these stages. The length and specificity of plans should be adjusted according to each stage.

The Transaction Theory

According to Coase (1937), as quoted by Ndaloma (2007) the transaction theory examines the transaction of goods and services within companies and markets. According to this theory high degree of transactions in the market brings about smaller business sizes whilst a high degree of transactions between businesses (vertical integration) resulted in the emergence of large firm sizes. The transaction theory is based upon two assumptions about human behavior. The first assumption is that human beings are rational, whilst the second assumption is that human beings are opportunistic. The choice between market transactions and business transactions is considered a function of three critical aspects namely, asset specificity, uncertainty/complexity and frequency. Asset specificity means an asset is transaction specific and cannot be redeployed to an alternative use without a significant reduction in the value of the asset. A high level of asset specificity means that the asset is difficult to transfer in the market and internal coordination will occur, which will lead to a larger firm size. The basic idea of this theory is that business size is dependant on human as well as transaction characteristics in a business environment. These characteristics will exhibit changes due to economic or institutional development.

The Integrated Entrepreneurial Theoretical Framework

With an entrepreneurship-in-network approach as viewed by Van der Sijde (2007), an interaction of actors takes place with regards to the recognition, preparation and exploitation of opportunities that which subsequently lead to value creation. This process is not a linear process because changing circumstances may require the entrepreneur to change or re-evaluate decisions made in earlier stages. This indicates that although the model of the entrepreneurial process is opportunity-based, the entrepreneur is still the driving force within these processes. Mechanisms embedded in a definition by Parsons as described by Van der Sijde (2007), shows that interaction between actors, a strive for goal attainment, optimisation of processes, pattern maintenance and institutionalization of shared symbols produced its own specific type of capitals needed, therefore each of these mechanisms related to specific "capitals":

- Interaction between actors linked to a social network capital
- Goal attainment linked to strategic capital
- Optimisation of processes linked to economic capital
- pattern maintenance and institutionalization of shared symbols linked to social capital

Generally the assumption will be made that all businesses will need sufficient "capital" to be sustainable over time and that all start-up businesses will have to be in possession of sufficient "capital" in all four areas to establish a viable and successful business.

The above explanation of the in-network approach as explained by Van der Sijde (2007) could by summarized by figure 2.

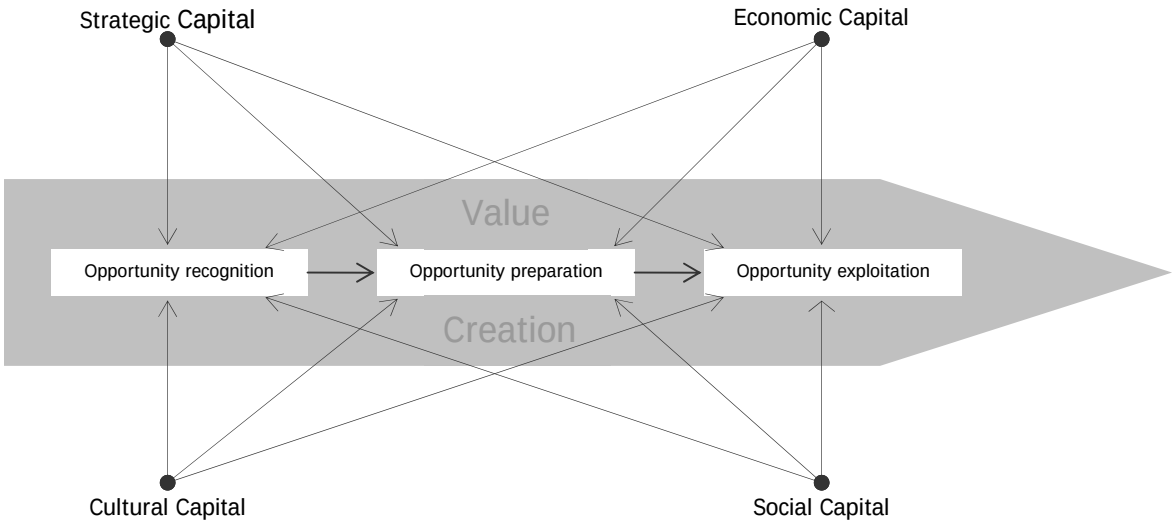

Figure 2 In-network approach
(Source: Van der Sijde (2007)

Study methods and design

The Integrated Entrepreneurial Theoretical Framework will be used to guide the planning, design and execution of the research.

After careful evaluation of other dental laboratories in the Pretoria area, using a criterion based benchmark approach:

- State of the art technology employed;
- Spectrum of dental speciality services provided;
- The four critical capitals of interest in the study and
- The life span of the business to allow for longitudinal investigation

Pretoria Dental Laboratory was selected as the most suitable business to justify the research project. In addition to meet the above criteria justification for selecting PDL could also be found in the "Background to the Company" discussed earlier. The following paragraphs will provide information on how the rest of the research will be executed.

The empirical part of the research will be embedded in a field research design approach using the survey data compilation technique as method to create at least medium level constraint conditions during the investigation allowing the researchers to deduct specific principals, thus promoting internal validity in the research, of how PDL utilizes entrepreneurial processes and critical capitals to achieve business success. According to Graziano and Raulin (2004) the term field research applies to a variety of research methods, ranging from low to high constraints, and observes natural behaviour under natural conditions in the field (Oxford English Dictionary, 2008; American Heritage Dictionary, 2000). A medium level constraint approach was decided upon as defining too strict constraints condition specifications will have a detrimental effect on deducting valid general principles resulting from the opportunity to make observations in the natural or real operations environment of PDL. The researchers' intention is therefore to opt for a research design that will enhance the making of generalization of results **consistent** in how PDL utilizes entrepreneurial processes and capitals from specific time settings to other time settings in the life-span of PDL. The intention is therefore **not** to make generalizations to a larger population of similar businesses nor is it to make generalizations of the study over time.

For the above reasons an interrupted time-series approach will be followed in which the same suppliers', customers' and clients' responses will be measured under different conditions defined by the different time-series specified by the researchers based upon advice provided by the business owner of PDL, and the business acquisition periods of PDL allowing for multiple measures to be taken and to accommodate variation in how PDL utilises entrepreneurial processes and capitals over time. Using interrupted time-series will enable the researchers to measure change disruptions in the utilisation of entrepreneurial processes and capitals, caused by a multiple of factors in the natural business environment of PDL, several times during a particular baseline observation period.

In this case, the field research design is considered suitable as research variables will be measured at the post-test level such as variables like environmental changes, the different capitals employed by the business owner of PDL, opportunity recognition, preparation and

exploitation will be analysed. This in essence implies that the research approach is ex post facto in nature. The second reason for employing this design technique is because it is suitable for the study of single research entities (Babbie et-al, 2006; Graziano & Raulin, 2004). In this particular case the research entity of interest is PDL and how it utilises entrepreneurial processes and capitals to achieve business success over a period of 16 years.

For the purpose of this study the population will be defined as the business owner, the financial auditor/s, all staff members employed, clients and suppliers over a period of sixteen years within PDL. This will represent the total population size of PDL for the sixteen year time span of this research. The sample frame from witch the criteria based sample will be selected constitutes all the above study units that will be available for providing information on PDL since its inception.

The sample units of interest that will be interviewed and whose responses will be analysed from will include:

- The business owner

Interviewing the business owner will provide the researcher with a self description of the owner of PDL on how entrepreneurial processes, capitals and environmental adaption occurred over a period of sixteen years.

- The financial auditor of PDL

This study unit is included to provide objective information of the financial position, history and financial capitalisation of PDL.

- Staff members

Selected staff members will be interviewed to compile data on human and social capital utilisation by the business owner.

- Clients and suppliers

Within this study the term client will represent all dentists that had a work relationship with PDL, at any time, over a period of sixteen years, and the term supplier will refers to all suppliers of materials, equipment, and services of any kind, at any time, over a period of sixteen years. Interviews will be conducted with both clients and suppliers to determine the trustworthiness, reliability, reputation and general entrepreneurial behaviour of the business owner to succeed in a highly competitive dental laboratory market place.

In this study the criteria based sampling technique, will be employed. Sample units will be selected based upon the following criteria. These criteria will be applicable with regards to the staff members, the clients and the suppliers of PDL as these units could only be selected if they meet the below mentioned criteria. It speaks for itself that the business owner and the financial auditor do not have to meet the specific requirements as they are selected because of their respective institutional positions in the business.

Selection criteria appropriate to be applied to all potential respondents:

- Have had a working business relationship with the Business owner for at least one year and respondents will be classified into one of the following categories based on the length of the relationship;
  - more than 10 years
  - 5 – 10 years
  - More than 1 year but less than 5 years

- The respondents in the abovementioned categories will be proportionally selected applying a 3:2:1 ratio. The reason is that more weight will be given to respondents that have a long working relationship with the owner.
- For suppliers and customers the monetary value of business with the laboratory will also be taken into account. Here the 80:20 principle will apply. In other words those 20% of suppliers and customers that contributes to 80% of business revenue will be considered for selection.

Data will be compiled using semi-structured questionnaires evaluating the following concepts: opportunity recognition, opportunity preparation, opportunity exploitation and utilisation of social, economic, strategic, cultural capitals and various component of relationship management over the 16 years of existence of PDL. Independent field workers will be trained and used to administer the questionnaires. A three round Delphi technique data analysis approach will be followed to analyse the qualitative data compiled. This will enable the researcher to reduce error variance and to maximise consensus among respondents. The quantitative data analysis may involve amongst others techniques like regression to the mean in order to evaluate and display how the behaviour of PDL fluctuates naturally over time. Recognition will also be given to the fact that because of the ex-post facto nature of the design, memory illusions may have a negative impact on the epistemology value of the research. Therefore inter-response reliability measurements and special treatment and consideration of outer-responses will receive special consideration. Further, only responses constantly differ sharply (significantly) from a previous period will it be attributed to a change in entrepreneurial processes and capital utilisation approaches and not because of natural fluctuations in the business or business environment of PDL.

The face validity of the research will be promoted by allowing experts in the field and at conferences, like dental technicians, academics and the business owner to critical reflect on the data compiling techniques, the measuring instrument and the findings of the researcher. The trustworthiness of the interpretations will be evaluated in terms of the level of consensus and stability of responses obtained as well as through the consensus seeking method applied in the Delphi technique.

Ethical aspects also require careful consideration. Approval for the conducting of this study by the researcher will be obtained from the owner of PDL and assurance will be provided to the owner not to incriminate him in person or the name of the laboratory. All participants in this study will be advised about the nature of the study being conducted and will be advised that participation is entirely voluntary. Unethical behaviour will be minimised in this research as all field workers, under the supervision of the researcher who will not directly be involved in the field work due to the possibility of creating bias in responses, will be properly trained in the correct administration of the questionnaire, expected ethical conduct during the field work and the treatment of information obtained. Participants will be required to sign and date a consent form indicating agreement to participate in the survey. The researcher will report the findings in a complete and honest fashion, without misrepresenting or compromising the outcome of the study. Confidentiality and participant's privacy will also be protected during the study by making use of a coding system during data capturing to ensure that responses of individuals

could not be identified. The identity of respondents will only be known to the researcher and the fieldworkers.

Conclusion

Pretoria Dental Laboratory (PDL), an influential and successful dental laboratory in South Africa which was established in 1992 specialises in three dental disciplines, namely Crown and Bridge, Prosthodontics and Orthodontics was selected as study object. The purpose of this paper was to outline the theoretical framework and research methodology to be utilised in the research in order to provide insight on how PDL interact with various stakeholders, respond to environmental changes, utilise various capitals (strategic, economic, cultural and social) through a process of business decision making to recognise, prepare and exploit business opportunities in the dental environment of South Africa. The outcome of the research is intended to enlighten entrepreneurialism and its application in a specific specialised environment of South Africa.

It is envisaged that the research design proposed will yield much stronger and valid research results than applying a simple business startup-to-current-state business (pre-post research design) design in which only one measure is taken at each phase. However, recognition should be given to the fact that history and how it is accommodated in the research measuring instrument may confound results in a study reflecting on a sixteen year business time span. Specific care will therefore be taken to rule these factors out by means of amongst others inter-response reliability measures and careful consideration on how to treat out-layer responses. The Delphi-technique to be employed may also assist in this regard. The research design is also considered appropriate because it will allow the researchers to gather valuable information in a natural business setting.

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The Growth and Exit of University and Corporate Spin-outs in the Medical Instrumentation Industry

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Abstract

Incubator organizations are said to exert a long term influence on their spin-outs. However, there is a great diversity in the types of spin-outs (Druilhe and Garnsey, 2004) and in types of incubators (Clarysse, Wright et al., 2005). This diversity is likely to affect the influence of the incubator on the performance of the spin-out. To contrast the impact on (similar) spin out firms of their very different originating organizations we compare two instrumentation spin-outs, one from Cambridge University and one from a technology consultancy firm in the same region. We go on to examine the evolution of the business models of these spinouts, their growth experience and exit routes of founders and investors. The central question is how the incubator organization affects the development path taken in the early life course of their spin-outs.

We find that although university or corporate origin exerts path dependent influence on the early development of these firms, the problems they face in scaling up are similar and largely unrelated to their origins. Critical problems arose from the shift in target market from technophile and early adopters to more mainstream customers as they moved from customized to standardized products, characterised by very different purchasing decisions of customers. Likewise the contrasting exit routes of founders and investors (trade sale and IPO) related to factors independent of the originating organization. We conclude that the business development of spin-outs can only be partly understood through a focus on their incubator organizations; their products and markets are of much greater impact on their development. However we found a shared set of influences on business model evolution, relationship with customers and exit pressures on the spin out companies, in that these were all shaped by knowledge networks and brokers of various kinds as the spinouts moved out of the orbit of their originators to create a network of new relationships on which their performance depended.

The incubator organization undoubtedly exerts an influence. However, this influence is indirect, in shaping the networks that the founders have built up or have access to via the incubator organization. Over time the spin-out co-evolves with an expanding network of relationships. Especially in a knowledge-rich environment such as that surrounding Cambridge, the initial disadvantage of university spin-outs (due to less industry experience and networks) in comparison to corporate spin-outs is less of a constraint. This shows that the direct influence of the incubator organization is relatively small, but that the networks that are developed from, and extended beyond those formed in the incubator organization are key enabling factors in the growth of these spin-outs.

1. Introduction

The commercialization of technology through spin-offs and the formation of HTSFs[1] (High-Tech Small Firms) exist in both universities and corporations. Studies of technology transfer on academic and corporate entrepreneurship tend to however depict spin-outs as a homogenous category (HEFCE and Office of Science and Technology, 2005) and not being differentiated or contrasted in literature. Studies that consider the diversity of spin-outs remain rare and one of the reasons being postulated is spin-out research does not focus on the firm level but rather on their environment and the infrastructure support and public policies that encourage the emergence and growth of companies from the science base (Roberts and Malonet, 1996; Casper and Matraves, 2003; Garnsey and Druilhe, 2004). Oakey (1995) for example criticizes the assumption that all HTSFs are alike, and has recognized the difference between categories of firms. Oakey claims that there are two types of high-technology small firms entrepreneurs, the first being spin-offs from higher education centers (university spin-offs, USOs) and second, spin-offs from corporations (corporate spin-offs, CSOs). At the university level (USOs) there has been a substantial rise in its creation and demand of commercial ideas from the universities into businesses (Lambert, 2003), as universities increasingly view equity ownership in a USO as an attractive alternative to licensing technologies in embryonic industries (Wright, Lockett et al., 2006). Similarly, CSOs have gained prominence of recent in both academic research and industry relevancy (Roberts, 2005). In recent years, the number of corporate spin-offs has accelerated (Chemmanur and Yan, 2004). Often, corporate refocusing and economic growth seems to promote the formation of spin-off firms by encouraging venture managers to leave their existing employment and to establish a company of their own with links to their parent organization (Garvin, 1983; Parhankangas and Arenius, 2003).

These two categories of firms are assumed to need and acquire different types of resources due to their different background (Lofsten and Lindelof, 2005). According to Monck, Porter et al. (1988) for example the firms established by those with an academic background perform differently and respond to different incentives from those founded in the corporate sector. A recent report from the British Ventures Capital Association (British Venture Capital Association, 2005) recognized significant differences between corporate and university spin-outs. They found corporate spin-out are often founded with the explicit aim of satisfying a known customer need and that frequently technology is already proven, customer needs have been established and team members with a mix of technical and commercial experience can be identified, recruited and incentivised. This effectively means that corporate spin-outs are launched at the equivalent of the cusp between market & technology development and product & business development.

This paper analyses the impact of incubating organizations on their spin-out firms by comparing two instrumentation spin-outs, one from Cambridge University and the other from PA consulting, a leading international consulting firm in the same region. Data was gathered from two types of firms with regard to their networks and product innovation. We examine the evolution of the business models of these spinouts, their growth experience and exit routes of founders and investors. The central question is how the incubator organization affects the development path taken in the early life course of their spin-outs.

The paper is structured as follows. We examine two case studies, which commenced operation roughly about the same time namely an USO, BioRobotics and a CSO, Diomed. We compare and contrast the findings from these case studies and draw conclusions on the influence of its incubator organizations over the development path (employment, business model, exit) of the spin-outs. Finally, we investigate some implications of findings from this research.

[1] There are many other terms used in the literature to describe high tech entrepreneurial start-ups (e.g. New Technology-Based Firms or NTBF and Research-based startups, RBSUs). For the purpose of this paper, the term High-Tech New Ventures is used. These terms are synonymous with each other and may be used interchangeably.

2. The development of spin-off firms

Many new firms originate from incumbent firms in the same or a related industry. Especially in high-tech industries, universities and other public research organizations are increasingly seen as important incubators of spin-offs. Spin-offs are different from other types of start-ups in that there is (to some extent) continuity in knowledge (resources) and networks from the parent organization. This is also likely to affect the performance of the spin-offs, either positively when it enables the identification and exploitation of opportunities, or negatively when it constrains this. The incubator organization can be an important stakeholder, by providing financial capital, intermediate inputs, specific knowledge, and leads for new customers. Especially in the early phases of the life course of the spin-off the support by the parent can be very important due to the lack of resources and legitimacy of the start-up firm. However, once the spin-off has survived the initial years and it has become able to generate its own resources, the influence of the parent organization is likely to decrease.

2.1. Resources and capabilities

What are the advantages of a university spin-out? Ownership of or a license to IP originating in a university can endow the start-up with a unique resource. It has been argued that valuable, rare, inimitable, and non-substitutable resources may endow a firm with a competitive advantage that translate to superior performance (Barney, 1991). This does not automatically lead to a competitive advantage, just as knowledge spillovers from universities and other research institutes cannot be absorbed by all firms. A key element is absorptive capacity: a firm's ability to recognize, value, and assimilate new external information (Cohen and Levinthal, 1989; Cohen and Levinthal, 1990). The increased absorptive capacity of new firms interacting with academic institutions may provide advantages for developing new products and alliancing with other firms, and ultimately improve the firm's performance. Empirical studies have shown a lack of (direct) positive effects of these university-industry flows on the post-entry performance of knowledge-based firms; an indirect effect via increased absorptive capacity may be more important (Rothaermel and Thursby, 2005; Roper, Love et al., 2006). Cockburn and Henderson (1998) demonstrate that firms must exhibit substantial absorptive capacity to capture and appropriate rents from publicly available knowledge. Corporate spin-offs can thus also benefit from academic knowledge if they posses sufficient absorptive capacity to turn this knowledge into viable opportunities.

In order to commercialise technical intellectual property, organizational knowledge is required by the new firm. This latter type of knowledge is the fundamental source of competitive advantage of firms (Grant, 1996). Opportunities must be identified by entrepreneurs and resources must be accessed, secured and mobilised in order to generate returns. Key problems facing the start-up venture must be solved by developing a repertoire of problem-solving skills or competence. As learning is built up to overcome these problems, competences and dynamic capabilities are developed(Hugo and Garnsey, 2005). Competences can be viewed as individual and team-based knowledge and skills which yield economic benefit. By accessing, developing, and integrating new and existing knowledge, firms will be able to reconfigure the nature of their resource base, which is necessary to achieve sustainable competitive advantage in a technologically dynamic environment (Teece, Pisano et al., 1997; Eisenhardt and Martin, 2000). The way firm growth is managed affects whether internal resources are developed and successfully matched to opportunities (Kogut and Zander, 1992; Penrose, 1995; Garnsey, 1998). In the case of the young knowledge-based firms, the key dynamic capability is the group's ability to detect opportunities for their new technologies and to use their competence to sustain innovation. This capability is more likely to have been developed in a corporate context than in a university context, and this provides corporate spin-offs with a better starting point than university spin-offs with respect to the recognition and exploitation of opportunities. There are several reasons

why CSOs may be in a advantageous position as compared to USOs (British Venture Capital Association, 2005): their technology has already been proven; customer needs have already been established; customers may have been closely involved with specifying and testing the solution and will place orders; teams with a mix of technical and commercial experience may well have been working together for some time and additional known people can be identified, and recruited; team members are more experienced technically and commercially; the concept has been sheltered, developed and funded in a commercial environment. However, this lagging position can be caught up when the founding entrepreneurs of the university spin-off attract members with a corporate background, and/or when they are able to learn and develop these capabilities during the early life course of the firm.

2.2. Developmental processes

Different types of resource base are built and used in different ways, depending on the activity and business model of the firm (Chesbrough and Rosenbloom, 2002). Developmental processes may occur in parallel when firms build capabilities for one product or service while being at an early stage in developing other planned offerings, as in the "soft to hard" strategy of product development funded on early service provision (Bullock, 1983). While each firm is unique, there are common processes that bring about development and common problems that have to be resolved. Common processes include opportunity recognition and resource matching, resource mobilization, resource generation and resource accumulation. These make possible the development of competences and capital in a base made up of productive, commercial and financial resources. Problems originating within or outside the firm may deplete this resource base, leading to a turning point in the life course of these firms. These have negative consequences when problems are not solved, but positive consequences when they lead to new solutions and the development of new competence that extend the firm's resource base. Hugo and Garnsey (2005) showed that the difficulties faced by new firms provide a stimulus to creating technological competence and marketing capability which propel their growth. Initial disadvantages are addressed by mobilizing resources in new ways, by resource economy ('asset parsimony': (Hambrick and Macmillan, 1984)) resource leverage ('bootstrapping': (Bhidé, 2000)) and by creating new resources (e.g. 'bricolage': (Baker and Nelson, 2005)). These efforts are linked in a dynamic process of problem-solving that requires strategic relations with others. Resource economy is achieved internally by rearranging the firm's activities and resources in order to produce more with less. New growing firms use their initial resources to gain further leverage. When faced with a resource deficit that cannot be remedied externally, the firms set out to build their own proprietary resources. Cooperative interactions with other parties, including funders, regulators and suppliers, are used to mobilize resources and open further opportunities. When market solutions proved unavailable, this barrier to the pursuit of the original business idea may be an opportunity to develop a new business idea. A key feature of entrepreneurial responses to adversity is cognitive. Entrepreneurs view the situation they face as a soluble problem which they can address proactively and on which they can have some impact. They reconsider their situation and find ways to turn obstacles to their advantage by re-routing the firm. Recurrent problem solving of this kind enables these new firms to build capability on a cumulative basis. As Penrose (1995) anticipated, to succeed they have to match their resources (in particular the competence they had developed) to shifting opportunities. Information asymmetries, technologies advancing ahead of market provision and government regulation are examples of sources of opportunity. Entrepreneurial opportunities often emerge when leads and lags in market needs and provision create asynchronies between supply and demand and stimulate innovative responses to 'market failure' (cf. (Metcalfe, 2004)) drive entrepreneurial activity.

Not any and every deficiency can be transformed by entrepreneurial problem-solving into an asset. The cliché that every problem is an opportunity does not recognize that problems can combine in such a way as to close off opportunities and crush motivation. Undoubtedly early endowments (financial and human capital) are facilitating and attract other favourable attributes in a self-reinforcing process.

In this sense, corporate spin-offs are likely to have a better starting position than university spin-offs as they are more likely to have built up production and marketing experience. Timing also plays a large part in securing favourable outcomes for these new firms. But more than good luck is involved in repeatedly identifying and exploiting resources and timely opportunities so as to improve productivity and build capability. Alliancing is essential, but the new firm must have something to offer partners in return. Building competence in response to problems makes it possible to establish useful partnerships that further increase the firms' capability. Not only opportunities but impending threats can be turned to advantage when they spur creative thinking about objectives and new strategic moves. Though most new firms are held back by the continual difficulties besetting growth, those that find their way around these problems grow to be major players in their industry.

Entrepreneurial founders do not necessarily have the problem-solving skills required by good entrepreneurial managers. People with the right combination of skills and experience are scarce and the assimilation and motivation of staff can create serious difficulties (Witt, 1998; Witt, 2000). As the firm grows management information becomes increasingly complex (Greiner, 1972). The difficulty for decision-makers in assimilating and making considered judgements increases under conditions of rapid growth. Where reserves have been run down, delays and ill-judged decisions can bring growth to a halt. As new firms grow they face increasing organizational complexity; according to some authors this will require periodic restructuring (Greiner, 1972; Romanelli and Tushman, 1994; Vohora, Wright et al., 2004). Competence based scholars have pointed to benefits of paced growth (Penrose, 1995; Teece, Pisano et al., 1997; Hugo and Garnsey, 2005), while organizational ecologists have undertaken studies which show why radical organizational changes impair growth prospects and even survival in young technology based firms (Hannan and Freeman, 1984; Baron and Hannan, 2002).

2.3. Blueprints

How the founders of new technology based firms approach organizational and HR challenges in the early days of building their firms may have enduring effects on the firms (Baron and Hannan, 2002, p.8-9). This is the issue addressed in several papers based on the Stanford Project on Emerging Companies (SPEC) (see for example (Baron, Burton et al., 1999; Baron, Hannan et al., 2001; Baron and Hannan, 2002). This study found an important determinant of growth of technology based firms to be organizational models or blueprints that entrepreneurs use in launching their new ventures. These blueprints guide entrepreneurs' thinking about how to organize employment and manage personnel. If the origin of the firm is formative for its subsequent development (Hannan and Freeman, 1977; Hannan and Freeman, 1984), blueprints are likely to be enduring in the life course of new fast-growing firms. Barron and Hannan (2002) showed that changes in organizational blueprints are in general very destabilizing to young technology firms, adversely affecting employee turnover, financial performance, and even survival. These findings suggest that disruption may be considerable when investors replace technical founders who have had a formative role in the company. Selecting people who fitted into the organization and coordination via peer control and, or, culture was more commonly found among firms that achieved an IPO (Baron and Hannan, 2002). Selection based on exceptional talent, intrinsic work attachment, and professional standards of coordination, most often found in biotech firms, was common in firms that fared best in the post-IPO phase (Baron and Hannan, 2002). These findings demonstrate the importance of dedicated people and a sense of community for the longer-term success of the firm. The initial blueprint is likely to differ between university spin-outs that are oriented towards developing a particular products and corporate spin-outs that are stimulated to grow substantially and eventually exit via sell-off or IPO. In addition, when these blueprints are radically changed in the early life course of these spin-offs this might lead to stagnation and unfavourable exits.

3. Research method

The exploratory nature of the research question required the use of the case study method as it offers an opportunity for in-depth exploration and results in rich understanding and a clear picture about the research issue (Gilgun, 1994; Rowley, 2002). A case study is "an empirical inquiry that investigates a contemporary phenomenon with its real-life context, especially when the boundaries between phenomenon and context not clearly evident" (Yin, 2003, p.13). Other methodologists described the case study as inquiry of a system bounded by time and place and the case is the event being investigated (Creswell, 1998), and, from the postgraduate research perspective, as a research methodology which relies mostly extensively on interviews (Perry, 1998).

The literature on case study provided a variety of typologies, for example, case study may be exploratory, descriptive or explanatory (Yin, 1984; Yin, 1989; Yin, 2003), particularistic, descriptive or heuristic (Merriam, 1988) and snapshot, longitudinal, pre-post, patchwork or comparative (Jensen and Rodgers, 2001). Accordingly, the category of the selected case studies of the current research is exploratory according to Yin's typology (Yin, 1984; Yin, 1989; Yin, 2003) as the research adopted the inductive approach in an attempt to add, combine and develop new aspects of the existing theory in the area of strategic management, marketing and entrepreneurship.
In spite of the criticism that has been directed towards case study strategy (e.g. lack of statistical generalization), it is extensively employed in many fields of social and business research because compared with other methods the strategy provides insights and rich understanding about the event being studied (Rowley, 2002).

4. Two Spin-offs in the Medical Instrumentation Industry

4.1. The Medical Instrumentation Industry

The medical instrumentation industry encompasses an extremely large variety of products and technologies. It covers hundreds of thousands of products that range from more traditional products, such as bandages or syringes, to sophisticated devices that incorporate bioinformatics, nanotechnology and engineered cells. These are often designed for use by practitioners, patients and healthy individuals in a variety of settings: hospitals, surgeries and private homes (Pammolli, Riccaboni et al., 2005). Although the medical devices market is not as large compared to the pharmaceuticals or consumer electronics market, innovation in medical devices, especially in Cambridge, Oxford, Silicon Valley and Boston have been extraordinary promising.

The high regulatory process for medical devices marketization and commercialization has set up a situation where innovation and creativity is high in the first few stages of the innovation value chain. However due to 510K[2], PMA (Premarket Approval)[3] and other FDA regulations the continuation of innovation and firm growth is heavily depended on whether products are approved and passing the clinical trial.

[2] Section 510(k) of the Food, Drug and Cosmetic Act requires those device manufacturers who must register to notify FDA, at least 90 days in advance, of their intent to market a medical device. This is known as Premarket Notification - also called PMN or 510(k) . It allows FDA to determine whether the device is equivalent to a device already placed into one of the three classification categories. Thus, "new" devices (not in commercial distribution prior to May 28, 1976) that have not been classified can be properly identified. Specifically, medical device manufacturers are required to submit a premarket notification if they intend to introduce a device into commercial distribution for the first time or reintroduce a device that will be significantly changed or modified to the extent that its safety or effectiveness could be affected. Such change or modification could relate to the design, material, chemical composition, energy source, manufacturing process, or intended use.

[3] Premarket approval (PMA) is the FDA process of scientific and regulatory review to evaluate the safety and effectiveness of Class III medical devices. Class III devices are those that support or sustain human life, are of substantial importance in preventing impairment of human health, or which present a potential, unreasonable risk of illness or injury.

4.2. Diomed

Diomed, a consulting spinout from Cambridge, UK pioneered the commercialization of endovenous laser treatment (EVLT®), an innovative minimally invasive laser procedure for the treatment of varicose veins caused by greater saphenous vein reflux. In September 2001, the company was the first company to receive the CE mark of the European Union for approval for endovenous laser treatment with respect to marketing EVLT(R) in Europe. In January 2002, Diomed was also the first company to receive FDA clearance for endovenous laser treatment of the greater saphenous vein. In December 2004, it received FDA clearance to expand the application of EVLT(R) to other superficial veins in the lower extremities.

Diomed Inc has an incredible didactic and varied history as a medical devices company. Its history combines the experiences, skills and talents of one man, Dr. Anthony Raven and several of his close associates at several consulting companies in Cambridgeshire, United Kingdom. This affiliation, drawn together by chance and in the words of Dr. Raven "fate" combined their international diverse skills of its members to launch, grow and eventually thrive, expanding into a successful public company listed on the American Stock Exchange. Its history is fraught with uncanny coincidence and opportune twists of fate. The case study illustrates the role of path dependent influence from incubator organizations and the role it played in providing the initial financing and intellectual property development. However as the firm grew these networks are developed from, and extended beyond those formed in the incubator organization as the key enabling factors in the growth of Diomed.

The Beginning

Dr. Anthony Raven graduated in Physics from Manchester University and obtained his MSc and DPhil from Oxford University. Subsequent to graduating he worked at Rutherford Appleton Laboratories (RAL) at the Chilton/Harwell Science Campus, a UK scientific research laboratory near Didcot in Oxfordshire and Osaka University in Japan. RAL hosts ISIS, the brightest spallation neutron source in the world, which uses neutron scattering to study the structure and behaviour of materials, providing research capabilities for around 1600 scientists from a range of disciplines. At Rutherford, Tony worked primarily at the Central Laser Facility, which houses the Vulcan and Astra lasers. During his visit to Osaka University he met valuable research and business contacts, most notably at Olympus. Both his educational background and his experiences at Rutherford and Osaka were to provide invaluable contributions to his entrepreneurial success.

The Years at a large Cambridge Consulting Firm

Tony joined a large consulting firm, PA Consulting in 1983 at its Cambridge office. The firm was one of the two dedicated applied technology facilities in the world, the other being at Princeton, NJ, USA. Tony was employed with the PA Consulting in the 1970s, and at that time the firm had several years of slow growth with weak revenues. The company was never very profitable and endured a number or financial crises which progressively weakened the company. Part of the consulting firm's problem was its ownership structure, but the other part was it was involved in several consulting disasters.

Despite these reservations Tony highlighted the importance of "getting out" into the dynamic consulting industry. He emphasized that vital but sometimes underrated role consultants have played in the "Cambridge phenomenon". Tony observed that the "Cambridge phenomenon" owes as much as to consultancy organizations in Cambridge than other institutions. He believed that consulting firms have "the best of two words" - works on the leading edge of technologies but also in a very commercial environments.

One positive aspect during Tony's employment at PA Consulting was despite the general decline in revenue there was the emergence of what has probably become the world's best Technology Consulting practice, located in Cambridge, UK. The firm rapidly built up a major strength in advising companies on multiple arcane technologies and their potential application to business issues. Arising out of this success, major technology centers were built around the world, including one located near Princeton University in Princeton, USA.

A Consulting Firm Spinoff

The consulting experience gave Tony an extraordinary number of contacts and network affiliates. However, PA Consulting continued to be plagued by management difficulties and internal problems. The Chief of Technology at PA Consulting in 1986 was Professor Gordon Edge, a well known entrepreneur and management consultant in the Cambridge area. Gordon had minor disagreements with the Board over the running of the company and had announced his resignation, to the consternation and shock of many in the company. Gordon's plan was to start a consulting company not only providing the same technology based services of PA Consulting, but with added management consulting service offering under a different business model. Sensing this to be an exciting opportunity, Tony and a few colleagues wrote to the Professor requesting to join the new venture. The group met during Christmas 1986 and Scientific Generics was subsequently formed in the beginning of 1987.

From its launch in 1986 as Scientific Generics the central characteristic of the company had been a drive to innovate and to create value from technology. This was achieved many believed by a corporate culture in which there was minimal hierarchy, and in which project teams were built from the best people for the job. Gordon believed vigorous interaction between peers and the encouragement of individual freedom. Most importantly, there was a strong emphasis on the polymath – the person whose knowledge base encompasses both technology expertise and business acumen.

Spinout of Diomed

One of the first projects Tony undertook at Scientific Generics was with a colleague with ophthalmic surgery background. The two enduring friends had long pondered whether one can use semiconductors lasers[4] to conduct eye surgery. Tony had held the opinion that they were not powerful enough.

In its early days Scientific Generics' employees were encouraged to be innovative and creative. Looking for a project to do, the duo re-explored the idea of applying semiconductor lasers to medicine and medical surgery. Tony illustrated vividly how the solution to the problem came to him. He termed the moment "spotting serendipity".

> *I've come to use a phrase, which is spotting serendipity... it just happened as a casual conversation.. a number of things which you could never predicted came together at a point in time and spotting that was an opportunity.*

Tony described the serendipitous moment occurred when somebody had sent him a competitive patent that another party had just filed with the UK Intellectual Property Office. Tony perused the document and from his physics background immediately hypothesized the invention could not work. The problem however was Tony could not prove why the device could not work. Whilst driving to

[4] Semiconductor laser is a laser in which semiconductor serves as photon source. Semiconductors (typically direct band-gap semiconductors) can be used as small, highly efficient photon sources. Such semiconductor photon sources find application in displays, optical storage, communications, printing, surveying, and as small efficient optical pumps for other optical processes. Semiconductor photon sources come in two major categories -- laser diodes and light-emitting diodes. Although both photon sources are fundamentally the same (in other words, a failed laser diode is an LED); application-based manufacturing differences mean that laser diode and LED products are constructed in fundamentally different ways -- and so possess fundamentally different optical properties.

Sheffield Northern General Hospital, Tony sat on motor way (incidentally in traffic congestion) thinking of the reasons why the device could not work and ways to improve on the imperfections. It suddenly dawned on him.

> *Then it dawned on me why it didn't work..I knew immediately from something I had done before.. how to make it work. They were trying to create a smooth curve, that is, new curve in the shape at the front of the eye to change the optical properties. They were trying to do it by making the laser beam stronger at the edge and weaker in the middle. I realized the process is very nonlinear in intensity so I said no you don't do that, what you do is you make it uniform. You actually make a couple of series of small incremental steps, so you remove a ring, then you remove a slightly smaller concentric ring and a slightly smaller ring still… everything. at the nanometer. What you get is like a Mexican Pyramid but when you look at a distance, it looks smooth.*

With this "eureka" discovery Tony got in touch with a company called Keela, a large ophthalmic instrumentation company. Keela had been a company Tony was introduced to whilst he was employed at PA Consulting. Through some gentle persuasion he managed to convince the company to back the project.

With the seed money from Keela they built and launched a semiconductor lasers for retinal surgery. This became quite successful within a year and captured a good proportion of the market in the United Kingdom. With this success Diomed was formed in 1991, and subsequent patents were lodged with in a local patent firm in 1992. Seeing the potential for medical devices, the duo decided to seek new capital and larger partners. They first tried securing sources from venture capitalists, but this route did not provide to be a fruitful route. Instead, they utilized their old networks at PA – which lead unusually to the investment bank Bears Stern. Again, through social contacts they had built up at PA, they were able to persuade the investment bank to back their new venture.

Having secured the capital, they used the money to enter the market for general surgical applications. Again utilizing their contacts from their times in consulting, the pair needed more capital, but more importantly technical and strategic expertise. They were introduced to a Finnish company by the name of Instrumentarium (now part of the PaloDEx Oy Group). The company operates in the international healthcare market, focusing on X-ray technology applications used in dental imaging. The alliance was a nature fit. Instrumentarium was a global leader in the design and production of state-of-the-art digital and analog dental imaging equipment for both intra and extra-oral applications as well as offering innovative software enabling superior image management capabilities. The company was a pioneer in bringing the first dental panoramic x-ray, Orthopantomograph®, to the market in 1961, and in the use of computed radiography (CR) systems for indirect digital image capture in dental since 1994. Instrumentarium's technical and financial expertise, in particular its investment in Diomed's early stage development in laser diode devices was instrumental and indispensable to Diomed's early stage growth. The partnership offered Diomed strong strategic fit, alignment, technical and financial support. More interestingly, throughout this alliance, Diomed was not subjected to any costly litigation, unlike its counterparts in the same industry.

Diomed had soon reached a thorough penetration of the private clinicians' (non-NHS) UK market. Coincidentally, at a trade show in the US Diomed's management had met a large medical devices distributor agent in Korea and was tempted by the opportunity for foreign expansion. The Korean market was unlike that of neither the US nor the UK. Diomed was able to leverage on the "viral" nature of fashion and cosmetic surgery in the country. This was unseen in the UK[5]. The customer and end users, and ultimately the surgeons desired to have the "latest and the best". Direct marketing was deemed and indeed proved to be the most effective method of market penetration and growth in Korea. Diomed however had been more familiar with the UK model of advertising to its end users and

[5] Minimally invasive medical procedures (such as Endovenous Laser Treatment for varicose veins) was popular in the UK but had not reached the "fever demand" in Korea.

customers - as the NHS would not entertain direct selling approaches. The NHS ran on a 12 month budgetary cycle and most of it was spent on salaries. Unfortunately this meant any direct marketing of medical instruments and equipment required a myopic view of ROI. Diomed had 18 months to 2 year pay back period. Again, Tony was able to leverage key resource contacts he had previously built up at the University of Osaka (where he had spent some years during his post-doctorate) and Olympus. Diomed leveraged these resources at these institutions and capitalized on the networks and its technology. It mobilized its human resources and concentrated its efforts on direct marketing to surgeons. This flexibility allowed Diomed to thrive in the Far East. Eventually, the Far East market proved to be a spectacular success[6]. This was due in part to the creation, leveraging and building a resource economy in a foreign market combined with its ability to evolve and adapt by matching its internal resources (experiences, human capital, supply chain) to its new environment.

Diomed is a case that grew out of "well spotted serendipity". It is the ability of the founders to spot this serendipity, combined with ability to utilize the tacit knowledge that contributed to its success. By 2005, Diomed had reached sales of US$13.85 million pounds and a profit of 1.2 million dollars.

IPO and Move to the US

Diomed took a strategic decision to directly manufacture and sale in the US in the early 1990s. It had initially faltered in the US, because it had followed its traditional patterns of hiring managers from large corporations in the UK and relied on the local hires to execute supply agreements. This method broke down in the US - citing disagreement with its local Texan distributor over earnings and disapproval over management style with a locally hired manager from a large corporation[7]. In short, the outside manager ("hired gun") did not fully appreciate the matching of Diomed's critical resources with how the DMU was organized within its customers' organization.

Diomed was able to learn from these experiences and adjusted its strategies accordingly. Eventually the company showed flexibility and recruited a manager from a small company - who had significant experience in the US medical devices sector. Sensing the huge opportunity in the US, Diomed made an executive decision to relocate - whereby the UK operations would be acquired by the US parent company so that it may gain better access to capital and markets in the up-and-coming Boston medical devices cluster. Again, it was able to show adaptability by leveraging greater financial capital in the US. Unfortunately nine-eleven delayed IPO for Diomed, but again it was able to create resources by raising capital from alternative sources during the intervening period. Eventually on August 29, 2003 Diomed made a successful debut on the American Stock Exchange.

4.3. BioRobotics

Founded in 1993, BioRobotics exemplifies the start up and growth of a successful manufacturing company in the Greater Cambridge Area. The secret of BioRobotic's success was to identify a niche market that was growing rapidly and to establish superior relationships with customers in that specialist niche. This was only possible because their product was well designed and met innovative customers' needs at a competitive price, outperforming the competition. They produced in-house until they had found local suppliers to whom they were able to outsource.

[6] Diomed had gained the most traction in the Far East of all its international markets.

[7] *"He had a very impressive CV from a very big corporate but actually that's where I learnt people from big corporates are very skilled at delegating not in doing so.. he had not done the job himself, he had always given it to someone else to do it…so I he actually always delegating."*

Origins

In the 1980s genetic research was expanding rapidly. Cambridge England was a centre of research into genetics. The structure of DNA had been identified in the 1950s and monoclonal antibodies developed at the Medical Research Council (MRC) (Kohler and Milstein, 1975). As the field matured, experiments were being conducted on an increasingly large scale. Unlike physicists, biologists had no tradition of creating their own research instrumentation. Researchers in this field were encountering problems that were brought to the attention of Dr Tom Bligh, a design engineer in Cambridge University Engineering Department. Peter Jones, a geneticist who was a lodger at the time Bligh was working at the Medical Research Council (MRC). Peter complained to Tom after having to pick 50,000 cultures by hand one weekend. Tom was asked to try this task and learnt at first hand how work in genetics research could involve time consuming and tedious manual procedures. Tom Bligh was sure that the process could be automated on a more effective basis than was currently available. This would remove a constraint limiting the volume of cultures on which geneticists could experiment. He produced a sketch of a fully automated machine using a robotic arm in 1991. He suggested that one of his students conduct a preliminary design study at the MRC as his final year project. Tom Bligh mailed his design notebooks to the Bursar of his college as proof of the date of the invention.

After graduation, the former student was funded by the MRC to carry on development work based on his design project. Tom Bligh had met Martin Davies, who had a PhD from the Engineering Department and had been working on vision in engines at Cambustion, a small spin-out from the department. He recommended Martin to the MRC to join the project. Together they developed the designs for the Biopick to the point where a prototype could be constructed, using the facilities of the manufacturing division of the engineering department. However Dr. Bligh and the staff at the MRC had different ideas for the prototype. The MRC preferred to manufacture and sell a prototype derived from the original design whereas Bligh argued that, to market the product successfully it was necessary to redesign the product along simpler, more reliable and easy-to-use lines. The prototype was based on a collection of sub assemblies and Bligh argued that it would be much less costly to produce if redesigned for manufacture.[8]

The idea to form a company to automate lab equipment was mooted by Tom Bligh, Peter Jones and Martin Davies. They approached a number of seed capital funds in Cambridge. The MRC did not believe they were capable of producing a professional product and proposed to license the design to a US company for manufacture. On hearing of ensuing disagreement, one of Dr Bligh's teaching colleagues, John Vince, showed interest in the idea of a commercial venture. He had a small amount of capital from a company he had set up earlier, which he was prepared to invest in a start up. However it was decided to do further work on the design in the department workshop before founding an independent venture.

The Original Prototype

The entrepreneurial team consisted of Tom Bligh, John Vince, Martin Davies, who wrote the software and Peter Jones, the geneticist. Tom Bligh, John Vince and Peter Jones were employed by the university but Martin Davies needed a salary. He had written the software for the MRC machine but had chosen to carry on working with Tom Bligh. Until the first machine was sold, the funding to pay Martin Davies and buy equipment was transferred from Cambridge Project Engineers, John Vince's company. John Vince provided £30 000 from Cambridge Project Engineers and his own pocket. However the venture was still short of finance. The head of the University Liaison Office, Eric Howell, suggested that they overcome their disagreement with the MRC and offer them a 10% equity stake in the venture. This proposal was not well received by their contacts at the MRC, who had already spent £600,000 on a team of technicians and engineers developing the original designs and had licensed them to a UK instrumentation firm, Hybaid.

[8] This sections draws on interviews and a write-up on these issues by Philippa Katz in a study of BioRobotics for coursework in 1996.

Tom Bligh knew that another centre of genetics research in Cambridge was the Pathology Department. He approached Professor Ferguson Smith (whom he did not know) and asked for 15 minutes of his time. He convinced him that their ideas for the Biopick would work where other designs had been ineffective. Professor Ferguson involved a colleague, Nabeel Affara, who had funds available from selling genetic markers. They opened an account in the pathology department for Bligh and his team to draw on to a total of £25,000 and were prepared to pay the Engineering Department for tools and materials used. In return the Pathology Department received the first Biopick. It was agreed that the product would be delivered the following spring. They worked flat out by the day in the university and when the lab closed at night they moved to Tom Bligh's workshop, machining well past midnight. Looking back on this period, Martin Davies wondered why they had endured the uncertainty and relentless labour. "I was too busy to stop to think why I was doing it," he reflected. Tom Bligh devoted his sabbatical leave to the project. Because funds were limited, they carried out all the work themselves, and did no sub-contracting to save expense. The Motorola driver board they used intermittently issued faulty instructions to the equipment, causing it to crash. Since this bug was irregular it took much time and effort to identify the problem. Martin Davies worked on developing their own software, which made them independent of the third party driver. With these and other problems overcome, they developed the product to the point where it could be used for demonstration purposes, with some contrivance to conceal limitations which were later overcome. When they ran late, their sponsors in Pathology insisted that they move the development work into the department. This had the benefit of enabling them to interact closely with the researchers who would be using the equipment. When development was complete, the Pathology Department had paid £28 000. The pricing of the Biopick was thus somewhat arbitrary, based as it was on available funds.

The Competition

The MRC continued in its attempts to manufacture and sell the original prototype after their disagreement with Tom Bligh. The design was licensed to Hybaid, a company with experience in this field. The design had been refined at the MRC at considerable expense, through extensive consultation with users, but it had an excess of features and functions. The design had not been simplified to meet manufacturing requirements as Tom Bligh had recommended. Finding that Tom Bligh owned the IPR on the original design, Hybaid tried to purchase BioRobotics, but the terms offered were not attractive. The six machines Hybaid had produced turned out to malfunction and were returned by customers. Hybaid withdrew from this line of business.

A viable colony picker had been developed under Hanz Lierach of the Imperial Cancer Research Group (ICR). This machine was developed to pick cultures on a very large scale. It was said to be very reliable, but was much larger and more expensive than the Biopick. This made it less suitable for sale and manufacture to any but the largest laboratories.

Setting up BioRobotics

When a second order for a Biopick was received in May 1993, John Vince and Tom Bligh decided that it was time to set up an independent company rather than relying on the resources of Cambridge Project Engineers and the University. The head office of the company was at this stage in John Vince’s back room. The department's workshop and help from the manufacturing division's technician, Charlie, (an arrangement supported by the head of division, Professor Colin Andrew) helped keep early production overheads low.

No external funding was used. The aim was to avoid the cost of interest repayments and to keep control of the company after their loss of control over the first design and licensing to the MRC group. They had not attempted to use Tom Bligh's ownership of the intellectual property rights to wrest it back through the lawyers. This would have been unpleasant and they could see benefits in a redesign. But they were reluctant to lose control of their reconstituted enterprise to venture capitalists. As Tom Bligh put it: "We wanted to produce world class products, but we wanted to manage the company

ourselves. When venture capitalists invest, they want to run the company. We wanted to do what we wanted to do, not what someone told us to do." The company was completely owned by the four founders, John Vince, the majority shareholder having 40%, Tom Bligh and Martin Davies 30% and Peter Jones 10%.

The prototype in the Pathology Department was now operational. In the course of developing it, they had acquired a better understanding of users' needs, which confirmed Tom's view that they should redesign radically for simplicity and ease of use. The filler mechanism was reconfigured to allow easier access for the user. The final design was streamlined to take up less bench space. The compact size of the machine was one of its major selling points.

The second order in 1993 was an unsolicited one from the Plant Breeding research lab at Norwich, the result of word-of-mouth recommendation. This had encouraged the BioRobotics team to move to their own manufacturing premises in the village of Comberton, Cambridge. The profits from the sale of the second machine paid the rent and salaries at BioRobotics. They recruited their own technician and trained him to build the Biopick. They now had a 700 square foot industrial unit in a converted farm building, much more space than was needed initially. They let some of it to a Human Resource consultant who subsequently helped them with their HR work.

To begin with, John Vince, the MD, was in charge of the strategic and tactical work. Tom Bligh dealt mainly with the mechanical design and Martin Davies with the software. Though they had originally done all their own work to save money, by 1995 they were outsourcing where it was beneficial to do so. "Cambridge is a great place to subcontract in. There are lots of small companies in printed circuit board production, design, machining and precision metal fabricating. They are near by and easy to work with." Martin Davies explained.

Marketing

BioRobotics was virtually unknown. Potential buyers had to be made aware of the existence of the company's product. The Biopick was a dedicated piece of equipment, its only market being genetics laboratories. The varied backgrounds and skills of the founders provided a strong combination, but they had limited experience of selling automation equipment into genetics laboratories, and the engineers initially lacked the necessary expertise in genetics to sell the Biopick. Peter Jones was too taken up with his work at MRC to be active on this front. Relations with him became tense because BioRobotics had no reserves and ensuring continuing sales was of vital importance.

It was decided to seek an alliance with a business already in the genetics field and having rejected Hybaid, they turned to the US firm, Genetics, who manufactured the microtitre plates used in the Biopick. Microtitre plates normally have 96 wells but the Biopick was designed to use 384-well plates, manufactured by Genetics. However Genetics did not find them any customers. It transpired that Genetics was also promoting the ICR culture picker designed by Hans Lierach. This machine was selling at around £120 000 compared to £50 000 for a Biopick, providing Genetics with a larger margin per sale. It was in violation of sales agreement to sell a competing product and BioRobotics dropped Genetics as their distributor.

BioRobotics then teamed up with Cambio, a Cambridge based company selling chemical reagents for use in biological fields. This seemed a promising alliance as the company was nearby and had the relevant knowledge in the genetics field. However all Cambio's sales experience was in chemical reagents. These are relatively widely used inexpensive products and require a very different sales technique. Cambio tried to market the Biopick through broad advertising campaigns and newsletters. The BioRobotics team believed that this was inappropriate for their product and that seeking out specific potential buyers would be more effective. There were approximately 200 genetics laboratories in the world large enough to afford a Biopick at £50,000. The BioRobotics had set as their objective achieving sales of the Biopick to two thirds of these labs, providing a potential market for between 100 and 150 machines. BioRobotics did not have the marketplace credibility of competitors such as

the ICR. They wanted to find specific potential buyers and demonstrate the machine in action. They aimed to persuade potential customers that the Biopick was accurate and efficient at half the cost of competing products.

They did not try to conceal the size of the company. They believed that a customer wary of small firms would not be persuaded to buy from BioRobotics, while other customers might prefer them precisely because of their size and service orientation. A customer phoning with a query was guaranteed immediate access to the person in charge. It became apparent to BioRobotics that Cambio were not selling their product either. No Biopicks were sold between July 1995 and January 1996. This was endangering their cash flow. BioRobotics terminated the alliance with Cambio and decided to take on an in-house salesman in February 1996 to maintain tighter control over sales. The sale of four units of their Biopick product to the Japanese Rice Institute occurred just in time to prevent the company going under. (How was this sale made?)

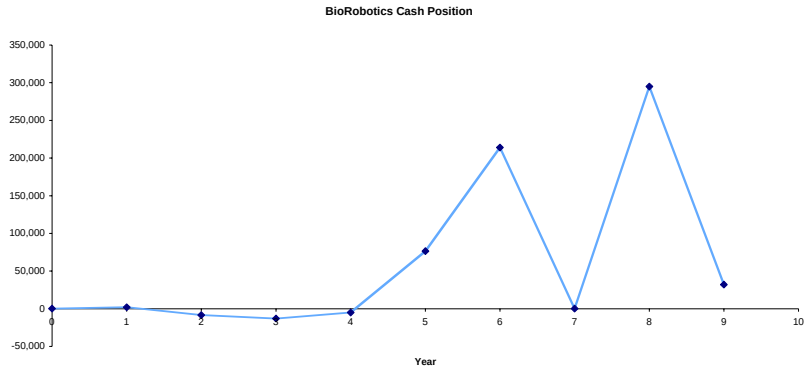
Pricing had been determined by the Pathology Department's funds of £28,000. Components cost around £7000, on top of which were salary costs throughout development and production. When sales were at a low point, they considered dropping the price to £25k. They thought better of this after going through a learning experience while dealing with a leading US customer, Amgen. They had a visit from an Amgen team to whom they demonstrated the product. The Amgen consultant engineer asked such penetrating questions that they assumed their product would be judged unsuitable. Later Amgen phoned to say Biopick was the only product that worked among those they had tried. They required liability cover for the US but seemed unconcerned about price. Martin Davies hazarded £40k. "That's fine," said the Amgen manager. "Will that be that dollars or pounds?" This brought home to them that for a product of this kind, pioneering customers were not concerned about BioRobotics' margin but focused on their own cost savings. If the product was saving them money, these customers were relatively insensitive to price. Meanwhile a geneticist turned UK marketing agent had approached them and offered to sell on their behalf. He suggested splitting the difference if he could set the price above £40k. His first sale was at £57k, reflecting the cost saving to the customer and the price of comparable alternative products.

By this time, the team had built up knowledge about genetics. Martin Davies attended a high tech marketing course at the Innovation Centre and took over direct sales himself. He learned about the innovation diffusion process, based on the work of Everett Rogers, at the marketing college in the Innovation Centre. First versions of an innovative product are bought by pioneering customers who are usually relatively price-insensitive. What matters to them is that the new product meets unmet needs or allows them to do something novel. These technophile customers are in touch with opinion leaders and recommendations are largely by word of mouth. Sales to opinion leaders ensure that the merits of the product are communicated throughout their networks. Opinion leaders shape the buying decisions of their social group. Leading scientists and research labs were opinion leaders for BioRobotics. Professor Nabeel Affara of Cambridge University Pathology Department identified conferences they should attend. He later became a Director of BioRobotics. Martin Roberts realised that it was essential to set up personal relationships with buyers, who were invited to Open Days and events like the company's Fifth Birthday, which was well attended by members of the Cambridge biotechnology community. Customer service was a big selling point. When the first product was sent out to Amgen in California, the carousel was broken by air cargo. BioRobotics had one spare carousel, among very few spare parts. Martin Davies flew out to California with the spare carousel and installed it the following morning. Amgen had never had a machine fixed so promptly. The story contributed to BioRobotics' reputation for customer service and helped sell further products in California.

Because their product was so specialised, BioRobotics needed to establish a global market as soon as possible. An agent was found in Japan, with an arrangement whereby the distributor received a set sum per machine sold. This provided the motivation to the agent to sell as many items as possible. It became clear after attendance at major conference in Heidelberg that genetics conferences provided their major marketing opportunity. BioRobotics were able to demonstrate their equipment in action at

the equipment stands of the conference, increasing awareness of BioRobotics among scientists in the genetics field.

Many of BioRobotics' potential customers were also severely resource constrained. To ensure that their customers had access to funds, laboratories capable of receiving funding had to be persuaded to apply for a grant for a Biopick. For example, a laboratory in New Zealand was targeted in early 1995 and obtained funding to purchase a Biopick. The Biopick had a finite market in human genetics and it was important to develop other markets and products. There were opportunities for BioRobotics to widen its market into animal and plant genetics. A broader product range was essential to smooth out the uneven cash flow that resulted from intermittent sales of a high value product. Parts cost £7000, and were bought in batches of five. Since revenues came in irregularly, the potential for a cash crisis was considerable. There were difficulties in paying salaries before revenues came in from the subsequent sale.



When a French Ministry was late paying for the purchase of a Biopick in September 1994, for the CEPH laboratory in Paris, the impact on cash flow was serious.

The Development of New Products

The Biopick's function was to automate the first of a number of relatively standard tasks required to create a genetic library. By now the team had learned a good deal about genetics research and its requirements. The design of new products was based on what they now knew about other processes involved in building genetic databases and which were suitable for automating. One process involves gridding. Like picking, this is a repetitive procedure which consists in placing cultures on a mesh at as high a density as possible. A gridder for automating this process would be highly marketable. A former student, Stuart Elmes, was taken on to produce a design.

The development of the Biogrid was entirely self financed from retained earnings, allowing the company to continue its policy of financial self sufficiency. There were competitors producing a gridding product. A lesson learnt from the Biopick was that its small size was a useful selling point. The Biogrid was therefore designed to sit on a bench and to take up a minimum of space. This became its key selling point as its competitors were floor standing and so much less practical for use in overcrowded labs. The first machine was sold in the Autumn of 1995.

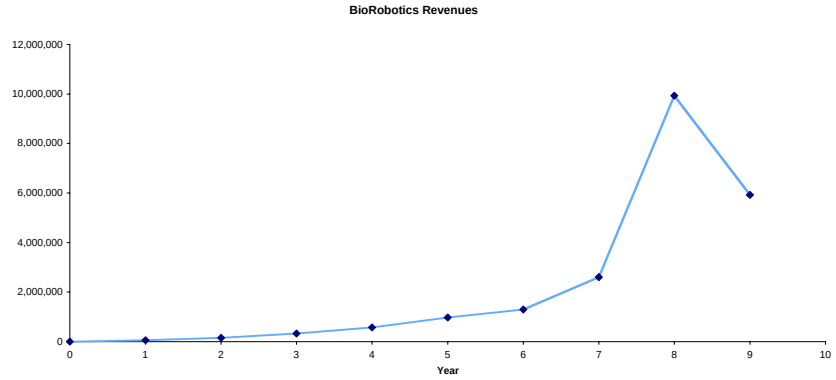
Stuart Elmes, the former student, was to have spent six months at BioRobotics before taking up a job he had been offered at Shell. However at the end of six months he opted to stay with BioRobotics. Final year students have also conducted marketing surveys for the company. Project students and students on vacation work have provided a stream of labour, with mutual benefits for the department, the students and BioRobotics.

A further product developed was the Biofill, a stand-alone filling machine. This had low development costs as the filling mechanism was identical to that on the Biopick. The idea for this machine came from customers . It is difficult to fill 384-hole titre plates by any other method. The design work on the first machine was carried out by Jo Appleton, a student on her year out between school and university. The first filler was sold in December 1995. Students from the Cambridge University Engineering Department carried out a redesign of the filler mechanisms with the aim of improving the sales of the Biofill.

The number of people taken on increased over these years, though because much of the work was sub-contracted to local firms, they only reached thirty employees in 2000. All the same, they were engaged in intensive recruitment efforts because of shortage of skilled people in the area.

The company founded in 1993 broke even in 1995, ending the financial year with a small profit. There was an influx of orders in 1998, when they launched their Microarray Grid, the first commercially available robot of its kind. Turnover had been doubling with each year of trading (Figure two).

Figure 1: Revenues BioRobotics 1993 - 2002



By 1999 it seemed that cash flow was no longer a problem. The company was for the time being cash rich and had the funds to reinvest in R&D. Over the next few years, the company grew on all measures, winning a "Rapid Growth Company" award in 2000. But though cumulative profit was looking good, operating profits were at risk should sales revenues. This was among the reasons why a trade sale was attractive.

The entrepreneurial team had shifted from being reactive, "engaged essentially in fire fighting", according to Martin Davies, to pursuing a proactive strategy. They had started without a business plan, but had subsequently developed one for operational and management purposes, rather than to reassure any external funders. They were aiming either for an Initial Public Offering or a trade sale, once the company was worth around £25 million. In 2000 the market for high tech IPOs collapsed. They sold the company to a US high tech company, Apogent, in March 2001. Apogent's press release made clear the extent to which BioRobotics was expected to create value, for customers and for a new parent company.

This was not to be, however. Performance plummeted during and after the change of ownership, and Apogent divested within three years.

5. Conclusion and Discussion

The case studies show how business development of spin-outs can only be partly understood through a focus on their incubator organizations; their products and markets are of much greater impact on their development. Through the case studies we found a shared set of influences on business model evolution, relationship with customers and exit pressures on the spin out companies. These were all shaped by knowledge networks and brokers of various kinds as the spinouts moved out of the orbit of their originators to create a network of new relationships on which their performance depended.

Although university or corporate origin exerts path dependent influence on the early development of these firms, the problems they face in scaling up are relatively unrelated to their origins. Critical problems arose from the shift in target market from technophile and early adopters to more mainstream customers as they moved from customized to standardized products, characterized by very different purchasing decisions of customers. The cases of Diomed and BioRobotics in the UK market demonstrated this. Likewise the contrasting exit routes of founders and investors, in the case of Biorobotics a trade sale and IPO for Diomed related to factors independent of the originating organization. We conclude that the business development of spin-outs can only be partly understood through a focus on their incubator organizations; their products and markets are of much greater impact on their development.

The incubator organization undoubtedly exerts an influence. However, this influence is indirect, in shaping the networks that the founders have built up or have access to via the incubator organization. Over time the spin-out co-evolves with an expanding network of relationships. The initial disadvantage of university spin-outs (due to less industry experience and networks) in comparison to corporate spin-outs became less of a constraint over time. This shows that the direct influence of the incubator organization is relatively small, but that the networks that are developed from, and extended beyond those formed in the incubator organization are key enabling factors in the growth of these spin-outs. Networks and marketing capabilities are an essential part of any business, but this is especially the case when HTNVs are constrained by resources.

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THE RISING NEW GENERATION OF HIGH-TECH ENTREPRENEURS: AN EXPLORATORY STUDY

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Abstract

Who are the high-technology entrepreneurs: superheroes or jack-of-all-trades? Is there a new generation of young entrepreneurs who "think different" and use new and unexpected perspectives to imagine their business, products and mission? This paper presents some empirical evidences emerging from a multiple case study composed by 20 Italian technology intensive firms. After a review of the high-technology entrepreneur topic, some typologies of the Italian high-tech entrepreneurs are analyzed and finally an elementary classification is proposed in order to clarify the difference between "old" and "new way" entrepreneurship. New trends, behaviours, strategies and business models are explored in order to contribute to the academic debate and the practical knowledge about high-technology entrepreneurship. The last section of the paper suggests a future research agenda.

keywords: high-tech entrepreneur, technology intensive entrepreneurship, case study, jack-of-all-trades, classification

1. Introduction

If a hippie was asked what the hippie culture is, he would answer "a way of life". If a high-tech entrepreneur was asked to define what a high-tech business is, he would answer "a way of entrepreneurship". In fact, in small firms, he is not only an innovator (Schumpeter 1934), a pioneer of technology and science fields, a founder, a capitalist, but he is also a careful organizer and a smart manager. Many roles and functions in a single agent: this is really a particular way of being entrepreneur (Oakey 2003, Westhead et al. 2005). Innovative technologies, new business models, ambitious challenges shaped by the knowledge economy and finally the tremendous international competition generate in our countries the need of new people ready to manage successful ideas and founding new business ventures. A novel effort is required to the academic communities and to practitioners in order to describe, highlight and encourage the new generation of high-tech small entrepreneurs who are the real engine of the most successful and innovative businesses in Europe. They are called "new generation" not because of their age status: they are "new" because of their innovative way of thinking. Borrowing the famous payoff used and worldwide diffused by Apple, we could say that the rising new generation of high-tech entrepreneurs is composed by agents of change who are able to think different and use another perspective to imagine their business, their product, their missions. "*The ones who see things differently. […]they change things. They invent. They imagine. They heal. They explore. They create. They inspire.*" (see note 1)

The figure and the role of the high-tech entrepreneurs have always attracted not only journalists, media experts and story writers, but even many academics and scholars. Is there a thin red line which links James Watt and Bill Gates? Guglielmo Marconi and Sergej Brin? Benjamin Franklin, and Robert Swanson? All of them have been real pioneers: they had a great idea, they started in a small firm context and at the end they have been real agents of change , thus innovators. It is not the aim of this paper to describe their lives and enterprises because they are already popular and well studied. The aims of this work are the following. Focusing our attention on HTSF entrepreneurs, exploring new trends, behaviours, strategies and business models adopted;

presenting some empirical evidence on high-tech entrepreneurship in the Italian context; and contributing to the academic debate on depicting the profile of the new generation of high-tech entrepreneurs.

Studying success stories in new industries , in start-up firms during technological innovation waves and in areas of new product innovations in markets still to come, are one of the main challenge of the academic community that focus on high-tech businesses. The internet, biotech and nanotechnologies and many other new industries are per se interesting for the analysis of how new firms emerge and compete (Cassia et al. 2006) Technological entrepreneurship plays a central role in regional transformation (Venkataraman 2004) and high tech small firms are one of the main asset of the globalized economy and the knowledge society. They are not only an important source of profit and employment, but the real locus of innovation. In fact some of them create new technology and contribute to the progress of science, while all of them include scientific applications and technologies in products or processes. New organizational structures, innovative market strategies, pioneer entrepreneurs, are just some of the most evident characteristics of the new technology-based business models which are the real engine of economic change. As Porter (1998) suggested: high-tech businesses "*are vital to the upgrading of the competitive advantage, […] because they feed the process of innovation*." Adopting a life cycle model of the firm, small and medium firms are indeed very interesting for scholars and academics, because great players and future champions usually start their evolution as young, small, smart and simple enterprises.

There is growing attention by policymakers on supporting the birth and the development of high-tech industrial clusters and single enterprises (Foo and Foo 2000). Recognizing the rising role of high-tech entrepreneurship, many governments proposed different policies for supporting research, and fostering development, innovation and collaboration between universities, public research agencies and small firms, trying to replicate the history of areas like Silicon Valley,

Cambridgeshire and Boston Route 128. In Italy, which is the scenario considered in this paper, there are many agencies and public centres, financed directly by central or local governments, that support single innovation projects and the collaboration between universities and firms. During last months, the Government started an impressive and ambitious program called "Industria 2015" as main instrument of high-tech industrial policy and implementation of the triple helix model (Leydersdorff and Etkowitz 1998, Etkowitz and Klofsten 2005). The program is articulated in organic projects which are designed to encourage the development of a specific type of products and services with a highly innovative content in strategic areas for the development of the country, based on the technological and production targets identified by the Government: energy efficiency, sustainable mobility, life sciences and biotech ,new technologies for typical "made in Italy" products, innovative technologies for culture, arts and tourism. An opportunity for all the high-tech entrepreneurs who need support for putting their ideas in concrete form and creating new products, markets or technologies.

This paper presents particular evidences from some small and medium Italian high-tech firms, focusing on the role and the traits of the entrepreneur, which is, thus, our unit of analysis. Entrepreneurship is a complex phenomenon. Since the seminal works by Baumol (1968), Low and McMillan (1988), Bull and Winter (1993), Shane and Venkataraman (2000), Gartner (2001), Zahara and Dess (2001) the boundaries of this research field are still in the middle of an exciting debate involving academics, scholars and practitioners. It's a field where different disciplines, paradigms, perspectives converge: high-tech entrepreneurship can be considered as a particular subset of the main entrepreneurship topic. Reading both rationalistic and constructivist contributions, we can conclude that entrepreneurship is not a pure phenomenon who can be studied exactly (like supply chain or accounting or new product development), but it's a research field who need to take in account personal skills, psychological motivations, environments conditions. Especially in HT industries, where new markets or niches are created, where ideas become real products, and where the future of our economies and societies is shaped, entrepreneurship is a hybrid phenomenon. Taxonomies (Pavitt 1984, Koberg 1996) and classifications of industries, business models, firms and entrepreneurs, tend to summarize and fix characteristics and properties, in the same time they risk to limit and reduce the richness and newness of the entrepreneurial phenomenon. Thus, following the suggestion of Gummeson (2006) , quantitative studies need to be enriched by continuous qualitative and exploratory studies in order to shape an interactive approach which can be useful for both comprehension and prediction. "Research includes a combination of perceptions of reality based on real world data, attitudes, received theory, and persona, whether these are expressed as numbers, equations, letters or words." (Gummeson 2006).

The rest part of the paper is divided into six sections. The following one is dedicated to an extensive literature review focusing on some theories and results regarding the skills and the traits of high-tech entrepreneurs. The third section presents a theoretical framework used for single and cross case analysis. The framework is enriched by the specification of the Italian context and the presentation of four entrepreneurial typologies. Section four is dedicated to the description of the adopted methodologies, the research protocol and the single case studies. Empirical evidences are shown in the fifth section of this paper, while conclusions and future research agenda are in the last one.

2. The high-tech entrepreneur: superhero or jack-of-all-trades?

Studying high-tech entrepreneurship means finding why and how technologically innovative small and medium firms grow, compete, collaborate and adapt to change in their environments. High-tech entrepreneurs are knowledge creators, agents of change, both pragmatic and visionaries: they usually present long range planning ability and a high degree of flexibility, because they are problem solvers who need to cope with an ever changing environment (Dosi and Malerba 1996). Innate talent or balanced acquired skills? The debate is still on. They have been studied through different theories, research paradigms, methodologies and models. In this literature review we

present the following contributions: the "traits" perspective, the "single industry" perspective, the frequency perspective, the hagiographic approach, the constructivist approach, the Lazear's theory and the Oakey's model. Why it is so difficult to study entrepreneurs? Because they are complex units (constructivists maybe would use the words human being) acting on a complex system. The need of high technology management adds complexity to the entrepreneurial research field. Complexity , turbulence, uncertainty (McGee and Sawyer 2003) are some of the main environment conditions who make difficult studying the HT entrepreneurship. Especially in Italy, where some dominant influencing factors are: the role of family, the influence of occupation experience and career, the availability of information and knowledge networks and finally the gender, age, social class, education, marital status and the ethnicity of the entrepreneur (Di Minin et al. 2003).

Since the famous citation by Say, Cantillon and the physiocratic school, the entrepreneur has been recognized as a key actor in the economies and societies. While Kirzner (1973) recognizes her/his ability to spot opportunities by creative alertness, the main role assigned by Schumpeter to the entrepreneur is being agent of change, thus innovator. The Schumpeterian entrepreneur changes the technological possibilities, alters convention through innovative activity and , hence move production constraints (Deakins and Freel 2006). Many other contributions focus their attention on some traditional entrepreneurship topics: the responsibility ,the willingness to calculate and accept risks: the imagination and the creation, the pro-activity (McClelland 1961). Deakins and Freel collected many suggestions about the characteristics of technology intensive entrepreneurs, both from empirical research and different theories : need of achievement , calculated risk taking, high internal locus of control, creativity, innovation, need for autonomy, tolerance of ambiguity, vision, self efficacy. As far the author knows, no contribution states that those elements have been falsified in the subset composed by the high-technology entrepreneurs.

Human wisdom tends to categorize. Phenomenon are classified, taxonomies are created. This conceptual routine is useful for learning and for a rational comprehension of the economic and social behaviours. Following this assumption scholars and academics tried to describe and predict the characteristics, traits and skills of the successful entrepreneur. Many "traits" theory, born after the seminal work by McClelland (1961) tried to describe and fix the core traits of entrepreneurs. During last years these proposals have been criticized by other theories which assert the uniqueness of every enterprise/entrepreneur and highlight the importance of environmental factors despite fixed and predictable personal skills. According to this perspective MCPhee (2000) says that "Each business start-up takes place against a backdrop of uniquely intertwined events and the personality of each individual entrepreneur si unique", while Delmar (2000): "the research results have been poor and it has been difficult to discover any specific traits of entrepreneurial behaviour. And finally Glancey and McQuaid (2000) "Research has failed to identify any traits which are associated specifically with entrepreneurs". If from one hand we agree with the impossibility to set definitely the traits of the successful entrepreneur, using a nomotethic approach, to the other hand, we should admit the importance that research activity contributes to design robust and shared models. Traits and models are useful to summarize, predict and explain the behaviour, the choices, the reasons and the ways entrepreneurs act, even if they focus only on some aspects of the entrepreneur 's ontology.

Technology intensive firms are often considered as a single set, because they present common problems and behaviours (risk of technological obsolescence, financing, continuous need of research and innovation, marketing strategies, knowledge and intellectual property rights management). Sometimes problems which are tipical of a particular industry, does not affect another. For example the time needed to develop a new drug is not comparable with the time to design and develop a new electronic device. So many academics studied technology intensive entrepreneurship in single industries. For example cyber-entrepreneurship (Carrier et al 2004), nanotech-entrepreneurship, or biotech founders or managers (Mueller et al. 2004), internet based business owners (Colombo and Delmastro 2004), green-tech entrepreneurs. This (industry-based) distinction can help on focusing on the different problems of each industry.

Another traditional classification of entrepreneurs which is business-based, considers the frequency in the process of business creation of start-ups. Focusing on what kind and how often start-ups are founded by the entrepreneur, it is possible to divide the subset of the high-tech entrepreneurs in: novice, serial, and portfolio entrepreneurs. (Westhead and Whright 1998, Westhead et al. 2005). Novice entrepreneurs are individual with no prior business ownership experience as a business founder (or inheritor or purchaser) of an independent business, but who currently own an independent business that is either new (purchased or inherited). Serial entrepreneurs are individuals who have sold or closed a business in which they had minority or majority ownership stake, and they currently have an ownership stake in a new single independent business. Portfolio entrepreneurs are individual who have ownership stakes in two or more independent businesses.

Another research flow on the technology intensive entrepreneurship adopts a quasi hagiographic approach, describing single entrepreneurs as myths or geniuses. The role, the importance and the behaviour of such individuals have been often celebrated by non academic literature, media and popular wisdom. Some name, for example Bill Gates, Steve Jobs, Herbert Boyer and Robert Swanson, became worldwide known and models for young generations of entrepreneurs. It is very important to know their stories in order to encourage young people.

This approach, is called by the constructivism the "Schumpeterian legacy". "In mainstream entrepreneurship research, it is customary to understand entrepreneurship as something extraordinary, and entrepreneurs as superheroes" (Karp 2006). While the rationalistic theory study the personality factors, the background, the choices and the behaviour, the skills of the successful entrepreneur, constructivism exploits different epistemologies and methodologies for exploring "the interior condition of the individual entrepreneur, and the perceived inner realities from which his or her entrepreneurial actions originate" (Karp 2006). Following the suggestions by Gartner (2001) these two completely different paradigms, rationalism and constructivism (Guba 1990), applied in the entrepreneurship field seems to be complementary. Even if this paper doesn't adopt the constructivist paradigm, we recognize that entrepreneurship and therefore high-tech entrepreneurship are not the fields of icy rationality. Therefore researchers should take in account that sometimes "entrepreneurs act subjectively in accordance with their own perception of reality, they act on the basis of feelings, intuition, and cognition, they engage in construction of a future they believe in and they develop and create according to their convictions and dreams (Karp 2006)

There is another perspective and theory which is gaining attention from the academic world and the communities of practice. It has been proposed by Lazear (2004,2005) and confirmed in different contexts and situations by some interesting studies (Wagner 2003, 2006, Silva 2007). Studying the career evolutions of Stanford alumni, Lazear asserts that entrepreneurs must be jacks of all trades who need not excel in any one skill but are competent in many. He asserts that individuals with balanced skills are more likely than others to become entrepreneurs. "Those who have varied work and educational backgrounds are much more likely to start their own businesses that those who have focused on one role at work or concentrated in one subject at school." (Lazear 2005) He describes the Entrepreneurs like polymaths, who put people together in particular ways and combine them with physical capital and ideas to create a new product or to produce an existing one at a lower or competitive cost. "An entrepreneur must posses the ability to combine talents and manage those of others." (Lazear 2005)

His idea is that entrepreneurs differ from specialists: the first have a comparative disadvantage in a single skill but have more balanced talents that span a number of different skills. On the contrary specialists can work for others who have the talent to spot and combine a variety of skills. Although entrepreneurs can hire others, the entrepreneur must be sufficiently well versed in a variety of fields to judge the quality of applicants. Does this theory fits with the high-tech entrepreneurship context? An answer will be proposed in section five.

The last model of this review is the contribution by Oakey (2003), which is one of the most balanced and grounded model of high-tech entrepreneurship. In Oakey's model technical management skills (ability to create and develop the product, ability to lead R&D teams, technical

knowledge), business management skills (accounting, marketing, human resources, strategy, fundraising) and motivation are the three main balanced elements of the ht entrepreneur. As we will see in section five, the Oakey's perspective fits better than Lazear's theory with the selected case studies presented by the paper. In fact, although technical ability has often provided the scientific knowledge necessary for an individual to become a successful technical entrepreneur, it is important the balanced presence of "the ability to develop business management skills with which to exploit such expertise" (Oakey 2003).

3. The theoretical perspective and the research context

Before presenting the case studies and the empirical evidences, the adopted theoretical perspective that we used to analyze the selected businesses and enterprises is now introduced. In the second part of this section, the research context will be described

From both theoretical and empirical studies we developed an analytic and comparative framework for high technology firms in order to describe them, their competitive advantage, the business models and the future evolution of a single firm, an entire industry or some firms located in the same area. This framework is born from a deep literature review which identified the main topics studied by scholars and practitioners and evaluated the four key elements of every high tech small business: (a) entrepreneur, (b) technology and knowledge, (d) ecosystem, (d) network and partnerships. The four parts of the framework can be considered as the axes of four dimensional Cartesian coordinates: they let the manager as well the academic researcher or the consultant to focus his/her attention on the fundamental drivers and assets of a high technology small firm.

(a) The high-tech entrepreneur: as stated above, his role is crucial over the entire life of a high-tech business. Some scholars call him/her the corner stone of an entrepreneurial experience (Adreutsch 2002, Shane and Venkataraman 2000). See the previous section for a deep discussion of this topic.
(b) Technology and knowledge. The word "family business", which is often used as a synonymous of small and medium business tends to be substituted in the high-tech Italian context by a different phenomenon that is "brain business". Family is not anymore a central resource for the firm, but knowledge (tacit and explicit) and ideas are the intangible assets necessary for competition and success (Nonaka and Takeuchi 1995). With the general expression of "technology and knowledge" we identify the set of scientific competences, the capabilities to use and exploit them, the ability to transform an idea into a product and to innovate. In our framework we assume that the topics connected with IP rights and their management are part of this section.
(c) The ecosystem is the habitat where HTSF are born and grow. The geographical, social and economic context are important elements because in many cases they offer potential help to the firms. Ideas from universities and public research poles, the presence of skilled labour force, the offer of modern financing opportunities (like business angels, venture capital, guarantee banks) that can support new or promising entrepreneurial ideas (Benneworth 2006, Chorev 2006)
(d) If the ecosystem can be considered as a static element of the framework (in fact it is generally equal for every firm located in the same geographical area), the relationships and the networks built by the firm with the different actors of the economic systems are a dynamic element. Robust and efficient relationships between the firms and clients, suppliers, competitors, institutions, investors, banks and universities are one of the main way to achieve success (Neill et al. 2001, Yli-Renko et al. 2001, Cave 2006).

Every case study has been written and analyzed using this reference framework.

The second part of this section is dedicated to the presentation of the research context, in particular some quantitative and qualitative information about high-tech industries in Italy. In this country

propensity towards entrepreneurship is especially high. For example in the north area of the country the self employment percentage is more than one self employed over 10 inhabitants. Italy exhibits a poor performance in high-tech industries with the ratio of research expenditures to GDP being close to 1% that is less than half the value in UE. (Colombo and Delmastro 2004, European Innovation Scoreboard 2007). From a financial point of view the entrepreneurs of Italian new technology based firms use their personal saving to finance their activities and support innovation (Giudici and Paleari 2000) and venture capital funds are not as popular as in other countries of Europe. The economic situation of the country has been well resumed by Di Minin et al (2003): "Italy, despite its traditional inclusion among the most important players in the world economy is a country which lags behind in R&D investments mainly because of its large number of very small firms and an overall lack of large R&D-based companies. Also, while the public research system has good scientific performance in terms of number and quality of publications, it does not generate a much needed intense technological transfer processes."

In this country, during last years techno-entrepreneurship is grown. Firms based on all those technologies which are changing the world - nanotech, biotech, ICT, green tech - are clustered in some areas of the country. Many corporations, for example in pharmaceutical or chemical industries, have been substituted by small firms who do not control the whole value chain but concentrate their efforts and knowledge over some reduced rings of the chain. New technologies have been imported and created new ways of entrepreneurship. Not only they need more qualified labour force, brains but even new business models. These rising role of high-tech enterprise is supported by the annual report by ENEA (see note 2) (Ferrari et al. 2007). In Italy the 7% of the whole industrial manufacturing population is composed by high-tech firms. More that 90% of the R&D activities are performed within them. The percentage of the Italian high-tech exportations over the global amount of high-tech exportations is 1,96%, while 2,7% is the percentage of high-tech importations over the global amount of high-tech importations.

Based on the ENEA report, on the recent work by Di Minin et al (2005) and on a daily analysis (performed by the author's research group) over media who present articles and interviews about high technology entrepreneurship , we can conclude that in Italy there are four main typologies of high-technology entrepreneurs. They are:

1) the emergent young entrepreneur: young people with smart ideas, sometimes highly educated, (phD or master degree) who are able to build, in a few years, rapid growing businesses. They are particular diffused in the ICT world (Colombo and Delmastro 2004)
2) former manager or scientist who create a spin-off. This typology is quite popular within the biotech and pharmaceutical world. Biotech in Italy is an industry which is growing, as stated by the Assobiotec – Blossom official report. If at the beginning of the century there were only few biotech enterprises, they are now more than 225, offering14.000 qualified jobs and an aggregate revenue of 4 millions of euros.
3) the academic entrepreneur. After too many years dedicated to education and pure research the Italian universities are slowly discovering their third mission: supporting the firms and the economic system in order to increase competitivity. A proxy of this shift is the number of universities and projects presented to the National Business Plan Competition (called Premio Nazionale Innovazione). In the year 2003, only 5 universities and local business plan competition presented projects, while in the last edition (2007), 32 Italian universities presented projects, thanks to the network and the support of 14 preliminary local business plan competitions. While Academic entrepreneurship as studied by Gibbons et al. (1994) is becoming more and more popular and universities are considered part of entrepreneurial system (Spilling 1996) the model of an entrepreneurial university (Clark 1998) and the idea of research groups as quasi-firms (Etkowitz 2003) are unfortunately still far from the Italian context.

4) "family entrepreneur": we use this term to identify individuals who inherit or buy a business. They are often the son of self employed artisan or small entrepreneur, active in a traditional industry. This new generation of entrepreneurs are the main responsible of the evolution of the previous firm from traditional products to innovations rich of technology upgrading and improvements.

A simple matrix (Fig. 1) can be drawn in order to present synthetically the situation of the Italian industrial system. This matrix is useful and intuitive in order to understand what the author calls the new generation of high-tech entrepreneurs. On the left we can consider the traditional division between mature and high-tech industries. Defining them is not in the scope of this paper, while a huge debate is still on, proposing different definitions and classifications of high-tech. Deakins (1996) for example stated that any approach to define high-technology or new technology small firms is fraught with difficulty According to the OECD classification, In this paper we consider "high-tech" the following industries: ICT, biotech, nanotechnologies, advanced machinery, automation, robotics, advanced chemicals, green-tech (energy and environment), microelectronics, biomedical and pharmaceutical. Close to the previous definition, we consider that a single business is qualified as high-tech if it involves new and sophisticated technologies as far as the products or the processes concern. The two columns of the proposed matrix refers on a generic old way of being entrepreneur and a new way of being entrepreneurs. The distinction between these two ways is one of the aim of this paper, and will be clarified by the obtained empirical evidences. The matrix, in fact, follows the assumption presented at the beginning of the paper, regarding the presence of entrepreneurs who are able to "think different" and creating something new compared to the past. The matrix is coherent with the work by Bruyat and Julien (2001) who divide general entrepreneurship into 4 main subfields: reproduction (of products, processes, strategies and business models), imitation, development and adventure. The matrix will be enriched in the "empirical evidence" section of the paper and a difference between old and new way will emerge.

	"old way" entrepreneurs	**"new way" entrepreneurs**
traditional and mature industries	*reproduction*	*development*
high-tech industries	*imitation/emulation*	*adventure*

Fig. 1, adapted from Bruyat and Julien (2001)

4. Methodology and Presentation of case studies

According to Yin (2002) and Flyvberg (2006), the exploratory nature of this study suggests the use of a qualitative methodological approach, and in particular the multiple case studies research tool. This choice seems to fit with the questions underlying the paper and let the authors to describe the new generation of Italian high-tech entrepreneurs. In fact the inductive research helps the possible emersion of new situations and behaviours of the economic and social actors, while case studies let the researcher to highlight differences and similarities within the samples considered. Finally the choice of case studies is supported by the explicit suggestion of Eisenhardt (1989) inviting the academics to use this tool for providing freshness in perspective to an already researched topics (in this case high-technology entrepreneurship) and in the early stage of research on a topic (in this case the new way of entrepreneurship). Multiple case studies research is furthermore a useful tool to understand the complex nature of entrepreneurship, as recommended by Gartner and Birley (2002). Many quantitative studies are actually available to describe the traits, background and skills of the

entrepreneurs, but this one is looking for new emergent phenomena we could difficulty managed by quantitative tools. The main limit of this approach is the possibility to present general determinants of phenomena through a limited number of cases. This limit can be widely accepted because the goal of the paper is stimulating new path and research ideas, not building a general theory about high tech entrepreneurship.

As recommended by Miles and Hauberman (1994) the first step of sampling is setting boundaries that define the population. It is clear that our population is composed by the Italian high technology small firms. The definition of high-tech enterprise is given in the section above while the definition of SME is based on the EU criterion. The category of micro, small and medium-sized enterprises is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million €, and/or an annual balance sheet total not exceeding 43 million euros.

This study is composed by 20 case studies. They have been selected by a wider population that comes from the overlapping of two sets of firms. The first is composed by a database of 200 high-tech firms located in the Vicenza area, in the North-Est of Italy. The high-tech small firms of the Veneto region, are a potential interesting empirical context for our research . They are approximately more than 900. The area is heavily industrialized: small and medium enterprises are more than 98% of the entire firm population. Like many other non high-tech regions of Europe, the Veneto region is shifting from the traditional fordist paradigms towards knowledge-intensive economy.

The second set consists of another database, composed by more than 100 high tech enterprises who have gained during last years visibility on national media. The overlapping let the researcher to take in account the contribution of emerging and well known business from all over the country as well as other unknown entrepreneurial experiences co-located in the same geographical area. The 20 cases have been strategically selected within the considered population, according to Flyvberg (2006) on basis of size, industry, products, innovative activities, geographical equilibrium and personal knowledge of the entrepreneur.

A robust research protocol has been built in order to guarantee the reliability of the collected data. The cases are based of semi-structured interviews with the entrepreneurs. Starting form the his personal story and career, the interview covered the following topics: story of the firm or previous business owned/managed by the entrepreneur, the products, the market, innovation activities, networks, industrial and economic ecosystem (see section 3) and technology and knowledge management The analysis of the annual reports, the website and other information available on the Internet have been performed before and after the meeting with the entrepreneur. A single case study has been written for every enterprise by the researcher, in order to summarize and fix the interviews and the entrepreneur and the author's personal opinions and considerations. A feedback mechanism has been exploited: every single case has been red , rectified or amended by the entrepreneur. The following figure presents the firms involved in the research and some information about them.

Ref.	industry	products	employees	turnover (mln €)	Year of establishment
A	chemicals	Monomers and polymers	25	45	1984
B	biotech	Bioactive molecules from plant cell cultures, biomedical application of silicon	31	0.4	1999
C	robotics	Robot humanoids	/	0.025	2005
D	Advanced machinery	Machinery and equipments for steel manufacturing	100	20	1977

E	services	Diagnostics and analysis for arts	21	0.8	1997
F	acoustics	Loudpseakers	18	10	1983
G	ICT	Networks and IP services	40	2	2003
H	Green-tech	Eolic turbine generators	/	0.087	2002
I	Advanced machinery	Machinery and equipments for leather manufacturing	98	17	1972
L	Medical devices	Innovative lancet	18	3	1988
M	Advanced machinery	Machinery and equipments for leather	20	10	1911
N	Internet	Web farm, e-commerce, web services	25	1.5	2000
O	Security	Video surveillance and security equipments	110	18	1986
P	ICT	Access gateways, IP video station	150	75	1993
Q	Medical devices	Diagnostic devices	50	11	1998
R	Biotech	Drugs discovery and molecular validation	43	9.8	2001
S	Services for new enterprises	Support for new venture foundation and their development	23	0.2	2007
T	Biotech	Drugs discovery and molecular validation	50	2.5	2002
U	electronics	Engines and automations	36	3	1978
V	Automation	Centrifugal machines	20	5	1983

Fig. 2 case studies presentation

5. Empirical Evidence

The first empirical evidence is that all the considered entrepreneurs present a skill that Venkataraman (2004) calls talent. In his view, totally confirmed by the case studies, talent is able to generate an idea, develop it, start a company, make a prototype, obtain the first customer, develop products and innovations and compete in the rough and tumble world of competitive markets. Of course this is a skill which "old way" and "new way" entrepreneurs both show.

The performed single and cross case analysis confirms the presence of the 4 typologies presented in the theoretical perspective. The young emergent entrepreneur runs firms E, F, L, N, P. The former manager or scientist is present in cases H, M, Q, R, T. An entrepreneur with academic background runs firms C, E, S. And finally enterprises A, D, I, O ,U, V are owned and managed by a "family entrepreneur". The confirmation of the four typologies is not the only result obtained by the cross-case analysis. There are, in fact, other interesting findings and evidences.

First of all we find in our samples a particular form of academic entrepreneurship: the shift from the traditional student or full time professor who dedicates completely to business, to a new form of part time professor-entrepreneur. Traditionally the idea of academic entrepreneurship includes undergraduate students and professors who suspend or close their experience in university by founding a new venture. In fact some of them, after the first revenues and profits find

entrepreneurship and running their firms or working on the business projects, more interesting and profitable than studying or doing research. Even professors or researchers in universities or public centres often decide to dedicate their whole time to business. The situation seems quite different in the considered subset, where academics involved in start-up activities continue to work in the university thanks to part time contracts or different forms of collaborations and in the same time they try to run their enterprise. Thus they do not abandon their chairs and research activities within the university and thus they become hybrid entrepreneurs, half professor and half business owner. Despite some problems of time management cited by the interviews entrepreneurs, this hybrid situation seems to be particularly useful , because it guarantees a real osmosis between the enterprise and the research labs.

Secondly, during our analysis (cases B, C, F, H, N, P, Q, T) we found that close to the Schumpeterian idea of the entrepreneur as innovator, in the Italian high-tech small firms there is an emerging phenomenon. A key role should be assigned to informal teams of co-innovators who support directly the entrepreneur in order to manage technology and general marketing problems caused by innovation projects. We call them "internal angels": people who do not necessary have the idea , but help the entrepreneur to transform it into a product. They are not only engineers or specialists, but even managers or marketing people who are close to the owner and are essential for the successful introduction of innovations.

The third interesting element that emerges is the "open way of thinking" of the some interviewed entrepreneurs. They build an open and networked enterprise. In some the case studies is not rare finding research labs open to third parts or clients, or other firms. For example case U is the only firm who posses in a wide geographical area, an anechoic chamber which is actually open and available to other firms for test activities and R&D. Another firm, labelled as I , opens its test room, with equipment and machinery, with the same purpose. This open mentality is confirmed even by the intellectual property right management: entrepreneurs of the "new way" are really conscious of the opportunities in terms of potential innovation and profit coming from an open approach to this area (Chesbrough 2004)

After the analysis of the traits of the interviewed entrepreneurs and the financial data and annual reports, we can assert that the industrial subset considered by this study shows a marked inclination towards the so called "giving back" behaviours. In fact, despite the idea and the imagine of the high-tech entrepreneur as a rational and pragmatic technologist, many of the entrepreneurs are visionaries and conscious of their social mission . Part of the firms shows an evident attitude towards corporate social responsibility (cases A, B, D, F, I, N, P)

The last empirical evidence is strictly linked with the already cited Oakey model (2003)and the jack-of-all-trades Lazear 's theory (2005). All the considered cases confirm the model proposed by Oakey where technical management skills, business management skills and motivation are the three main balanced dimensions of technology intensive entrepreneurship. A reconciliation of the two theories could be find in the domain of high-tech entrepreneurship if we consider the entrepreneur as a master of integration, as the individual who knows enough from many learned trades and skills to be able to bring disciplines together. So the Lazear figure of speech could be shifted to "jack of all trades, master of technology", highlighting the central role and the relevance of mastering technology in high tech businesses.

Cross case analysis have been useful in order to enrich and complete with some key words the 2x2 matrix presented on Fig.1, especially in the lower part. The completion of the upper quadrants is not made through the performed case studies. As stated in section three, we focused our attention only on high-tech small and medium firms, while the two upper cells regard entrepreneurs and firms belonging to mature and traditional industries. The completion of the upper quadrants is thus based on literature contributions. We report them briefly because they are useful to understand differences between old and new way of being entrepreneurs.

	"old way" entrepreneurs	**"new way" entrepreneurs**
traditional and mature industries	*family business, traditional italian clusters* *competitive advantage: cost reduction and incremental innovation* *keyword:* ***reproduction***	*firms who won the challenge of innovating in declining and mature contexts, through effective internal and external R&D, radical innovation, cooperation with universities and public or private research centres, a mature and conscious management of intellectual property* *keyword:* ***development***
high-tech industries	*they don't trust intellectual property rights, they think local and not global, they don't adopt open innovation in order to broad the innovation opportunities. They are too much technology focused, and sometimes neglect financial aspects and marketing. They replicate business models and strategies valid for mature industries even in new industries* *keywords:* ***imitation/emulation***	*pioneers: entrepreneurs who create new products and processes in frontier fields and experiment new ways of managing businesses and running enterprises, global thinkers, promoter of networked enterprises. "Open entrepreneurs", the professor-entrepreneur hybrids, entrepreneurs socially involved and responsible and the jack of all trades, master of technology* *keyword:* ***adventure***

Fig. 3

In Italy the upper left quadrant is populated by small-medium enterprises, often clustered in industrial districts (Beccatini 1990, Porter 1998). In such firms entrepreneurship, leadership and management are based on family, personal networks and the ability of the owner in technology management. The competitive advantage strategically obtained by the entrepreneurs consist of cost reduction and incremental innovation. The upper-left entrepreneurs tends to replicate other similar entrepreneurial experiences, according to the suggestions by Bruyat and Julien (2001)

The upper right quadrant is the area of the emerging businesses in mature industries, well studied and described in a recent contribution by Cassia, Fattore and Paleari (2007). The quadrant is populated by entrepreneurs and firms who won the challenge of innovating in declining and mature contexts, through effective internal and external R&D, radical innovation, cooperation with universities and public or private research centres, a mature and conscious management of intellectual property. Renewed market reputation, technology upgrading, knowledge based organization, changes in cost structure can drive firms belonging to mature industries to success, growth and a long life. The introduction of such innovations and changes is often made by entrepreneurs who think and act in new ways. Following a kirznerian approach, and the suggestions of Shane and Venkataraman (2000) Cassia et al. (2007) describe this new way of entrepreneurship in mature industries focusing on the following three phenomena: the arising of sources of opportunities , both explicit (market niches) and tacit (undiscovered needs), the identification and evaluation and finally the deployment of resources aimed at the exploitation of new opportunities. "Emerging business are the results of entrepreneurial ideas that emerge where others are unable to capture the weak signals of change or do not yes perceive the presence of an underlying regular trend in what are otherwise seen as obvious anomalies". (Cassia et al. 2007)

As far as the bottom-left quadrant (new industries, old way entrepreneurship) is concerned, few firms of our set belong to it. In this quadrant we potentially find internet, biotech, nanotech, software, ICT, green-tech, energy, medical devices entrepreneurs who show an old way of thinking the business an the whole enterprise. For example they don't trust the help provided by intellectual property rights, they think local and not global, they don't adopt open innovation (Chesbrough 2004) in order to broad the innovation opportunities. They are too much technology focused, and sometimes neglect financial aspects and marketing. They replicate business models and strategies valid for mature industries even in new industries. This choice creates a mismatch: new products

and processes need new way of thinking, organizing and configuring the business.. This "old school" entrepreneurship can be however successful because of technology supremacy or because the exploitation of niches or new markets.
The fourth quadrant (lower right) is the most interesting, and its entrepreneurs have been described at the beginning of this section. In this quadrant we find the real pioneers, those entrepreneurs who create new products and processes in frontier fields and experiment new ways of managing businesses and running enterprises. Here we find visionaries and global thinkers, builders of star and networked enterprises. Focusing on the particular Italian context we find the "open entrepreneurs", the professors-entrepreneur hybrids, entrepreneurs socially involved and responsible and finally the jack of all trades, master of technology, as mentioned above.

6. **Conclusions and future research agenda**

This exploratory study presents some empirical evidences of a new generation of high-tech entrepreneurs. Their newness is not linked to their age but to their way of thinking and running their business. The standard typologies of the high-tech entrepreneurs have been confirmed by the case studies, and some new perspectives and phenomena have been presented The bottom-up approach limits the presentation of general determinants or aspects of phenomena because of the small number of the cases, but this is coherent with the aim of the paper, which is stimulating new path and research ideas, not building a general theory about high-tech entrepreneurship.
The performed exploratory study needs to be broaden and deepened. The evolution of the classic four typologies of the Italian high-tech entrepreneur need to be compared to other European and non European models and researches. The incidence and the diffusion of the rising generation of the "new way" high-tech entrepreneurs must be studied through ad hoc surveys and quantitative methods. Exploratory studies on high-tech entrepreneurship should be encouraged in order to find new phenomena, to update taxonomies and classification and to provide better comprehension of the rapid changing high-tech business environment.
The main empirical evidences emerged in the last paragraph can be an interesting agenda for further research. The possible correlation between corporate social responsibility and high-tech core of the business can be explored. The role and the importance of co-innovators can be an interesting research field for academics, scholars and practitioners who study both innovation activities and informal or formal organizational paradigms. Finally, the actual body of knowledge about academic entrepreneurship can be enriched by studying the hybrid figure of the academic entrepreneur who runs the business and in the same time teaches or researches within the university.

Notes

(1) advertising slogan created for Apple Computer in 1997 by the Los Angeles office of advertising agency TBWA\Chiat\Day
(2) ENEA is an Italian public agency, funded by the Italian Government, operating in the fields of energy, the environment and new technologies, in order to support Country's competitiveness and sustainable development

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Towards a Classification of Instruments for Valorisation of Academic & Industrial Knowledge. An exploratory analysis of eight European incubators in the life sciences

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Abstract -- There are numerous instruments for knowledge valorisation creating economic value from academic and industrial knowledge, including incubators, spin-offs, contract research and post-graduate training. Their performance is unpredictable and enormously variable. In the absence of a theory as to how, why, and when these instruments work, universities, research institutions and companies are formulating their own policies for knowledge valorisation. Drawing on ideas from economics and social sciences, a definition and a model of knowledge valorisation are created. From that model, a typology of knowledge valorisation instruments is defined, as well as the operating principles underlying these instruments. An exploratory in-depth analysis of 8 European incubators in the life science academic area is used to illustrate both soundness and applicability of the typology. So the ultimate question may be answered: when and where does a specific knowledge valorisation instrument work best? The paper tries to fill a void by providing a systematic interpretation of knowledge valorisation instruments.

Index Terms – knowledge valorisation, typology, commercialization, incubators

I. Introduction

In today's knowledge-based economy, the prosperity of individuals, companies, regions and countries derives more than ever from their ability to develop and exploit knowledge (OECD 1996). Creating business value from knowledge, which we will refer to as Knowledge Valorisation, is the foundation of this ability. In order to effectively increase this ability, various Knowledge Valorisation approaches are researched and implemented by universities (AUTM 1999, Kreijen & van Tilburg 2003). However, Knowledge Valorisation is not lectured or taught systematically, and insight into what constitutes effective valorisation of knowledge is currently lacking (Swarte, 2005).

Various aspects of Knowledge Valorisation such as spin-offs (e.g. Kreijen & van Tilburg 2003), intellectual capital management (e.g. Teece 2000b), and valuation (e.g. Tipping et al 1995) have been studied extensively. However, the subject has not yet been studied in its full range using a unifying

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theory. So the question remains: What is Knowledge Valorisation? Knowledge Valorisation encompasses a wide range of instruments, including incubators, campus companies, brokerage events, post-graduate education, corporate venturing, various schemes of intellectual property protection and licensing, and entrepreneurship incentive schemes etc. To enable thorough comparisons this multitude of instruments of Knowledge Valorisation will need to be structured. This brings us the following research question; How does a typology of knowledge valorisation instruments look like?

To be able to answer the research question key questions to be answered about each valorisation instrument include:

1) **How** does the instrument work: what does it do?
2) **Why** does it work: how does it create value from knowledge?
3) **When** does it work: under what circumstances does it work, and when not?

To answer question 1, a typology of Valorisation Instruments is developed. Based on this typology, we will introduce Valorisation Operating Principles, each of which explains one dimension along which a Valorisation Instrument works. We explain why each Valorisation Instrument works by mapping it with one or more Operating Principles, thereby answering question 2. Finally, as a start to answer question 3, we introduce several contingent properties based on a synthesis of prior research.

This paper contains the results of a definition study to capture the essential properties of (instruments for) Knowledge Valorisation. The study was set up to develop a typology of these instruments, based on the assumption that no single recipe for successful Knowledge Valorisation exists. In order to derive normative guidelines for Knowledge Valorisation practices, contingent factors such as industry sector, type of knowledge, macro-economic environment, have to be examined. Section II scans the challenges to Knowledge Valorisation. Next, in section III, the paper proposes a definition of Knowledge Valorisation. Based on the market for knowledge a model is developed, by which the Business Value of a Market Resource is defined. We develop the Typology of Valorisation Instruments in section IV. To explain how these instruments work, we introduce a number of Operating Principles which relate to elements of the knowledge market model. An Operating Principle is a fundamental lever to increase the total value of knowledge. The contingency properties related to the applicability of the typology are presented in section V.

Next, to link the framework to practical application, an exploratory study of eight incubators across Europe is presented, in section VI. The emphasis in this study is on services and benefits offered to by the incubator to the tenant ventures. Finally, section VI presents conclusions, mostly aimed at the usefulness of the classification, and identifies recommendations for further research on Knowledge Valorisation.

II. Theory

The strategic and economic importance of scientific knowledge has long been recognized (Kuznets 1966, Teece 1981). Governments and industry have invested large sums in research, expecting this to be a worthwhile investment. As public funding has risen drastically since the 1970's, there has been an increasing demand for greater accountability of university technology transfer (Bessette 2003). This has resulted in a number of studies into the effectiveness of University Technology Transfer, particularly in North America (Rogers et al 2000, Foltz et al 2000 Thursby et al 2000, 2002, Siegel et al 2002, Carlsson et al 2002, PCAST 2003, Grant 2002). It is concluded that, while University-derived technology-based innovations have a considerable economic impact, the effectiveness of the transfer programs varies greatly (Rogers et al 2000, Parker & Zilberman 1993), with best-in-class being up to six times more effective (Grant 2002).

Other studies have focused on valuation methods for technology or knowledge (Tipping et al 1995, Park 2004). Valuation is the estimation of the worth or sale price of an asset. While valuation of a knowledge asset may be of use in deciding whether or not to commercialize it, it says nothing about how to do so in the most effective manner.

Often in literature the term commercialization is used to denote the market introduction of a product or service. The term usually refers to new products and processes to be lauched on the market, and it is often used in the context of an University-based technology (Del Campo et al 1999, Friedman & Silberman 2003, Campbell et al 2004, Siegel & Phan 2004). Academic literature recognizes that there are different ways of commercializing University research. There has been some work on categorizing these routes, mostly based on the legal forms of the transaction (Del Campo et al 1999, Gu et al 1999, Read 2003). Much of this research is focused on the optimal use of resources, leaving untouched the question which methods are actually most suitable, given that you have developed some knowledge and are seeking to harvest its value. Pries and Guild have proposed a categorization scheme drawing on ideas from transaction cost economics (Pries et al, date?); this scheme is, however, still limited to a categorization based on types of transaction and does not address suitability of transaction types.

We may derive from this literature, there is no common framework attempting to predict which routes of commercializing basic and applied knowledge work best under which circumstances. The starting point to develop that framework is the definition and modelling of Knowledge Valorisation.

III. From the Definition to a Model

As mentioned above a lot of prior research is centred on technology transfer. A useful starting point to relate our definition for Knowledge Valorisation to other concepts, may be the following definition of technology transfer: “The formal transfer of new discoveries and innovations resulting from scientific research conducted at universities and non-profit research institutions to the commercial sector for public benefit.” (AUTM 1999)

Knowledge Valorisation encompasses more than just technology transfer. Firstly, Knowledge Valorisation covers research in the commercial sector as well. Secondly, it is oriented at creating economic value from knowledge, so the focus is on private benefit more than on public benefit. That brings us to the definition of Knowledge Valorisation:

“Knowledge Valorisation is the formal transfer of knowledge resulting from basic and applied research in universities and research institutes, as well as from applied research and development in companies, to (other parties in) the commercial sector for economic benefit.”

In this context, we use the OECD classification for basic research, applied research, and (experimental) development (OECD 1993).

There is increased recognition that the competitive advantage of organizations depends on four important capabilities: being able to create, transfer, utilise and protect difficult-to-imitate knowledge assets (Teece 2000a). Creating and utilising knowledge will only be considered to the extend that they are directly influencing Knowledge Valorisation. Here, the focus is on the capabilities transferring and protecting knowledge, as they are an integral part of Knowledge Valorisation.

This definition enables us to build a basic Knowledge Valorisation model based on the principles of supply and demand. Our supply and demand model of Knowledge Valorisation takes a process view in which market participants (i.e. Knowledge Suppliers and Knowledge Customers) involve products and services (i.e. Knowledge Assets) in a transactional exchange. As Ulkuniemi (2003) points out, there are several advantages to using the market process view: it enables to examine various elements of the phenomenon under study, and it includes dynamism. Furthermore, it is suitable in studying markets in an industrial (i.e. business-to-business) context, because it allows for market relationships as well as closer relationships between buyers and sellers. The business-to-business context is typical for knowledge transactions.

To focus on only those aspects of product or service development that are relevant for Knowledge Valorisation, we will treat it as an idealised aspect system. Knowledge Valorisation can occur several times within the supply chain. Note that this does not necessarily imply a linear progression; iterative network models such as Open Innovation (Chesborough 2003) relate to multiple chains in different

configurations. To the extent that Knowledge Valorisation can be seen as identifiable transfers or transformations of knowledge, our definition and the forthcoming models are applicable. The model can be visualized, using a double unit cell representation initially developed by Van Engelen and presented in Omta (1995).

-- insert figure 1 here –

Figure 1 presents a simplified model of a knowledge market. A *Knowledge Resource* is some basic collection of scientific knowledge owned by a *Knowledge Supplier*. It is the knowledge equivalent of a resource, just like iron ore or labour. A knowledge transaction between a supplier and customer does not usually transfer the knowledge itself – it often stays with the supplier (Teece 2000b). To distinguish between the Knowledge Resource and that which is transferred, we use the term *Knowledge Asset* (Teece 2000a) for the latter. What is actually transferred can be a variety of items, as we will discuss later. On the other side of the exchange there may be one or more potential *Knowledge Customers*, typically a business, institution and/or investor wishing to exploit the knowledge. The Knowledge Customers are not usually the end-users; rather they transform the acquired Knowledge Asset into a Knowledge-based product or service (KPS): an end-product or service based on scientific knowledge. The restriction in the definition of Knowledge Valorisation to Knowledge Customers that focus on creating economic benefit, implies that the Business Value can be determined by traditional, economic valuation methods. We define the *Business Value* of a Knowledge Resource as the economic value of the sum of all transactions in Knowledge Assets (x) derived from that Knowledge Resource in a particular Knowledge Market within a specific time frame.

The Business Value of a Knowledge Resource is formalized in equation 1.

$$BV_{KR} = \sum_{KA} BV_{KA} = \Sigma^{x}_{KA}\ TVa_{KA} * TVo_{KA} \qquad (1)$$

$$\text{where } TVa_{KA} = TP_{KA} - TC_{KA}$$

BV	= Business Value
TVa	= Transaction Value
TP	= Transaction Price
TC	= Transaction Costs
TVo	= Transaction Volume, or number of transactions
KR	= Knowledge Resource
KA	= Knowledge Asset resulting from the KR

This model does not explicitly specify the boundaries of the knowledge market. However, practical applications of this model will typically limit this market to a defined set of knowledge suppliers (e.g. European university biomedical research, or even a single research centre), or a defined set of knowledge customers (e.g. Knowledge Valorisation aimed at SMEs in a country or region).

By this terminology, a *Valorisation Instrument* may be defined as a means to increase the total Business Value of a Knowledge Resource in a certain market context. From the formula, it derives that

this Business Value can be increased by summing over more Knowledge Assets (broadening the scope), as well as by increasing the transaction value of and/or volume in certain Knowledge Assets.

Having formalized the Business Value of a Knowledge Resource the research question can be reformulated as: Which Valorisation Instruments can be used to achieve higher Business Value across the Knowledge Market?

To answer the research question, we start by looking at examples of Valorisation Instruments. From these examples we derive a typology of Valorisation Instruments. There are many and diverse examples of instruments that aid Knowledge Valorisation. To be better able to understand how and why these examples work, we group similar examples into a class, which we call a Valorisation Instrument. Thus, each Valorisation Instrument is representative for a distinct class of examples.The results of this exercise are detailed in section four.

IV. Typology of Valorisation Instruments

The interpetation of the various aspects of the examples according to the double unity cell modelfacilitates the definition of the different classes of Valorisation Instruments. A study of best practices for the specific instrument of spinning out, conducted by the European Union's PAXIS programme, has come to a classification of upstream, assistance, and downstream support activities (ITT, 2003). This matches with the stream of knowledge from a knowledge supplier to a knowledge customer in our model.

-- insert figure 2 here –

As Figure 2 shows Knowledge Valorisation, essentially depicted by the dotted rectangular, can be understood as a process with an input, a transformation and an output. Different examples of Knowledge Valorisation should be placed in a different position in the Knowlegde Valorisation model , representing different inputs and outputs. This provides us with the first three, out of a total of five, characteristics as the basis for the typology:

- What is the valorisation Input? In principle this can be a Knowledge Resource (KR), an (Knowledge Asset as held by the supplier (Supplier KA), an Knowledge Asset as acquired by the customer (Customer KA), (the supplier organisation), or the Knowledge Demand from a customer (KD).
- What Transformation takes place in the valorisation process? This summarizes the main activities executed as part of the valorisation process.
- What is the valorisation Output? This can in principle be any of the items listed under valorisation Input, or one Knowledge-based Product or Service (KPS).

Furthermore, several Valorisation Instruments have their own assets, used to facilitate the process. These assets, such as distribution channels, sales forces, and after-sales support are complementary to the transferred knowledge asset (Teece, 1986). The differences between these complementary assets provide another characteristic of Valorisation Instruments:

- What complementary assets are available as part of the valorisation instrument?

Finally, many Valorisation Instruments encompass a management function which is distinct from the transformation process. The steering function may be taken up by the knowledge supplier, knowledge customer or by a third party.This provides the final characteristic of Valorisation Instruments:

- Who manages the valorisation instrument? The management function can be taken up by the Supplier, Customer or Agent (third party)) (see figure 3).

-- insert figure 3 here –

By comparing examples to the characteristics derived from the model of Knowledge Valorisation, we arrive at the following typology of Valorisation Instruments:

-- insert figure 4 here –

This typology of Valorsation Instruments is useful for determining what classes of instruments exist, and for describing how they work. To explain why each instrument works, how it creates value, we will introduce Operating Principles". An Operating Principle explains a particular valorisation effect in terms of a subset of the defined elements from the Knowledge Valorisation Model. We then proceed to show which Operating Principle(s) are used in each identified Valorisation Instrument.

We defined Knowledge Valorisation, by equation one, as improving the Business Value over all transactions of a Knowledge Resource, where that Business Value consists of:

$$BV_{KR} = \sum^{x}_{n} TVa_{KA} * TVo_{KA}$$

This gives us three areas to look for operating principles, namely:

- Creating additional KA's (affects $\sum^{x}_{KA}$)
- Improving the value of a transaction of a KA (affects TVa_{KA})
- Increasing the volume of transactions of KA's (affects TVo_{KA})

The operating principles in the three areas are next to be detailed.

First, we look at the area of creating additional KA's, which affects the number of Business Values to be summarized. This area clearly has the largest potential, for it opens up whole new value chains. In this area, we see the following Operating Principles:

- Developing Customers

- Supply Intelligence
- Bundling Knowledge Assets

The operating principle Developing Customers refers to situations where the greatest value may come from a transaction with a new knowledge customer. Typically this is the case when the knowledge asset opens up a whole new market. In such cases it may make sense to create a new knowledge customer, based on the analysis that the underlying business value of such a newly created knowledge customer is superior to the value existing customers may derive from it. In effect this means bundling the Knowledge Asset with more suitable Complementary Assets than other Knowledge Customers have.

The operating principle Supply Intelligence aims at structurally improving the chances that a customer looking for a Knowledge Asset finds existing Knowledge Suppliers. This includes informing knowledge suppliers about the kind of knowledge assets that the potential customer is looking for. As a result, Knowledge Customers will be more readily able to develop new or improved products or services, which results in new business value.

The operating principle Bundling Knowledge Assets occurs when the Knowledge Customer combines a knowledge asset with Complementary Assets, either internal (i.e., also owned by this customer) or external assets (i.e., obtained by cooperation with other Knowledge Customers). This is useful when the customer is better positioned to combine Knowledge Assets, which is due to either superior insight into available knowledge assets, a superior understanding of the synergistic effects, or when the customer has better access to available Knowledge Assets. The result is a greater compatibility with existing values, past experiences and needs of potential users (Rogers 2003).

Second, the area of improving the value of a transaction of a KA, which can be achieved by either increasing the price or reducing the transaction cost. Assuming that the Business Value of a KA is proportional to the (potential) Business Value for the customer (i.e. the Business Value of their KPS), then increasing the latter would also result in a potential for a higher transaction price. Suppliers with a monopoly through a unique value proposition can appropriate a large part of the market value. In a knowledge market, however, this uniqueness is limited due to the fact that the customer has the alternative to imitate the knowledge asset (Teece 2000b). In a heterogeneous knowledge market, a supplier with a unique value proposition can increase the appropriability by increasing the Market Value of her knowledge or by increasing the barriers to enter the market, i.e. raising imitation costs. Operating Principles to increase the transaction price are:

- Protecting the Knowledge Asset
- Bundling Knowledge Resources

The operating principle Protecting the Knowledge Asset usually means legally preventing others from using it without the supplier's permission, for example by patenting the knowledge. From a valorisation point of view, protecting a Knowledge Asset aims at increasing the imitation costs, thereby improving the appropriability of the Business Value. Also, a Knowledge Asset may become more attractive to a customer if it is not available to it's competitors. This can be achieved for example by acquiring exclusive rights to a Knowledge Asset. As Teece points out, the inherent replicability of the Knowledge Asset also influences the appropriability: inherently easy to replicate knowledge items have a low appropriability, which protection can only partly compensate (Teece 2000b).

The operating principle Bundling Knowledge Resources refers to the practice where the supplier creates a KA by combining a Knowledge Resource with complementary Knowledge Resources, either internal (i.e., also developed by this supplier) or external resources (i.e., obtained from other suppliers). This bundling is useful when the supplier is better positioned to combine knowledge assets through superior insight into available knowledge assets, superior understanding of the synergistic effects, or superior access to available knowledge. In our terminology, Open Innovation is an example of a method which promotes bundling Knowledge Assets from different suppliers with Knowledge Assets from different customers. (Chesborough 2003).

The other way to increase the Transaction Value of a KA is to decrease the transaction cost of the knowledge transfer. The transfer cost is higher when a higher portion of the knowledge is tacit (Teece 2000b).
Operating Principles to decrease the transfer cost are:

- Codifying a larger portion of the tacit knowledge
- Fitting a Knowledge Asset to the knowledge demand

Evidently, the operating principle of Codifying the tacit knowledge of a knowledge resource requires a good understanding of the knowledge (Teece 2000b). Once codified, the transfer may no longer need face-to-face contact and the transferred information on the Knowledge Asset will be less ambiguous. These factors greatly reduce the transfer costs.

The operating principle Fitting a Knowledge Asset to the knowledge demand refers to situations where the supplier adapts the KA, either physically or legally, to better suit the customer needs. Transferring codified knowledge may be profitable, but whether the codified knowledge will be considered meaningful by those who receive it depends on whether the latter are familiar with the selected code as well as with the different contexts in which it is used (Shannon and Weaver 1949). By improving the fit, suppliers may change the value proposition to a customer from one where customers see no viable business case, to one where they do.

Third and final, we find operating principles in the area of increasing the volume of transactions of Knowledge Assets. Improving this volume typically means finding more Knowledge Customers, particularly in a heterogeneous market. Note that achieving multiple transactions is only possible if the transfer of the KA is possible without transferring people from supplier to customer, i.e., if effective Knowledge Transactions are non-destructive to the KA. Increasing the volume of transactions is easiest with codified, autonomous knowledge and most difficult with tacit, systemic knowledge (Teece 2000b). In this third area, we see the following Operating Principles:

- Understanding Knowledge Demand
- Improving the Knowledge Asset fit
- Increasing the market volume

The operating principle Understanding Knowledge Demand (or Knowledge Demand Intelligence) is used to transform the potential business value into actual business value through market intelligence. A Valorisation Instrument can identify more Knowledge Customers interested in the Knowledge Asset (i.e., market penetration), or identify related Knowledge Assets that have a synergistic effect with the original Knowledge Resource, a so called knowledge cluster, or a technology cluster (Rogers 2003).

Another Operating Principle is Improving the Knowledge Asset fit with Complementary Assets of potential customers, such as competitive manufacturing capabilities, distribution channels, sales forces, after-sales support and complementary knowledge (Teece 1986). This unlocks potential business value by making the knowledge asset a viable proposition for customers where it otherwise would not be. This also serves to reduce the uncertainty for the knowledge customer, thereby increasing the chance of adoption (Rogers 2003).

A Valorisation Instrument may Increase the market volume for a Knowledge-based Product or Service (KPS), e.g. through marketing or through developing a complementary infrastructure. This is particulary important for systemic knowledge: For example, without a system for generating and distributing electricity, the tungsten filament light bulb would not have found such a wide application (Teece 2000b). The assumption is that there is a high price elasticity, allowing the business value to increase significantly with an increase of volume. The Increase of the market volume is another operating principle to increase the volume of transactions.

Alternatively, the volume of transactions can be increased by decreasing the Transaction Price.When this leads to a net increase of Business Value, this is effective. We see the following additional Operating Principles in this area:

- Supplier development

- Imitating knowledge

The operating principle Supplier development refers to practices where the Knowledge Customer cooperates with an existing Knowledge Supplier to lower the price of a Knowledge Asset. This can be achieved, e.g., by giving the supplier insight into the customer's development process. Supplier development can also refer to situations where the customer helps the supplier to set up pilot production facilities, thereby speeding up the knowledge asset's learning curve.

Finally, the operating principleImitating knowledge refers to practices where a customer creates a new knowledge supplier for the purpose of imitating a Knowledge Resource that already exists but that is too expensive to the customer's market. The aim of imitation is to lower the transaction price so that previously non-viable products or services become viable, unlocking latent Business Value. Imitating knowledge is easier when the knowledge is observable (e.g., represented in a product) as opposed to non-observable knowledge (e.g., process technology) (Teece 2000b). Intellectual Property Rights may also hinder the imitation of a knowledge resource.

Summarizing, the definition of Knowledge Valorisation gives us three areas of relevance to look for operating principles. Analysing each area has resulted in twelve distinct Operating Principles. Figure 5 shows how the Valorisation Instruments identified earlier are associated with these Operating Principles.

-- insert figure 5 here –

V. Contingency properties

In order to prepare a contingency theory for Knowledge Valorization, we have contructed a number of hypothetical dimensions of this contingency theory. This may function as an illustration of the applicability of the typology.

-- insert figure 6 here –

Figure 6 shows an example of the positioning of Valorisation Instruments against the two properties Alliance Type and Technology Impact.

Another example of the positioningof Valorisation Instruments is shown inFigure 7. In this case, the development phase a Knowledge Asset is in is set out against the valorisation dynamics of the Valorisation Instrument. The valorisation dynamics indicates which actor (supplier, customer, or agent) initiates the knowledge valorisation process.

-- insert figure 7 here –

Next section links the framework to a practical application by an exploratory study of eight incubators. It lends support to the presented typology of Knowledge Valorisation.

IV. Application: an exploratory study of eight incubators

In order to investigate the usefullness of the tvalidate the applicability of the knowledge market model, the double unity cell framework, and the typology presented in figure 7, we have studied a sample of eight business incubators across Europe in the life sciences.

Articles and reports on life sciences business incubators reveal the following two assumptions of the beneficial role of being located in a business incubator:

- 'Companies develop better because of the business assistance offered by the incubator and its management.'
- 'Companies develop better because of the help inside the incubator.'

Most of these studies focuses on the business incubator itself (e.g.:Tornatzky et al., 2002; CSEC, 2002). The few studies that concentrated on the relationship between the incubator and its tenants, only investigated relationships within the context of a single incubator (e.g. Bøllingtoft&Ulhøi, 2004; Seidel, 2001).

Based on the principles of Yin (1984) we have performed a multiple case study research. The primary research object was the life sciences start-up company, with the focus on the related business incubator. Data were gathered over 2004 by means of questionnaires, including direct and indirect questions on the background of the venture and the incubator, their relationship and performance. Interviews were taken by means of a questionnaire and follow-up telephone interview after completion of the questionnaire. Incubators have been selected on their life sciences orientation. Incubator managers have been asked to suggest high performing companies in the incubator, and CEOs of these ventures have been interviewed about their venture and the role of the incubator.

-- insert table 1 here -

The study includes two Danish, two British, one Belgian and three Dutch incubators. Table 1 presents key properties of the incubators. All the Dutch incubators are of recent date,.the other incubators are older. It is clear that incubators 1, 2 and 3 are large incubators, both by the amount of square meters and the number of companies inside the incubators. The oldest incubators, that is incubators 1 and 2, both Danish, realised the highestnumber of graduated companies. All incubators claim to offer a wide

range of services, including R&D assistance, accounting and legal services, management and strategic planning, marketing and sales advice, business development, financing, human resources management, and networking and search (e.g., clients, investors, and alliance partners). This data shows that older incubators also handle more companies per manager, an efficiency property that may relate to both scale and experience. Outlier in his efficiency parameter is the Belgian incubator number 4. Combined with the largest footprint per venture, this points at an incubator working under its optimal utilization rate.

-- insert table 2 around here -

The ventures in the study together show a wide spread in founding, degree of maturity, and company focus (see table 2). We also found diverse rationales for choosing the incubator. All companies valued highly the location of the incubator, either because of having academia or related companies nearby. The incubator itself had to offer the right office and laboratory units. Also the relationship with the incubator manager was considered to be of crucial importance. Interestingly the other companies inside the incubator were less important for the locating decision. The location itself turned out to be no discriminating factor. Discriminating reasons for locating could effectively be reduced to either the price or the business services.

-- insert table 3 around here -

Table 3 presents the results of asking both incubator and tenants about typical values added services (potentially) offered by the incubators: i.e. networking, coaching, and co-location. The difference in perspective is measured by relating the incubator score to the tenant score on the associated scale, in number of steps. This results in a positive difference if the tenant score exceeds the incubator's score, and a negative difference if the tenant score is lower. The resulting difference metric can be seen as a measure of the incubator's under-estimation (positive value) or over-estimation (negative value) of that value added service. When we analyze the incubators, incubator 1 is the only one in the study that consistently underestimates its benefits, and incubator 6 matches the expectations of the ventures perfectly. Looking at the differences per value added service, the largest differences can be found in the least tangible of the three offerings, that isnetworking, whereas co-location is the most overestimated service of the incubator.

From the case study data, further analysis has revealed the following:

- In 5 out of 8 incubator-cases the number of contacts amongst tenants is very low. Where these numbers of contacts were not low, they were mostly about access to finance.

- In 3 out of 8 incubator-cases, allinterviewed tenants were dissatisfied about the incubator. To their opinion the expectations concerning the services offered were higher than the actually offered services. Services promised but not offered are the biggest complaint.
- Most incubator managers had the idea that companies want to solve business problems on their own. Although the incubator managers of incubators 4 and 8 have a tendency to help better performing ventures more, in both cases this was not perceived as such by the related ventures.
- In those cases where pricing was more important than business services, tenants knew this and were satisfied by the offered services.

The incubator managers were not aware of the disappointment of some of the CEOs in their incubator and in the incubation process.

From the spread in difference metrics as well as the detailed analysis, one may derive that incubator managers seem to overvalue their contribution to succesful knowledge valorization. This small sample size study matches the conclusions drawn by Scholten (2005) in a broader study of entrepreneurial success of spin-offs . His research shows that high levels of support by an incubator or mother university correlates with lower growth figures of the related ventures.

The study does confirm the position of the incubation valorisation instrument close to facility sharing in figure 7, and its independence from other valorisation instruments such as subsidizing and venturing.

V. Discussion and Conclusions

Previous research has identified such a variety of instruments and properties of knowledge valorisation that a definition study seems appropriate to capture the essential properties of (instruments for) Knowledge Valorisation as to which instrument works how, why and when. This paper tries to fill that void.

A typology of Knowledge Valorisation Instruments has been developed. This typology is based on a definition of Knowledge Valorisation a structural model of a knowledge market, and a formalized presentation of the Business Value of a Knowledge Resource. An initial set of Knowledge Valorisation Instruments, mainly from the Dutch context, has been collected and used to illustrate the suitability of the typology for answering the following two questions about each instrument:

1) **How** does the instrument work: what does it do?
2) **Why** does it work: how does it create value from knowledge?

As to the first question, the typology of Valorisation instruments is developed. Parallel a repository of instruments has been set up in which relevant properties (according to the framework) of each instrument are documented (see Swarte, 2005).

The answer to the second research question is based on a set of Valorisation Operating Principles: the underlying leverss that can increase the economic value of scientific knowledge. These Operating Principles have been identified by elaborating upon the structural model of a knowledge market, itself based on previous research. The typology together with the operating principles is able to answer why certain Valorisation Instruments work.

Both the need for the typology as well as specific properties of the typology have been validated in an exploratory study on the key operating principles of a group of European life science incubators. The study confirms the added value of a typology of Knowledge Valorisation by demonstrating, first of all, a significant difference in the operating principles across incubators: some depend on subsidizing, some on venturing, some on facility sharing, and some on coaching. Secondly, the study highlights mismatches between the views of incubator and tenants about the importance and performance along these dimensions. The framework developed in this study addresses the key aspects of knowledge valorization, and as such, can provide a common language for improving incubator service design as well as execution.

Further verification of our typology by testing its applicablity for other valorization instruments than incubators could lead to further improvements. Refinement of the model by inclusion of results from research into spill-over effects as well as network dynamics is another direction of future research. Also the appropriateness of Instruments in 1-on-1 and many-to-many contexts (such as open innovation networks) needs to be investigated. The current model does not yet cover highly exploratory open innovation, specifically in situations where it is unclear a priori who will be knowledge customer and who knowledge supplier.

The third question put forward in this paper is more difficult to answer:

3) **When**: under what circumstances does a Knowledge Valorisation instrument work well?

To answer the third question further research is needed to find out which properties of each of the elements of our Knowledge Valorisation model significantly affect the efficiency and effectiveness of Valorisation Instruments. Although this has been done for several of the valorisation instruments identified (such as spin-offs), the relative success across different instruments leaves room for future research. Moreover, the various instruments must be classified according to their usefulness for industry, university, or policy institutes as either knowledge suppliers, customers, and valorisation agents. Obviously, more research is needed to confirm the validity of the proposed effectiveness for each Knowledge Valorisation instrument. The results needs to be validated in further empirical analysis of best practices. The results may help to develop effective regional, national, or international policies for Knowledge Valorisation.

A direct output of this research is the better understanding of the essential properties of (instruments for) Knowledge Valorisation. This may help to discuss, compare, and disseminate examples and

experiences with Knowledge Valorisation Instruments. Also, because it builds on an systematic understanding of why Knowledge Valorisation instruments are effective, it improves the understanding of a proper valorisation instrument selection (for policy makers) and of implementing a certain instrument. For example, an instrument's Key Performance Indicators derive naturally from the key operating principles.

The research may also function as a basis for educational programs directed at key people involved in setting up and running Knowledge Valorisation Instruments in industry and science; the research provides both a solid background on the possible operating principles of various instruments, and examples to learn from. In order to support such education, Simbon has developed the Knowledge Valorization game, a simulation board game in which participants can experience the relative inpact of different valorization mechanisms during the lifecycle of new technologies.

Summarizing, this research develops a typology for studying Knowledge Valorisation. The key aspects of Knowledge Valorisation have been defined, a model to understand their functioning has been developed, and areas for future research have been identified. However, the results of this study have also shown practical value for policy discussions, training , and for supporting effective management of Knowledge Valorisation Instruments.

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Appendix Description of the incubators studied

Incubator 1 is a very large Danish incubator that is orientated on biotech and ICT. The incubator is an initiative of the government and academic institutes. The incubator's goal is to improve entrepreneurship and commercialize academic know how. The incubator manager has industry management experience. Venture 1 is a medical chemistry company, which provides specialized laboratory services. The company is independently established and 100% privately owned, moved into the incubator and became profitable in November 2003. The start-up team consists of two people; both have research background in a company environment.

Incubator 2 is a Danish incubator that is set up in collaboration with academic institutes and local government. The incubator's focus is on young biotechnology companies. The incubator manager has industry management experience. Venture 2 produces human therapeutical peptides. The company is a university spin-off and is already older than 20 years. The company is largely owned by venture capitalists. The start-up team consists of two, both worked in academic research. The current CEO had its own business and joint the team in July 2004. The venture has become profitable in January 2004. Venture 3 produces medical screening equipment. The company is a university spin-off and is 100% privately owned. They started doing business and moved into the incubator in April 1998. The venture has become profitable in January 1999. The start-up team consists of four, all worked in academic research. CEO had its own business.

Incubator 3 is a British incubator set up together with local academia and government. The main focus is on young biotech companies in the human health. The incubator manager had her own business and has a scientific background. Venture 4 produces allergy-monitoring products. The company is independently established and is 20% privately owned and 80% by private investors. The company started doing business in July 1999, moved into the incubator in January 2000 and will become profitable in December 2004. The start up team consists of two; both have research background and worked in a company environment. Venture 5 provides services and products towards identification of molecules. The company is a university spin-off and is 35% privately owned and 65% by the incubator. They started doing business in June 2000, moved into the incubator in November 2001 and started to generate revenue in November 2004. The start-up team consists of one person, experienced in the research, worked in a company environment and research lab. After half year a CEO followed and a product developer.

Incubator 4 is a Belgian incubator and is an initiative of Universities and research institutes. The incubator has its role to commercialise patents and ideas from the academics. The incubated companies should be of high growth (e.g. from 4 to 50 people). The incubator manager has PhD in chemistry/molecular biology and has research and management experience from the industry. The rest of the incubator management provides the services, each from its own speciality. The incubator

takes equity in the incubated ventures. Venture 6 provides in screening assay services and products in the field of infectious human diseases. The company is independently established. The venture is 100% privately owned. The company started doing business in June 2001 and moved in the incubator in September. The venture has become profitable in September 2003. The start-up team consists of three, one had his own business, two have research background and all have previous management experience. Venture 7 is an internationally orientated biotechnology company, which produces bioinformatically designed therapeutic peptides. The company is a university spin-off. The company is largely owned by a private capitalist. The company started business in July 1999, they moved into the incubator in February 2001. The company will reach financial break-even in 2005. The company start-up team consists of four. All have research background, two had previous management experience and one had his own business, one member left.

Incubator 5 is a small British incubator that is focused on the development of young life sciences companies in the human health and environment. There is strong relation with the nearby academics specialized in human health. The incubator manager has a management background. Venture 8 is a Systems Biology company focused on the discovery of new drugs for diabetes and obesity through the use of novel, human, cell-based technologies. The company is a university spin-off and is 25% privately owned and 75% owned by private capitalists. The company started doing business in January 1999, moved into the incubator in September 2002 and became profitable in January 2004. The start up team consist of three, all have academic research background. The current CEO is not part of the start-up team and joined the company in January 2004. Venture 9 provides products and services for human therapeutics. The company is independently established and is 100% privately owned. The company started off in January 2000, started to generate revenue and moved in the incubator in September 2001 and became profitable in August 2002. The start-up team consist of four; all have research background and had their own business.

Incubator 6 is a Dutch incubator that is mainly focused on young human health related biotech companies. Incubator manager has her own business. Venture 10 provides services and products in catalysts. The company is a research centre spin-off and is 100% privately owned. They started doing business in January 2003, when they moved into the incubator. The venture will become profitable in December 2004. The start-up team consists of two and both have academic research background. One had its own business. Venture 11 provides genomics and proteomics services. The company is independently established in June 2002, when it moved into the incubator. It became profitable in June 2003. The venture is 100% privately owned. The company is a price fighter. The start-up team consist of five and all have research background. Two have their own business.

Incubator 7 is a Dutch incubator set up with a university hospital and other local academia. The incubator has its focus on young biotech companies in the human health. The incubator manager had

his own business and the management experience. Venture 12 is a human diagnostics service and product company. The company is independently established and is 55% privately owned, 33% venture capitalist. They started doing business in April 2002, moved into the incubator in June 2003 start-up team consists of three, two had their own business and three have research experience and one worked at a research lab. Venture 13 is a human therapeutics product company, focused on skin diseases. The company is independently established and is 100% privately owned. They started doing business and got in the incubator program in October 2001. The company will generate revenue in December 2004. The startup team consists of three, one had his own business and two have research experience and worked at a research lab. All three worked in accompany environment.

Incubator 8 is a Dutch incubator that has its focus on agro technological biotechnology. The incubator manager has its major expertise in marketing and sales and has a broad experience in management. Venture 14 produces genetic screening products. The company is a university spin-off and is 100% privately owned. They started doing business in December 1998, moved into the incubator in May 2003 and are already profitable since its start in December 1998. The start-up team consists of two; both have had their own business and have a research background. Venture 15 provides genetic screening services. The company is a university spin-off and has an exclusive contract with a large industrial organization. They started doing business, moved into the incubator and became profitable since June 2003. The start-up team consists of two, both have research background; one worked in a company environment.

Figures with TEM paper

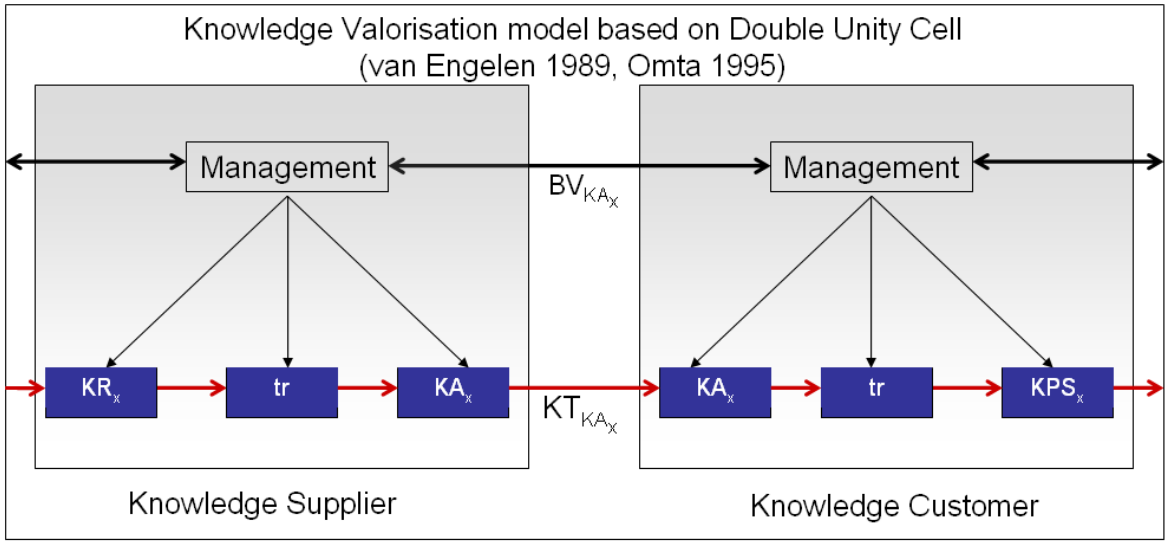


Figure 1 - The Knowledge Valorisation model

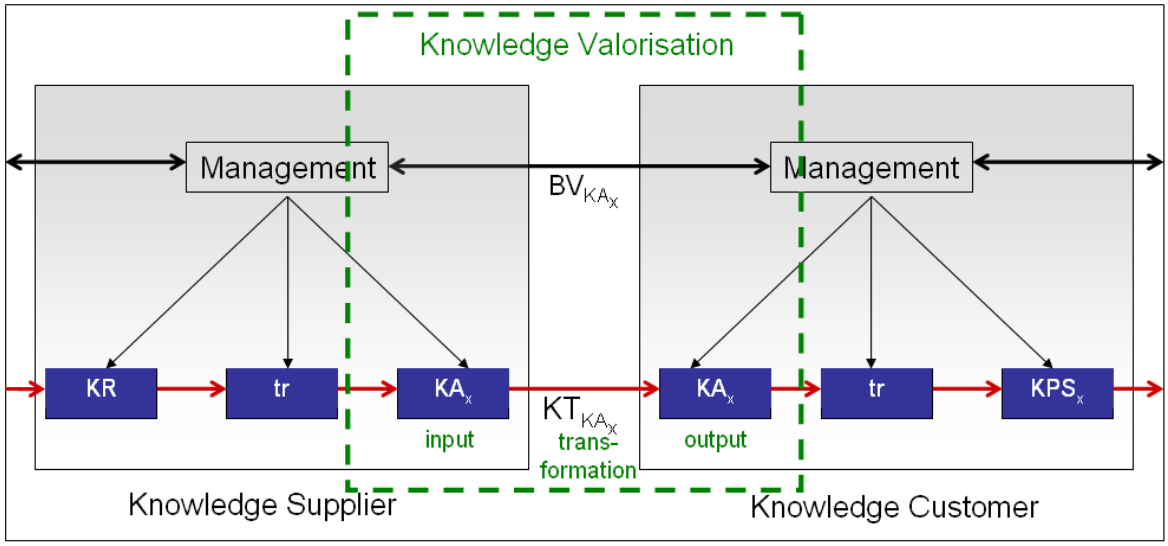


Figure 2 – Example of a Knowledge Valorisation instrument

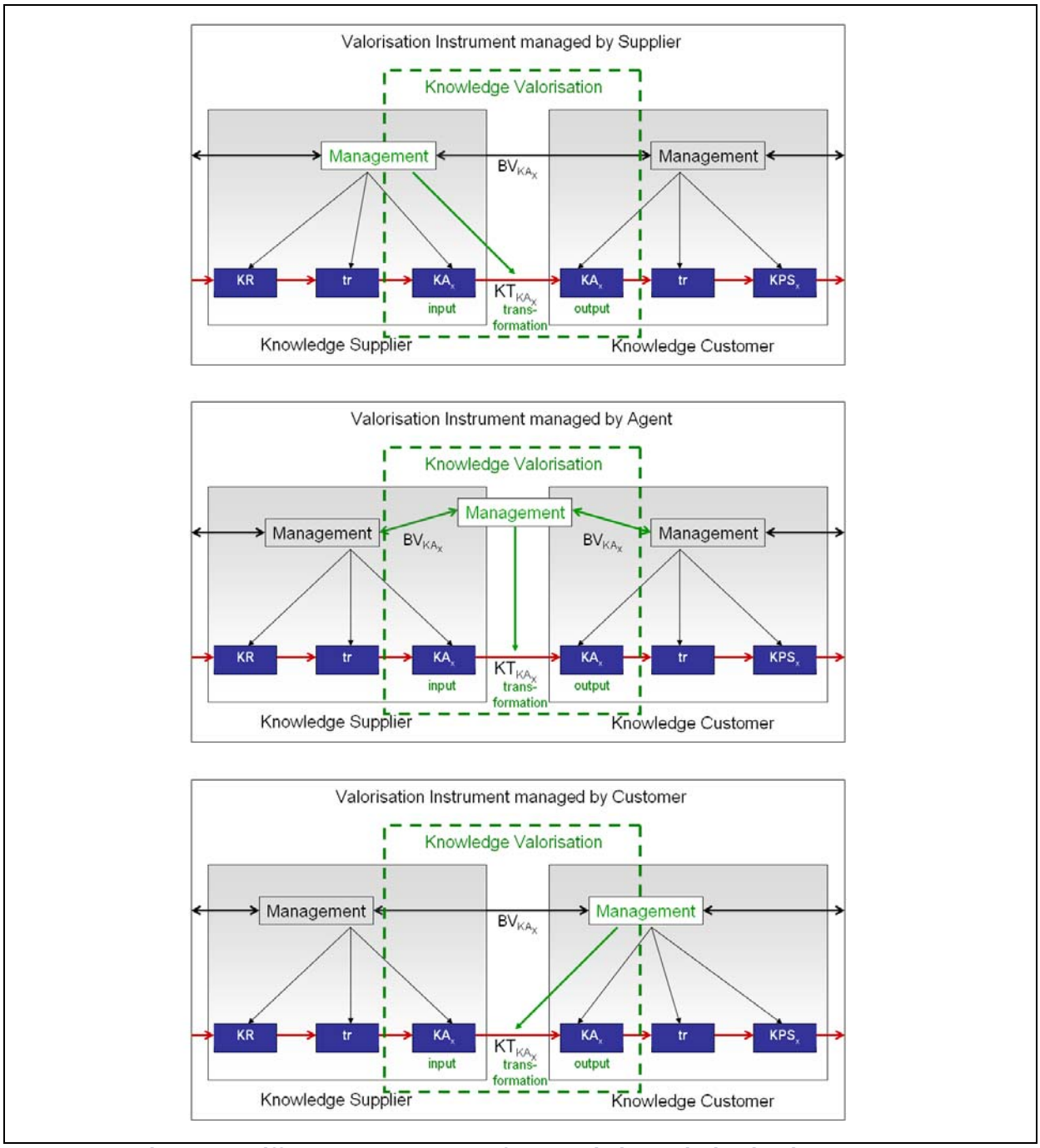


Figure 3 – Different management of a Knowledge Valorisation instrument

		Characteristics				
		Input	Transformation	Output	Complementary Assets	Management
Valorisation Instrument	**Brokering**	Supplier KA or KD	Match	Customer KA	Sales force, distribution channels	Agent
	Contracting	KD	Research	Customer KA	Funds	Supplier
	Facility Sharing	KR	Lab testing or trial production	Supplier KA	Manufacturing & Laboratory capabilities	Agent
	Incubating	Supplier or Supplier KA	Improve Mgt & transformation	More capable Supplier	Office facilities, Services, Capital	Agent
	Licensing	KR	Protect	Supplier KA	None	Supplier
	Spinning-in	Supplier	Acquire	Customer KA	Capital, Services	Customer
	Spinning-out	Supplier KA	Start-up company	New Supplier	Capital, IPR	Supplier
	Subsidizing	KD	Match & Fund	Customer KA	Funds, Incentives	Agent
	Training	Supplier KA or Customer KA	Training Development	KPS	Facilities, Services	Supplier or Customer
	Transferring	KR	Protect, Transform	Supplier KA or Customer KA	Facilities, Services, distribution channels	Supplier or Agent
	Venturing	Supplier KA	Start-up company	New Supplier	Capital	Supplier

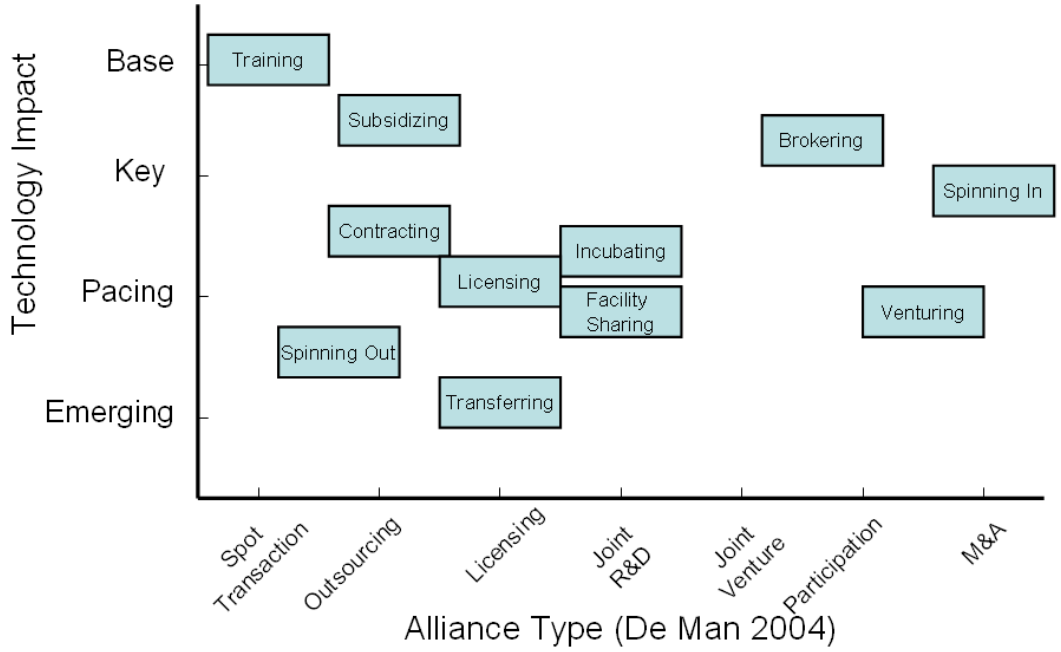
KR = Knowledge Resource. KA = Knowledge Asset. KD = Knowledge Demand. KPS = Knowledge Product or Service.

Figure 4 – A typology of Valorisation Instruments

		Operating Principles											
		Additional KA's			Greater Value				Greater Volume				
		Developing Customers	Supply Intelligence	Bundling KA	Protecting KA	Bundling KR	Codifying KR	Fitting KA	Understanding Demand	Improving KA fit	Increasing Market Volume	Developing Supplier	Imitating KA
Valorisation Instruments	Brokering		+			+		±	+	+	±		±
	Contracting					±	+			±		+	±
	Facility Sharing			+	+	+	±	+			±		
	Incubating			±	+		±	±	±	+			
	Licensing				+			+					
	Spinning-in			+		±		+					
	Spinning-out	+					±				±		
	Subsidizing	+	+				+	±	±	+	±	+	
	Training			+		+	+						
	Transferring			±	+		±	+	+	+	±		
	Venturing	+		±				±	±		±	±	±

Legend:	+	operating principle is definitely applicable for this instrument
	±	operating principle could be applicable for this instrument
	KA, KR	Knowledge Asset, Knowledge Resource

Figure 5 - Relation between Operating Principles and Valorisation Instruments



Base:	necessary and available to all
Key:	source of competitive advantage
Pacing:	technology expected to be future key
Emerging:	early stage with unclear potential

Figure 6 – Valorisation Instruments set out against Alliance Type and Technology Impact

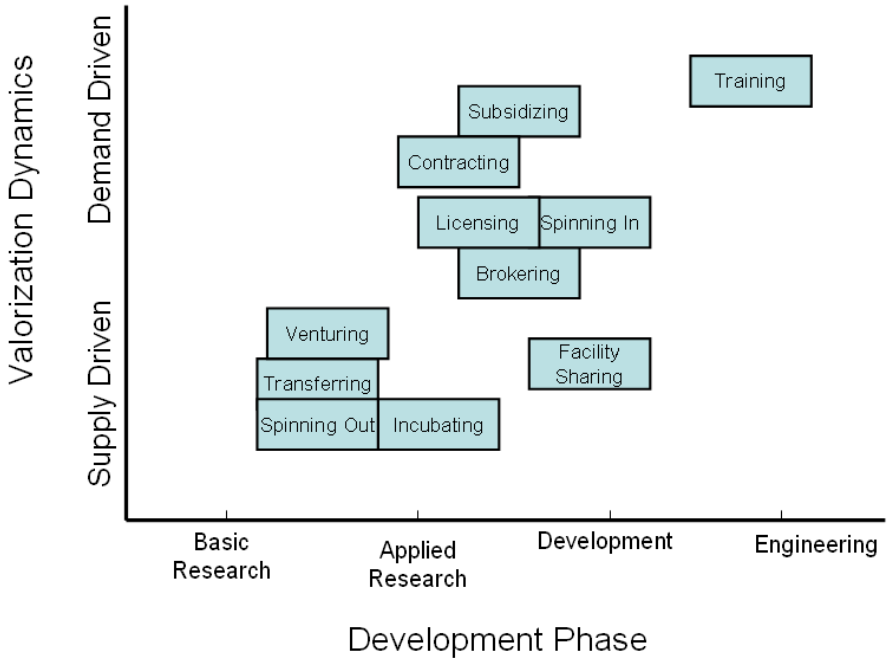


Figure 7 – Valorisation Instruments set out against Phase and Dynamics

Incubator #	1	2	3	4	5	6	7	8
Country	DK	UK	UK	NL	NL	NL	DK	BE
Opening year	1985	2001	1998	2002	2002	2002	1986	1999
Square meters	20000	500	4200	855	3500	1100	10865	3750
Companies (now)	80	6	21	5	6	12	58	5
Companies (graduated)	250	2	10	0	0	0	120	0
Management (fte)	8	2	8	2	1	3	8	7
Surface per company	250	83	200	171	583	92	187	750
Companies per manager	10	3	3	3	6	4	7	1
Depends on subsidy	No	Yes	No	Yes	No	Yes	No	No
Equity in tenants?	No	No	No	No	No	No	No	Yes
Incubator expertise								
Finance	x	x	x	x	x	x		x
business development	x		x	x	x		x	x
customer services		x			x		x	
clinical development	x						x	
Production		x						
intellectual property	x		x	x	x	x	x	x
HRM	x	x	x					x
Alliances	x			x		x	x	x
Marketing	x				x		x	
R&D			x		x	x	x	x
venture capital	x							
pre-incubation			x					
Subsidy						x		
Services offered								
Pre incubation services	x	x	x	x	x	x	x	x
Research and development advice/assistance	x		x	x		x	x	x
Administrative services (e.g. legal, accounting)	x		x	x	x	x	x	x
Management and strategic planning	x		x	x	x	x	x	x
Marketing and sales advice	x		x	x	x	x	x	
Business coaching			x	x	x	x	x	x
Business development	x		x	x	x	x	x	x
Financing	x		x	x	x		x	x
Networking		x	x	x	x	x	x	x
Assistance with finding potential customers	x		x	x	x	x	x	x
Assistance with finding alliances	x		x	x	x	x	x	x
Assistance with finding investors	x		x	x	x	x	x	x
Human resource management	x		x	x	x	x	x	x
Introducing company in the sector	x		x	x	x	x	x	x

Table 1 – Key properties of the incubators in the study

Incubator #	1	2	2	3	3	4	4	5	5	6	6
Venture #	1	2	3	4	5	6	7	8	9	10	11
Incubator perspective											
Networking	no	no	no	no	no	passive	passive	active	active	no	passiv
Coaching	no	no	no	passive	passive	passive	passive	active	no	passive	passiv
Colocation	low	low	low	high	average	high	low	low	low	average	high
Venture perspective											
networking	active	no	no	passive	passive	active	active	no	no	no	passiv
coaching	mixed	no	no	passive	passive	active	passive	no	passive	passive	passiv
colocation	low/avg	no	no	high	average	low	low	very low	low	average	high

Table 2 – Incubator and venture perspectives on colocation, networking, and coaching

Venture #	Founding	Maturity	Financial structure	Patents	Business model
1	indep	established	private	0	service
2	spin-off	established	vc/private	4	hybrid
3	indep	middle	private	0	hybrid
4	indep	middle	n.a.	4	product
5	spin-off	middle	vc/parent	7	hybrid
6	indep	middle	private/vc	2	hybrid
7	spin-off	early	private	2	product
8	spin-off	established	parent	n.a.	tool, product
9	business unit	established	parent	0	service
10	spin-off	middle	private	3	hybrid
11	indep	established	private	0	service
12	spn-off	established	vc/private	10	product
13	spin-off/joint venture	established	private	8	hybrid
14	indep	established	private	1	hybrid
15	spin-off	middle	vc	9	service

Table 3 – Key properties of the ventures in the study

ACADEMIC ENTREPRENEURSHIP: CHALLENGES FACING SOUTH AFRICA

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ACADEMIC ENTREPRENEURSHIP: CHALLENGES FACING SOUTH AFRICA

Abstract

Academic entrepreneurship in general implies *ipso facto* the involvement of academic staff in commercial activities in a system that builds on university-industry relations. In this relationship it is expected from industry to acquire knowledge from institutions of higher education and to utilize this knowledge in the innovation process. On the other hand, academic entrepreneurship also occurs within the national boundaries of a specific country possessing a distinct history and culture. In the case of South Africa, the entrepreneurial culture was build over more than three centuries, 1652 to 1994, on an institutionalized political system of racial segregation. True democracy was only achieved in April 1994 when South Africans saw the first-ever democratic vote and election in South Africa. This paper intends to analyze and evaluate the challenges of academic entrepreneurship for institutions of higher education in South Africa following a historical and survey research design approach. The results revealed that higher education institutions in South Africa, despite remarkable achievements, are still struggling to comply with the demands of the knowledge economy and in the enhancement of academic entrepreneurship.

1. Introduction

In South Africa, as in the rest of Africa, the drive for education could be considered as a response to two aspects of European penetration. According to the anthropologist Herskovits (1965) Africa initially related the European power over them as dependent on writing skills ability enabling Africa to communicate with Europeans and the technological controls associated with this skill. Later, as European ways became better known, higher education institutions expanded their visions to aspire to master European skills and higher standards of living.

Despite the fact that South Africa is currently experiencing huge transformations in higher education, higher education institutions are still inclined to offer European-oriented education. European-oriented higher education therefore continues to exert a profound influence on South African higher education institution's attitudes, practices, policies and aspirations as it operates in a global world. England, as colonial power in South Africa for many years however, adopted a rather "elastic" educational approach based on the principle that the maximum of initiative and responsibility should rest with the colonial administration (Herskovits, 1965). This elasticity approach eventually led to the development of a segregated higher education system offering access to students based upon race and funded by government accordingly.

Presently, South Africa being a country undergoing a radical transformation process from being a segregated society towards becoming a fully integrated society, places special demands on higher education institutions to promote academic entrepreneurship. Academic entrepreneurship in general implies ipso facto the involvement of academic scientists in commercial activities, primarily by means of a country's national innovation system that builds on university-industry relations. In this relationship it is expected from industry to acquire knowledge from institutions of higher education and to utilize this knowledge in the innovation process (Jaffe, Lerner, Stern & Thursby, 2007; Kroll & Liefner, 2007).

2. Problem Statement

The principal research question under investigation is to evaluate to what extend academic entrepreneurship came into being in institutions of higher education in South Africa, and secondly, what challenges are created by this phenomenon for South Africa's higher education institutions?

Whilst South Africa is in a process of transforming higher education to address the imbalances of the past, the question arises whether higher education is able to make the transition to academic entrepreneurship as expected by the new global economy which regards knowledge as a commercialized commodity.

3. Purpose

The first purpose of this paper is to explain the transitional changes that occurred in higher education in South Africa over time, deduct the nature of the modern university, and conclude challenges for South Africa in its perusal to promote academic entrepreneurship. The second purpose is to investigate two principle learning orientations of South African students to make deductions with regard to their readiness to make a contribution to society in terms of academic entrepreneurship. The latter purpose will give an indication to which extend academic entrepreneurship was installed in the clientele of higher education institutions. The learning orientations investigated are labelled and defined as:

- **Grade orientation** – This orientation emphasises learning for the sake of learning. Students tend to construe their tertiary career in terms of the grades they obtain. Grades, rather than learning, become the primary objective of the students.
- **Learning orientation** – This orientation emphasises learning as a mechanism whereby students get the opportunity to gain access to significant ideas, innovative technologies, and new ways of thinking.

This part of the paper assesses the positive and negative values that students attach to learning and grade orientations. Three main components were assessed namely, current orientation towards studies, current study behaviour, and ideal study behaviour. Differences between current and ideal scores were considered to be indicative of the degree of dissatisfaction with their present orientations. The ideals expressed are considered to be necessary change catalysts that will guide adaptation of current learning behaviours.

4. Scope

This paper restricts itself to higher education institutions that are defined as "Universities" in the South African context and which include Comprehensive Universities as well as Universities of Technology.

5. Literature Review on Academic Entrepreneurship

To describe academic entrepreneurship in South Africa it is important to clearly define the concepts under investigation and to investigate the emergence of academic entrepreneurship in South Africa.

5.1 Clarifying "Academic Entrepreneurship"

Balázs (1996:3) viewed academic entrepreneurship essentially as behaviour, which modifies behaviour of research and education in the sense that it should be considered an "income-oriented" activity which could be seen as "risk-taking", technology- and knowledge-based and causing greater stability for the university through their involvement in business activities. Whilst this debate centers primarily on the "commercialization" aspect of higher education and the utility value thereof to achieve a country's economic goals (Imenda, 2006), Van Staden (2006) cautioned against equating entrepreneurialism in universities with commercialization and proposed that a more holistic perspective is required when analyzing an entrepreneurial university in which academic criteria dominate financial matters i.e. finance should follow academic matters and not vice versa.

5.2 The Evolution of the University Concept

To truly understand academic entrepreneurship in Higher Education Institutions, it is firstly necessary to understand the concept "University" in terms of its roots and essence to be able to reason meaningful about its existence, present role and drive towards academic entrepreneurship. It is therefore essential to reflect on the historical development of the modern university.

Initially universities were known as "Universitas Magistrorum et Scholarium" which directly translated means a community of teachers and learners. To refer to a particular university the Latin word "Studium" was used. Universities later adopted the terms "Studium Generale" where the term "generale" indicated that the university was open for any student coming from any part of the Christian world. The whole corporation of universities was in those days known as the "universitas magistrorum et schlarium studii Parsienis" with the right to employ its own employees and developing its own statutes (Pauw, 1975).

The beginning of the 12th century for example represented a change in the fortune of intellectual history of Europe. During this time period a new spirit for investigation and innovation emerged caused by renewals in the church, the cultural domain, international trade, rapid growth of cities and economic prosperity. This led to the flourishing of theology, philosophy and Law in search for truth on the one hand and in search for truth based on what was already discovered (surrendered tradition). Education and training in general became more important and the guild system – a self managed regulatory system - was formed to ensure that only people properly qualified and considered masters in their respective disciplines were allowed to become members of a guild. In the field of education this trend resulted in the formation of a "brotherhood" of intellectuals able to protect their educational offerings and interests. The formation of the "brotherhood" of intellectuals in which learners were educated along similar lines followed by the guilds i.e. apprentice, journeyman to master craftsman, provided concrete content to the principle of "autonomy" in education by universities (Pauw, 1975).

Issuing a “licence” known as “licentia docendi” ensured that only people considered to be masters in their disciplines could present subjects. An incorporation ceremony known as “inceptio” was also established. This ceremony was created to give a chance to the novice teacher to conduct an inaugrial lecture or to engage in a public disputation in the presence of his former master and other fellow masters. By so doing the teacher proved his ability to teach in the field he has chosen. Only after proven ability was the teacher admitted to the “fellowship of the elect masters”. The establishment of this practice introduced the concept of “corporation” into university life as the intelligential realized that their power and influence lied in taking shared responsibility to protect the interests of each other (Pauw, 1975) and to create knowledgeable societies following an endogenous approach (growing from inside) (Stern, 1970).

5.2.1 The Period 1873-1994 in South Africa

The first university in South Africa – “*Die Universiteit die Kaap die Goeie Hoop”* – was established in 1873 and remained till 1918 the only university in South Africa. University education in South Africa is thus only 135 years old. The university that was established in 1873 according to Act 16 of 1873 was in essence an examination practicing institution. The degrees issued were recognized in all universities belonging to the British Empire. Being a grade oriented institution the focus of education in those years have fallen on performance evaluation and grades obtained in evaluation. Little emphasis was placed on scientific research (Boucher, 1973). It can be concluded that in the beginning years of higher education in South Africa, the university could be considered as a certificate-producing factory.

The first articles confirming the important role of research at institutions of higher education in South Africa started to emerge in 1912. It was indicated that the research conducted should be of use to the whole commercial community of South Africa (Boucher, 1973).

Prior to 1994 the higher educational sector in South Africa was designed to reproduce, through teaching and research, white and male privilege as well as black and female subordination in all spheres of life. Although not all South African institutions of higher education shared these ideals, it can be reasoned that all the institutions, in different ways and to different extends are implicated in this (Cloete, Pillay, Badat & Moja, 2005). The higher education system in South Africa could thus also be described as fragmented and differentiated along the lines of race and ethnicity resulting in segregation and inequalities in educational standards, a lack of quality education to the majority of the people, duplication of functions, services and responsibilities, and vast disparities in the funding of 17 different education systems running in parallel with one another (Edrong, 2000). This educational system was also characterized by low Black education enrollments representing in 1993 only 46% males and 43% females respectively whilst, being, the largest demographic group in the country (∀70% of total population). It is therefore not surprising that the South African Department of Education, shortly after the 1994 election, realised that the inherited educational system was largely dysfunctional in meeting the development priorities of the nation as a whole (Department of Education, 2001).

Yet, despite the negative consequences of the apartheid legacy, the educational system in South Africa were considered to be the most developed in Africa, with access to substantial resources. Some institutions of higher education were even able to developed internationally recognized

competitive research and teaching capabilities (Edrong, 2000).

5.2.3 The Period 1994 – 2008 in South Africa

This period introduced radical transformation in the higher education system of South Africa. Whilst trying to retain the valuable features and achievements of the past, the Department of Education needed to address the system's inequalities, imbalances, and distortions as well as the educational challenges facing a non-racial democratic society (Edrong, 2000). Primarily, this entailed broad based social, political, economic and educational transformation in order to develop and construct an egalitarian and healthy South African education community.

To transform into an egalitarian and healthy South African education community, the government of South Africa embarked on a three-phase approach namely:

1. An initial focus on macro-policy formation, in which the policy and the regulatory framework for this systematic restructuring was elaborated;
2. Development of a planning framework, including the development of a new budgetary framework; and
3. The incremental implementation of the planning framework at national and institutional levels, which is currently taking place.

Further, globally as well as in South Africa, changed external expectations for economic development and internal pressures to generate new sources of income, universities have begun to drastically escalate their involvement in technology transfer, the process of transforming university research into marketable products (Powers & McDougall, 2005). As such it is expected that universities in South Africa will become more and more engage in risky forms of entrepreneurial activity. This implies that South African higher education institutions are seen as 'enterprises' and academics as 'entrepreneurs' contributing towards a "knowledge economy" demanding an exogenous education, research and innovation approach (growing from outside). The South African National Plan for Higher Education therefore gives greater emphasis to link government and business appropriations for universities to the quality of their performance in education and research (Adams, 2006). This in essence force higher education institutions to interact with industry to assist in meeting the needs of the national economy as these institutions are largely depended on money that could be gained from knowledge commercialization (Kroll & Liefner, 2007; Niewenhuizen & Kroon, 2002).

The White Paper on Education 1997; The Higher Education Act 1997; The National Plan for Higher Education 2001; and The New Funding Framework 2003 – offers a framework to higher education institutions to deal with national challenges in higher education and to formulate goals in terms of the (Roberts, Gouws & Van der Merwe, 2006):

- National planning and policy priorities;
- Quantum of funds made available in the national educational budget; and
- Approved plans of individual higher education institutions.

The above framework acts as one of the steering mechanisms by which higher education institutions in South Africa are governed. The funding Framework of 2003 offers excellent opportunities for entrepreneurial universities to (Roberts, Gouws & Van der Merwe, 2006):

- Increase student participation by increasing enrollments as 56% of block grants from the government are allocated to input subsidies;
- Increase output funding by increasing graduate outputs or graduate output rates;
- Enlarge institutional factor grants by proportionally increasing the number of African and Coloured students who are considered to be disadvantaged students based on the previous Apartheid political system of South Africa;
- Ensuring that higher education institutions adhere to the desired 40:30:30 Full Time Equivalents (FTEs) in Humanities, Business and Commerce, and Science, Engineering and Technology; and
- Optimising desired proportions by taking into account the funding groups according to the Classification of Education Subject Matter (CESM) indicated by Table 1.

Table 1: Funding groups by Classification of Educational Subject Matter (CESM)

Funding Group	Ratio	CESM Categories
Group 1	1.0	Education, law, librarianship, psychology, social services, public administration.
Group 2	1.5	Business/commerce, communication, computer science, languages, philosophy/ religion, social sciences.
Group 3	2.5	Architecture/planning, engineering, home economics, industrial art, mathematical sciences, physical education.
Group 4	3.5	Agriculture, fine and performing arts, health sciences, life and physical sciences.

Over and above the funding formula, the South African government has embarked on a steady improvement of higher education via public accountability by means of the National Qualifications Framework (NQF) and the South African Qualifications Authority (SAQA). This system – a system of "reward and punishment" – was created to establish rules for the assessment of the quality of program offerings at institutions and to ensure economic, social and political rationality thereof as a principal of legitimacy (Adams, 2006). These underlying principals clearly allows one to deduct that higher education programs are considered to be commodities in which students, society and businesses become rational choosers as consumers of these commodities.

6. Research Methodology

The research design adopted is based upon firstly; a historical research design approach discussed above and secondly, a survey research design in which a sample of six institutions of higher education in South Africa was selected to participate. Gay (1987) and Leedy (1993) defined the historical research method as the systematic collection, objective evaluation and interpretation of data related to past occurrences as it occurred in a particular space of time to help explain present events and anticipate future events. As this method of research is unable to control phenomena and the research is limited to what data is available as the historical researcher cannot "create" data, the data compiled from existing data was used to clarify and expand existing knowledge to identify challenges facing South Africa in pursuing academic

entrepreneurship. As the educational system of South Africa is highly intertwined with that of Europe, the historical space of this research included both Europe and South Africa.

As South African Higher Education Institutions were historically known as focusing on "certification" and thus promoting the grading of students (endogenous learning) it was decided to conduct a survey to determine the installment of a learning orientation in students (exogenous learning) driven by the knowledge economy and resulting in an academic entrepreneurship approach. The results obtained from the survey will provide an indication of Higher Education Institutions' responsiveness to the demands of the new knowledge economy.

6.1 Data Collection and Measuring Instrument

The data collection process consisted of an in-depth literature review and detective work in the form of primary and secondary sources. The primary sources constitute the original policy documents and reports used in drafting the paper, whilst reference books and journals used represent the secondary data.

A 5-point scale questionnaire was designed for the collection of primary data in order to measure different aspects of students' orientations towards their studies as well as with regard to their study behaviours. A response of 1 with regard to any question was indicative of a student having a complete learning orientation with regard to that question, whilst a response of 5 was indicative of a complete grade orientation with regard to that question. The questionnaire comprised 20 questions. Student orientations were determined by calculating the sum of all students' responses to all questions.

Total student grade orientation would be achieved if all students' responses to all questions were equal to 5 whilst a total student learning orientation would be achieved if all students' responses to all questions were equal to 1. The middle value between a total grade and a total learning orientation represents the "turning point" between learning and grade orientations. Scores below middle values represent a learning orientation, whilst scores above the middle value represents a grade orientation.

6.2 Sample Description

A total number of 229 respondents were randomly selected from a stratified sample selecting respondents from the following subject fields:

- Cost and management accounting (15,8%).
- Credit management (4,8%).
- Economic management analysis (21,9%).
- Logistics (20,2%).
- Marketing (26,8%).
- Public management (9,2%).
- Purchasing management (1,3%).

The sample consisted of 60,4% female and 39,6% male respondents and the average age of the respondents was 21,9 years (with the highest representation (69,6%) in the age category 19-22

years). The 11 official languages of South Africa were represented by the sample as were the nine provinces in terms of geographical distribution of schools attended by respondents. Most (65,9%) of the respondents had to repeat subjects (most repeated 1-2 subjects with an average of 1,6 subjects).

6.2 Data Analysis

The Chi-square test was utilised to test goodness of fit between response distributions of different categorical variables. No difference could be illustrated between the response distributions of:

- Gender;
- Fields of study;
- Study years;
- "Repeaters" vs. "non-repeaters"; and
- Church members vs. non-church members.

With regard to the following categorical variables chi-square test values were not valid due to the fact that the variable presented too many categories, and that too few responses per category were obtained:

- Language groups;
- Provinces where school years were spent; and
- All age categories.

6.3 Data Synthesis

To synthesis findings the researchers adopted the notion that the more similar a new situation is with a former situation, the more applicable will generalizations be that builds on the past situation.

7. Findings

For the purpose of this paper the findings from the historical research design and the survey are interpreted in the following sections.

7.1 Findings from Historical Research

The historical research revealed that the concept of academic entrepreneurship is not an entirely new concept amongst researchers and academic staff in higher education institutions. Both current conditions i.e. research funding, educational funding by governments - nationally and internationally - and the wider socio-economic environments have challenged academics throughout history to modify their patterns of behaviour as well as higher education institutions to adapt to ensure their relevance. Despite the inherent aspiration of higher education institutions, irrespective of time, to create knowledgeable societies, the "knowledge society" of today differs from the knowledge society of the past. Whereas in the past universities were interested in the systematic production and application of knowledge (Stern, 1970) following primarily an endogenous (growing from within) approach to where today higher education institutions are seen as 'enterprises' and academics as 'entrepreneurs' contributing towards "knowledge

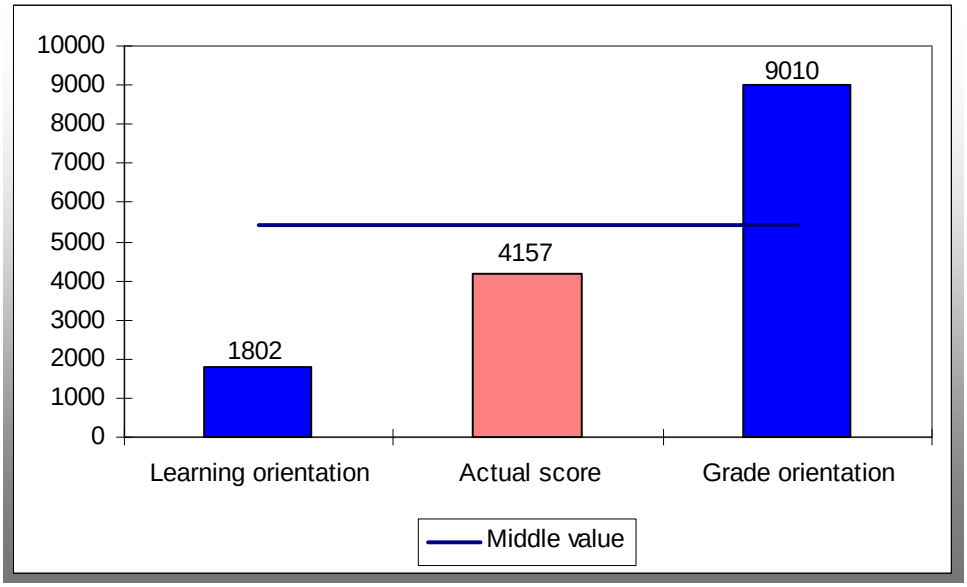
economies" because of an exogenous (growing from outside) approach. The concept "knowledge economy" does not mean the restructuring of the economy according to scientific knowledge, but rather to economize knowledge production to add value to the real needs and demands of society (Lorenz, 2006). This represents a shift from being *homo academicus* (the creature, who dwells with the entirety of his or her being in the educational sphere) towards being *homo economicus* (Economic man as a rational and self-interested actor who desires and contributes towards wealth, avoidance of unnecessary labor, and who has the ability to make judgments towards those ends) (Parker & Jary, 1995:331). The latter implies that the knowledge economy is no longer represented as the domain in which science demonstrates its applied success, but the knowledge economy is rather represented as the domain that determines whether intellectual production is value adding or not.

It appears from the historical research that academic entrepreneurship in essence takes advantage from the "university technology transfer phenomenon" that emerged over centuries caused by constant demands that higher education institutions should be more relevant to societies.

7.2 Findings from Survey

By relating the research on learning orientation to the design of learning environments and learning content it was possible to investigate how learners approach their learning, how they perceive themselves as learners and what they value in the learning experience.

Figure 1: Orientation towards studies



- ***Study orientation***

Figure 1 indicates the orientation of students towards studies. A potential total score of 1802 was achievable for a complete student learning orientation (i.e. if all students had allocated a value score of 1 to each question). On the other hand, a potential total of score of 9010 was achievable for a complete student grade orientation (i.e. if all students had allocated a value score of 5 to each

question). The middle value – represented by the horizontal line – represents the "turning point" between learning and grade orientations. In figure 1 the actual scores of the students fall below the middle value indicating that students know that they have to be learning orientated.

- ***Current study behaviour***

Current study behaviour of students as indicated by Figure 2 shows an inclination towards a grading orientation. This is in contrast with the current study orientation of students where a learning orientation was preferred. This result may be indicative of the strong held belief in society that grading is the most important indicator of studying success.

Figure 2: Current study orientation

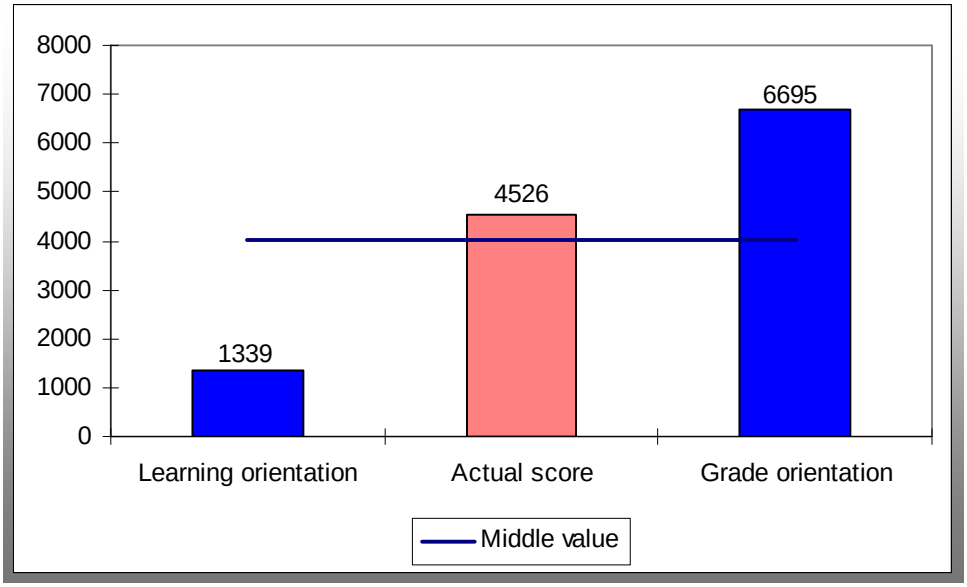
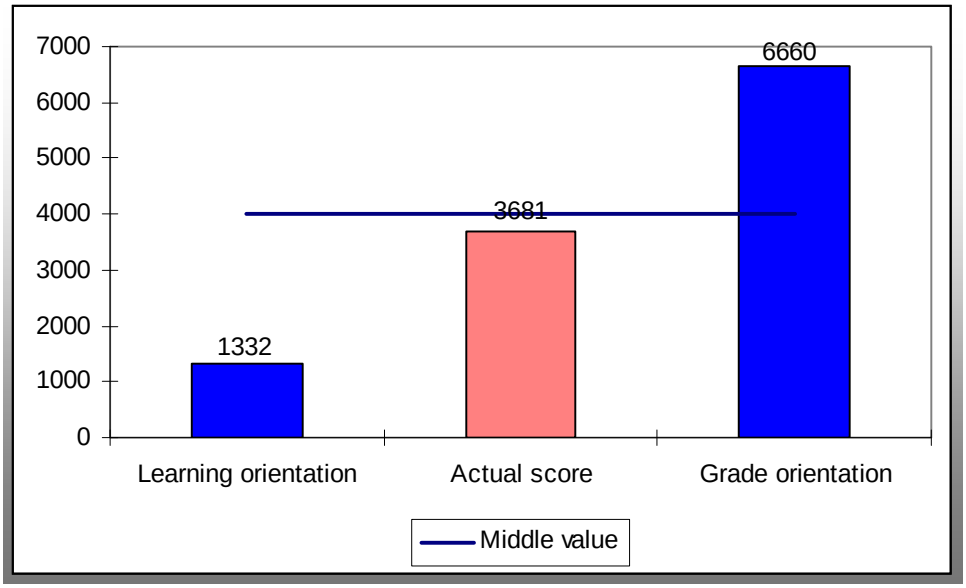


Figure 3: Ideal study behaviour



- ***Ideal study behaviour***

Figure 3 indicates that the students' ideal study orientation is a learning orientation. This implies incongruence between their current study behaviour and their ideal study behaviour. Students are thus aware that they should be learning orientated (Figure 1) but that their behaviour does not reflect that they apply this approach in practice.

- ***Orientation determining factors***

Analysing the individual variables it is revealed that in their current orientation towards studies, learning orientated students feel more strongly about:
- Understanding the field may lead to a good job;
- The study objective being to understand the field and apply the knowledge obtained;
- The need for exposure to a broad spectrum of information; and
- The purpose of studies is to obtain knowledge.

The grade orientated students on the other hand feel most strongly that high marks are an indication of academic success.

Analysing their current study behaviour the learning orientated students feel more strongly about:
- Focus should be on obtaining information about their field;
- Relating course content and practice; and
- Seeking the application of knowledge.

The grade orientated students on the other hand feel most strongly about:
- Knowing prescribed course material; and
- Being driven by prescribed course guidelines.

With regard to ideal study behaviour the learning and grade orientated students respond respectively as follows:

Learning orientated students feel more strongly about:
- Relating course content and practice;
- Being driven by personal development needs; and
- Using various sources of information.

Grade orientated students feel more strongly about:
- Knowing prescribed course material;
- Using prescribed course material; and
- Focussing on the prescribed course.

The researchers discovered significant differences between response distributions of current orientation towards studies and current study behaviour (degrees of freedom = 9, $p = 0{,}005658$). This implies that students' study behaviour is incongruent with what they believe their study

behaviour should be. One can therefore expect that students may feel uncomfortable in the way they understand and manage their own personalised learning approach.

No significant differences occurred between response distributions of current study orientation and ideal study orientation (degrees of freedom = 9, p = 0,517), implying that students understand what study orientation is preferred. This raises the question of whether the educational framework may possibly institutionalise study behaviour that is contradictory to the learning belief orientation of students and the expectancies of the knowledge society.

Several implications for practice emerge from the findings of this research. First, awareness of differing study preferences will help promote understanding of difficulties experienced by students possessing different learning orientations. Second, a question that needs to be addressed is whether the study orientations of students are similar or dissimilar to the preferences held by academic staff, and thirdly, what the effect of academic staff preferences are on the study orientations of students. Discovering the impact of the latter on the study orientations of students may enable higher education institutions to adapt instructional methods to suit the needs of the society better. Lastly, understanding study orientations of students as described by the empirical results may create an opportunity for educators to ensure that an optimal learning environment is provided in accordance to the principals of academic entrepreneurship.

8. Conclusion and Recommendations

It can be concluded that since the medieval period, till today various challenges in the environment in which higher education operates necessitates consideration of establishing co-operative features between institutions of higher education to firstly, capacitate the institutions in terms of resources and secondly, to protect the core function of these institutions to create new knowledge.

Recognition should be given to the fact that since the inception of the university system it was open to students from different parts of the world, giving universities by nature firstly, an international character secondly, allowing students to study under the masters of their choice and lastly, establish a comparative status and reputation for a higher education institution against other higher education institutions.

Further, the offering by institutions of higher education in South Africa today, are to be considered as commodities that could add value, nationally and internationally. However, the current academic entrepreneurship departure point is still relatively weak and the relative performance level is indeed modest as can be expected from South Africa's educational historical past as well as from the transitional challenges imposed on it. However, some positive signs were detected which indicated that higher education institutions in South Africa would be able to position them appropriately to respond to the marketplace demands. In this regard promoting an international character for higher institutions in South Africa may enhance accumulation of entrepreneurial capability and skills as well as purely scientific knowledge which will enhance the potential to transfer expertise from academia to industry and even from abroad to the local market. However, the transfer of expertise can only be achieved if proper mechanisms are created to manage the interface between higher education institutions. In this

regard Balázs (1996) considered mechanisms such as science parks, technology centres and small spin-offs as possibilities.

The integration of academic and business goals forms the basis for growing the entrepreneurial university. Institutions of higher education in South Africa are increasingly recognized to have a broader role in the economic development of the country. The idea is that scientific knowledge has to prove its economic value. In this regard two critical challenges are imposed: first, how to develop a professional interest in academia to work with industry, especially in those working in the applied sciences? and second, what funding formula should be applied to condition academia to engage with industry?

Higher education institutions in South Africa are furthermore challenged to transform themselves into a learning academia. Ensuring successful transformation into a learning academia, higher education institutions must be able to constantly adapt to new challenges in and position itself as a global player in the knowledge economy. Through the latter, universities will fulfill a role as an instrument for bringing high quality human capital into the society. The survey results emphasized the challenge by indicating that the majority of respondents still clearly have a grade orientation instead of having a learning orientation towards their studies. This illustrates the challenge of higher education institutions to install a learning orientation in students as a critical prerequisite to promote academic entrepreneurship in South Africa.

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ACADEMIC ENTREPRENEURSHIP: CHALLENGES FACING SOUTH AFRICA

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Problem Definition
Whilst South Africa is in a process of transforming higher education to address the imbalances of the past, the question arises whether higher education is able to make the transition to academic entrepreneurship as expected by the new global economy which regards knowledge as a commercialized commodity.

Research Questions
The principal research question under investigation is to evaluate to what extend academic entrepreneurship came into being in institutions of higher education in South Africa, and secondly, what challenges are created by this phenomenon for South Africa's higher education institutions?

Theoretical Framework
A historical theoretical framework, in which a timeframe perspective was adopted, combined with a learning theory framework - based upon the commonalities in the learning theories of Carl Rogers, the social development theory, situated learning, the behaviouristic theory and the constructivist theory – was adopted to explain the transitional changes that occurred in higher education in South Africa, to deduct the nature of the modern university, and to conclude challenges for South Africa in its perusal to promote academic entrepreneurship.

Empirical Context
The empirical context in which the study was conducted was in the South African higher education environment.

Research Phase
This research forms part of a more comprehensive research programme focusing on the repositioning of higher education in South Africa to address the educational imbalances of the past and to ensure the relevance of higher education institutions in an increasingly competitive global environment.

Contribution
The paper provides an indication of the transition in higher education in South Africa and the challenges currently faced.

HTSF 2008 - PhD Research:

Complementors and Innovation

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The theoretical setting: Innovation and collaboration

A lot of innovations arise not from any single individual or single organization but instead of collaborative efforts of multiple individuals or organizations. This often faces difficult decisions and might result in losing (partly) control over core processes, the lost of know-how, and shared rewards. At the other hand collaboration creates opportunities that enable learning, more scale, faster development times and shared risks (Gulati, 1998; Gulati, Nohria, & Zaheer, 2000; Powell, Koput, & Smith-Doerr, 1996). The increasing amount of research in business relationships is able to emphasize the contribution to innovation and is argued in several themes: For instance, Network configuration (Burt, 1995; Granovetter, 1973; Håkansson & Snehota, 1995), or network management (DeSanctis, Glass, & Ensing, 2002; Riccaboni & Pammolli, 2003; Ritter & Gemunden, 2003; Von Raesfeld Meijer, 1998). Although recent studies have explored the impact of network position on the performance of a firm to innovate (Ahuja, 2000; Coles, Harris, & Dickson, 2003; Nooteboom, 2000), empirical studies still find ambiguous results:

Need for more entrepreneurship and general network research

Network research in general has been performed for many years and brought about by significant insights into today's body of research. In relation to innovation performance and entrepreneurship, research opportunities remain:

It is argued that all network structures have some benefits (Uzzi, 1996, 1997). To make use of these benefits, entrepreneurial decision making is crucial in directing the firm into the a (good) network position (Burt, 1995; Dhanaraj & Parkhe, 2006). An understanding of the networks dynamics that influence the formation of new alliances can provide insights for managers on path-dependent processes that may lock them into certain courses of action as a result from their current ties (Gulati, 1998). Network-based research in entrepreneurship is still in conflict about the effects of strong ties vs. weak ties, and the benefits of embedded networks vs non embedded networks (Hoang & Antoncic, 2003).

A recently conducted overview of 12 years of entrepreneurship research (Van Praag & Versloot, 2007) concludes similar trends: A scattered picture for the state of research and its results are at large. A lot of variety in definitions of the entrepreneur (and its counterpart), variety in the innovation indicators, and a low sample sizes, are partly responsible for the cause.

The bulk of empirical evidence available is often based on (strategy) research, conducted at large multinational organizations that use patents to protect their mainly technological innovations. Strategy research does include SME's only recently, and non technological innovations are very seldom included. This in contrast to what NPD theory builders argue. They say that making a distinction on the novelty of markets and novelty of technology is important for a thorough understanding on innovation management (Garcia & Calantone, 2002). So far, there has not been made a clear distinction in this context variable market vs. technology. Subsequently, a bias occurs in the measurement of the real innovation performance of companies. Further, in the empirical world, SME's are the major bulk of firms and have entrepreneurs as leading entities. So entrepreneurial research, conducted with clear control groups (Hoang & Antoncic, 2003; Van Praag & Versloot, 2007) (difference between managers and entrepreneurs), is of great value here (Hagedoorn, 2006).

The need for complementor research (as part of the above)

At first, a lot of research has been done to enhance (vertical) collaboration, along the supply chain including customers, see for an extensive overview Pittaway et al., (2004). The role of involving customers in the innovation process is proven to be evident and beneficial (Ritter & Gemunden, 2003). Relationships with suppliers are one of the most important networking arrangements that affects innovation performance and productivity positively (Lamming et al., 2002). Although much of evidence points towards the role of suppliers and customers, it is the praxis that recognizes other parties for innovation. Regarding, parties that provide complementary products (complementors[1](Yoffie & Kwak, 2006)) that lead to innovation.

Current empirical research fails to distinguish clearly between supplier/customer networks and complementor-customer networks. The network literature falls short in highlighting the vast heterogeneity of actors and their consecutive different roles for innovation (Dhanaraj & Parkhe, 2006). Strategic alliances make distinction on how the alliances are formed and how partners are chosen (Borgatti & Foster, 2003), but overlook the implications caused by complementarities. The marketing literature recognizes similar concepts like, supplementary services (Anderson & Narus, 1995), bundling, partnering, co–development co–maker ship co-branding (brand alliances) etc. Of course there exists a risk of making oversimplifications but in general these marketing theories show two fundamental restrictions: At first, classic marketing focuses too much on static economic models and thinks that transactions economics are leading. However, for this research, the following argument is of more importance. Market exchange is truly seen as rational economic based actions in which actors are independent and price is leading (Håkansson, Harrison, & Waluszewski, 2004; Håkansson & Snehota, 1995). This in contrast to one of Granovetter's (1985) most fundamental and proven propositions is that economic action is very strongly affected by networks of social relationships. So, at last, the above fields may benefit clearly from empirical based complementor research.

The empirical setting: the Dutch printing industry

For centuries, the printing industry has served civilization. Distributing and conserving knowledge, news or other data have been there main tasks and are indirectly accountable for the wealth of modern society. They are also responsible for a significant portion of economic activity to national markets. Currently, regarded to jobs and turnover, the Netherlands recognizes almost 50.000 jobs that generate an annual turnover of almost € 7.4 billion (www.kvgo.nl, 2006). From the total amount of 2.996 enterprises, small and medium sized enterprises (SME's) are accountable for the biggest share; 96% of the companies have fewer than 50 employees and only 63 companies have more than 100 employees. The printing industry is a dynamic business characterized by technological- and market change (Boczkowski & Ferris, 2005; Cox & Mowatt, 2003; Hardstone, 2004; Nijhof & Streumer, 1998). Although the paper less office ("The Office of the Future", 1975) didn't prove to be truth, the printing sector is an industry in which computer based technology has already made enormous impacts. This extensive digitizing of products and processes, created many threats, as well as opportunities(Matthyssens, Vandenbempt, & Berghman, 2004). Nowadays (even for higher volumes) traditional offset printing, accountable for the bulk of printing, is more and more replaced by digital printing. Recent industry related developments (Vachon & Klassen, 2006) show that some printing companies have encountered in an early stage that they are dealing with a technological mature industry in which is mainly competed on price (Tidd, Bessant, & Pavitt, 2005) and profit margins are squeezed. For western companies and especially SME's, price competition is in most cases a harsh business and indicates the necessity for innovation.

Enhancing innovation in this technological mature industry is hard to achieve for a single company, for a SME even harder (Hanna & Walsh, 2002). The printing SME's do not have a lot of

[1] *"Complementors are companies that independently provide complementary products or services directly to mutual customers"*.

(e.g. R&D or financial) resources to develop new technologies, what would result normally in a better competitive position. By the way, this is not the issue here. The printing technology is assumed to be more than sufficient. The sector already recognizes some very large high-tech providers (f.i. Xerox, Heidelberg, & Kodak) who manufacture effective machines. Those expensive machines, including stagnation of the demand, have currently caused overcapacity and a large shake out is stirring (Matthyssens, Vandenbempt, & Berghman, 2004). Nevertheless, another issue concerns that most of the printing companies serve low-tech mass markets, in which only little added value can be generated. This underlines that nowadays, business opportunities in the printing industry lay rarely within technological improvements, however printing companies have to search for or expand their network with potential parties that could add value to their product. Alliances and collaboration agreements with non printing parties (complementors) such as IT companies or Logistics partners are becoming very popular to achieve successful innovations.

Research question

Keeping the constraints and opportunities in mind of the printing industry as well as the current state of research and especially the role complementors may play in innovation; the following research question can be derived:

How does collaboration with complementor contribute to the innovation performance of a firm.

This leads to the following set of subquestions:

1. In general, what are complementors and how can they be distinguished from suppliers? Are there different types of complementors, do they fulfill different roles at different times (Empirical & Theorethical)?
2. For a deeper understanding, what are the preconditions if a company wants to collaborate with a complementor to improve the innovation performance? These pre-conditions should include explicitly the characteristics of management in this (Theorethical & Empirical)?
3. How are managers able to proactively design their own networks for a higher innovation performance by means of collaborating with complementors?

Approach

Documented in 4 consecutive papers that will enclose the dissertation, I want to achieve this purpose as follows:

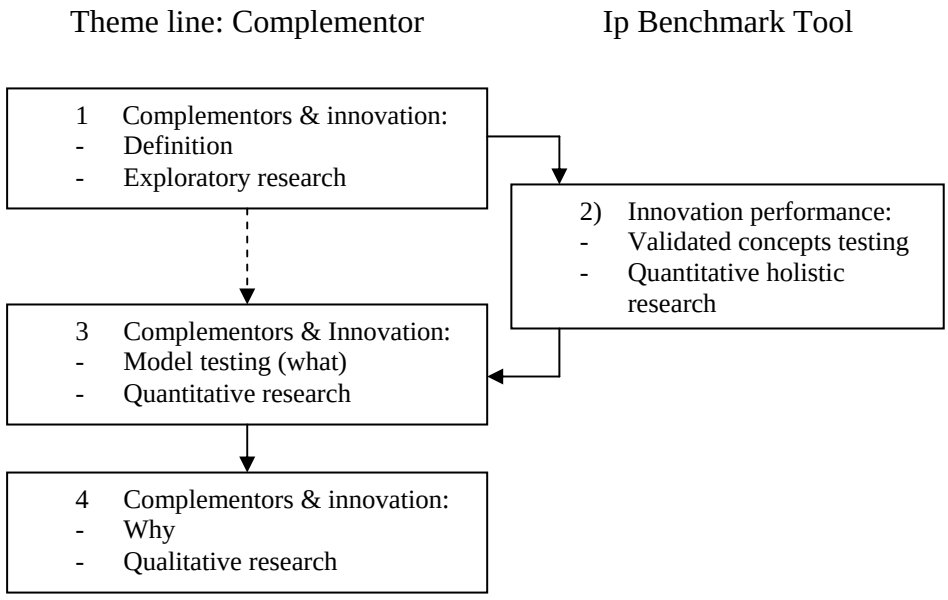

Fig 1. Overview dissertations and its parts / papers

Paper 1:
The primary purpose of this paper is to argue the importance that complementors play in innovation and how the configuration of a business network may affect this. Firstly I will explore the literature for the expected role of complementors, how they are embedded in the value net and how they affect innovation performance. Then, drawing on empirical evidence of the Dutch printing industry we conclude that, complementor collaborations play a key role for market innovation. Interests are frequently misaligned compared to supply chain collaborations subsequently, complementor collaborations are subject to a more complex interplay of strategies, technologies, and market needs. Future research demands for indicating success factors of network configuration and complementor roles.

Paper 2:
The purpose of this paper is twofold: At first I want to replicate past findings by testing "proven" and relevant concepts. This step should bring more insights *in*, but in particular construct a solid base *with* factors that determine innovation performance. Second purpose concerns a more practical purpose. It is given that the printing companies -who are being interviewed- need to receive immediate advice. This will be done with the Innovation Performance Benchmark (IPB) toolbox. The interview is being carried out by consultants that possess a lot of industry knowledge and are able to translate theory into practice. Doing this with validated and well researched scales, shall improve the quality of the advice significantly. Remark: This paper is not the backbone of my "complementor" dissertation, this will be realized by the three-stage rocket paper 1, 3 & 4. However, paper 2 remains a very important step to acquire a valid data set to test complementor hypothesizes.
To achieve the above purposes the following approach will be taken: The tool will be constructed with a model that tries to capture the innovation performance in a holistic way. An Entrepreneurship in Networks (EiN) model (Groen, 2005; Kirwan, Van der Sijde, & Groen, 2006) will serve as framework and is operationalized with proven concepts and validated scales.
The entrepreneurship in networks model conceptualizes that during the entrepreneurial process four kinds of capital in four different domains are accumulated to create value:
• Economic capital: the financial resources in cash and kinds a venture has available and access to. This capital is operationalized with variables like: turnover growth, EBITA percentage to turnover, added value per employee and other known measures from finance & accounting.
• Strategic capital: the way a venture positions itself in the market and attains and uses power. This capital is operationalized by using the Entrepreneurial Orientation (Lumpkin & Dess, 1996) and the market orientation (Narver & Slater, 1990).
• Cultural capital: the knowledge, technology, know-how, experience, and values a venture puts into practice as well as how it organizes this. In this capital we measure the education level of the employees and its consecutive work experience. There is also looked if the company commits resources to training.
• Social capital: the relations of an entrepreneur and his venture with his environment, and the position of the venture within the network. The network for innovation will be analyzed with strong ties and weak ties (Granovetter, 1973), structural holes (Burt, 1995), on a micro (portfolio) level and use an adjusted version of McEvily and Zaheer's (1999) research operationalization.. Further is looked at the content of the relationships and the role every relationship plays. The network analysis will put a solid base for paper three and is. Paper two is a forthcoming of complementor propositions derived from paper 1.

Paper three:
In paper 2 a holistic model was used to assess the innovation performance of a firm in general. In paper 3 a more precise model is constructed by using network theory. The purpose of this paper is to test in depth success factors that affect the innovation performance of a firm when collaborating with a complementor or not. Collaborating with a complementor is not on an ad hoc base. Management should feel a need to collaborate to innovate. However, collaborating with partner's outside your industry is a bigger challenge and concerns more risks. Also a higher degree of pro-activeness is desired to recognize opportunities, and especially take the value out of it. Subsequently, logical

reasoning says that some entrepreneurial orientation probably has a mediating effect and is to be included. The model will be quantitatively assessed by the gathered data from paper 2. Directions for further research will put a basis for paper four.

Paper four:
As paper 2 and 3 explores the contribution of the success factors, in the last paper will be tried to understand *why* these factors cause the success. Here I will use a qualitative approach to find in depth explanations for findings in paper 1, (2,) and 3. Two companies, a complementor and a supplier company are being planned to interview and will serve as case study.
A small introduction about the two companies:
Company "C" fullfils a prominent role as a complementor. "C" is a software company that offers printing companies, as well as end users print on demand (PoD) software. The unique selling points of PoD software is that end-users can make better use of the flexibility of a digital printing machine (f.i. shorter production runs, lower stock / employee costs or the opportunity to variable data printing). Their network approach to collaboration and orientation towards the markets make it a best practice example to qualitatively assess the role of being a complementor.
"OL" is a manufacturer of variable data printer software that can be integrated into the workflow software of the printing OEM's. "OL" sees itself as a true technology provider to optimize variable data printing issues. "OL" collaborates extensively with the big OEM's, via these relationships they are trying to market their product. So whereas "C" is looking to make the pie bigger, "OL" is given users tools to take a bigger piece of the pie.

Empirical Cycle & Research domain:

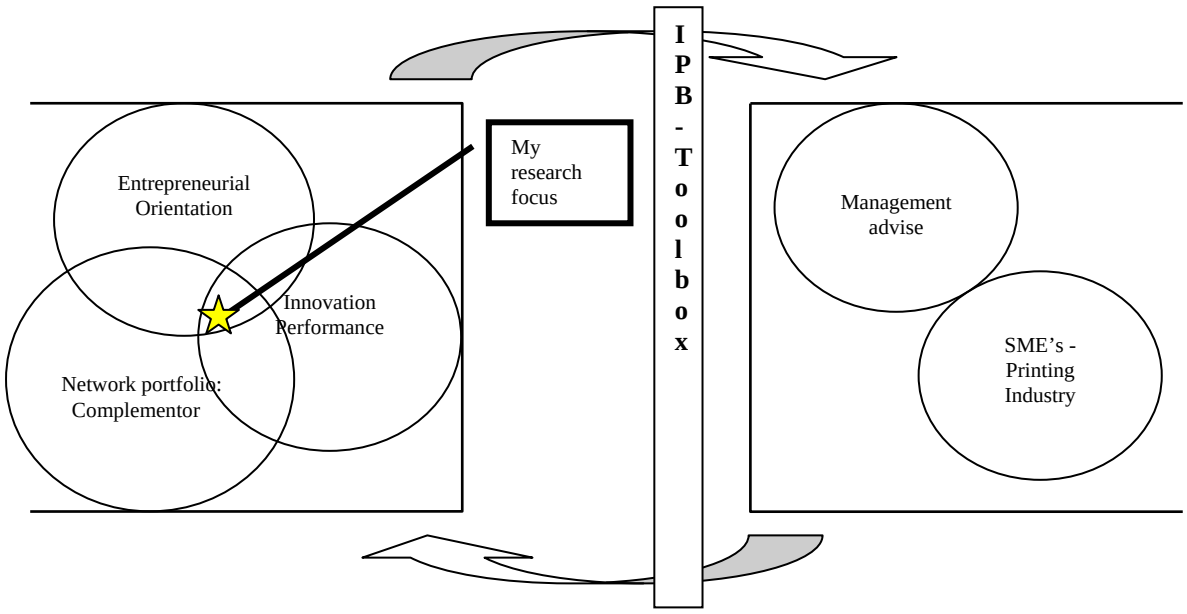

Fig 2.

Renewing insights of research
In this research will be looked to the role of complementors, this is (becoming) a common practical business term but lacks a clear scientific foundation. Definition problems and related (scientific) empiric evidence play a major role in that.

Theoretical and practical relevance
An important direction for the mainstream strategy research lies in incorporating a deeper understanding of adopting a relational or network perspective (Gulati, Nohria, & Zaheer, 2000). The challenge of my research lies not only in studying networks and alliances but to translate theory into practice and give managers feasible recommendations.

Applicability potential and economical perspective

Innovation and network research are very important for the industry for sustainable competitive advantage, although enough questions are not answered yet. More significant empirical results should contribute to the body of knowledge. The economical perspective is to consult firms with the developed IPB tool and help them creating sustainable competitive advantage.

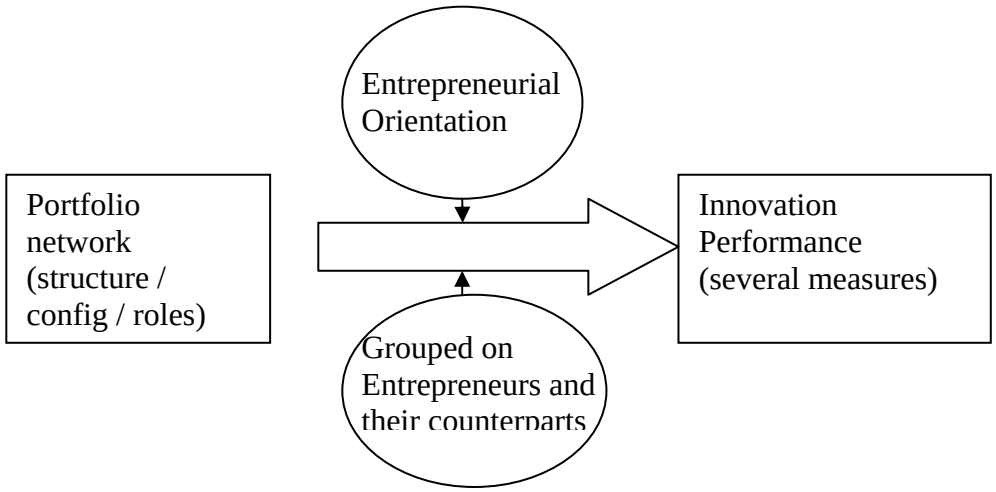

Fig 3. Overview Research Model 1:

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The (r)evolving knowledge transfer function

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Extended abstract

In a previous paper (Van der Heide et al., 2008) we have discussed the different configurations of the knowledge transfer (KT) function at four European universities. The knowledge transfer activities we distinguish are: patents and licensing, university-industry networks, spin-off and enterprise creation, continuous professional development (CPD), international cooperation, European affairs, grants, national and regional subsidies, alumni affairs. The KT function encompasses (1) the knowledge transfer office structure, i.e. the way universities have embedded and organise their KT activities; (2) the focus towards the KT task, linked to the KT strategy and (3) the KT activities itself.
The four exploratory cases of European universities show various motives to perform the KT task, different KT strategies and distinct interpretations of KT activities. We have demonstrated that the configuration of the KT function depends on the university's KT strategy. Various variables explaining these differences can be found in literature, ranging from regional context, university characteristics (# students, # scientific staff, research focus, etc.), funding, government policy, etc. For our present study, we decided to elaborate on university's KT strategy and its KT function by formulating the following research question:

How do mutually comparable universities, located in the same country, organize their knowledge transfer function?

The main objective is to study in more detail the evolution of the KT function at universities with a comparable KT history. We therefore selected three universities of technology from a European country. The universities operate in a different regional context, and vary somewhat in size, number of students, number of staff, etc. However, their official mutual KT history starts in 1979. That year, each university established a 'knowledge transfer point', supported by government funding. Its main purpose was to match business people (especially SMEs) with academics, in order to

improve the university's accessibility and to stimulate knowledge exchange. Ten years later, in 1989, funding for these transfer points ceased. Since that moment on, the KT function developed quite differently at the three universities. However, despite these diverging developments their current configuration is rather similar. Although emphasis differs for various KT activities, the universities pursue the same objectives, i.e.: stimulate economical development, promote employment, and support technological development. Hence, in contrary to our previous findings, the knowledge transfer functions at these universities bear resemblance.
These findings imply that there might be opportunities for developing a blue print or good practice for optimizing the knowledge transfer function in this specific country, at least for these three universities. Regional and national policy, along with the variables mentioned above (regional embeddedness, etc.), seem to have a strong influence on the configuration of the KT function. Therefore, it might be hard to transfer KT function models to other countries. Additional research at more universities should make our tentative conclusions more profound.

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Van der Heide, S., P.C. van der Sijde and C. Terlouw. 2008. The institutional organisation of knowledge transfer and its implications. Higher Education Management and Policy, 20(3): to be published December 2008.

THIRD PARTY REFERRALS IN THE VENTURE CAPITAL FINANCING PROCESS: DO NETWORK TIES MATTER?

WORKING PAPER!

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ABSTRACT

In this paper we focus on the role of third party referrals in the venture capital funding process. Taking network theory as our theoretical perspective we explore if and how third parties play a role in the funding process. Hereby we focus on both the network ties between new venture teams and third parties and the network ties between VC's and third parties. To do so we collected in depth information on 25 venture capital investment decisions and studied how third parties played a role in three investment stages being (1) deal flow, (2) the initial meeting and (3) during due diligence. Our data shows some interesting findings. (1) When a third party is involved in connecting the new venture to the VC fund, strong ties between both the venture team and the third party and between third party and VC seem to be favorable. (2) At the initial meeting between new venture and the VC, third parties don't seem to play a role at all. And (3), during due diligence the role of third parties becomes important again as information source for VC's, however the effectiveness of particular network ties seems to be dependent on the type of information provided by the third party.

INTRODUCTION

During the past decades researchers in entrepreneurship have shown the importance of networks to the entrepreneurial process. In venture capital research however, researchers have shown the importance of networks as well. In this paper, we look at the cross section of these two areas by studying one particular role network ties can play for new ventures and VC's, namely the use of networks ties as third party referral or informant. On the one side third parties are used by the new venture team to act as referrals and on the other side the VC uses third parties as informants in several stages of the investment process. In this paper we focus on the micro processes in the venture capital investment process and we explore if and where third parties play a role in the investment process. Added to this we also research whether existing network ties between venture teams and third parties and between VC's and third parties matter for a third party in order to be influential in particular investment stages. In this way we can explore whether the network of the new venture team or the network of the VC plays a more dominant role over the investment stages. This can have large implication for entrepreneurs, because it provides a fruitful insight in the controllability of the venture capital investment process. For example when it turns out that the tie between the new venture team and third party informant is important in a certain investment stage; this means that this stage can be actively controlled to some extend by explicitly using third party referrals.

By taking this approach we contribute to multiple streams of literature. First we contribute to network literature. Although many researchers have focused on the role of network ties in entrepreneurship, there are still many questions unanswered surrounding the effectiveness of strong and weak ties for entrepreneurs. In this paper we especially contribute to this literature by focusing on the role of tie strengths to third parties that could be helpful in acquiring resources, hereby focusing on multiple micro stages of the venture capital investment process. The micro processes of the investment process we identify are (1) deal flow (2) first meeting and (3) due diligence. Related to this we contribute to the literature on legitimacy, status and signaling by new ventures through the use of third parties. Although past research has shown how a variety of third parties can be beneficial to the entrepreneurial process, there has been a lack of focus on the actual network relations that are most effective for these third party referrals. Finally we contribute to venture capital literature, since current studies on venture capital decision criteria are mostly under socialized. However we expect that especially in early stage investments, the uncertainty and lack of information surrounding new ventures

will force VC's to look for other information signals. One of the information signals that can play an important role in this are third party referrals. Added to that we will study the effectiveness of network ties to these third parties for sourcing three types of information during the venture capital due diligence process, which has not been done in literature before. To conclude with we contribute to literature by combining network literature from a new venture perspective with literature from a VC perspective. By doing so we are able to show whether there are trade offs between the importance of entrepreneur network ties on the one side and the network ties of the VC on the other side.

We will proceed this paper with a literature review. After having identified the shortcomings in literature we will present our analytical model. Subsequently we will present and discuss our findings. This paper provides a lot of new insights into the role of networks on a micro level; however the paper also gives rise to interesting new questions. Therefore we conclude this paper with proposing some new areas for future research

LITERATURE REVIEW

In this paper we try to combine literature from two perspectives. First we take literature that takes the perspective of new venture networks and researches how networks are beneficial to the entrepreneurial process. Secondly, we use the literature that focuses on the role of networks in venture capital deal flow and venture capital decisions. In this chapter we will discuss existing literature from these two perspectives.

New venture perspective: Networks and the entrepreneurial process

In the past decades the research on social networks and their effects on organizations has grown rapidly (e.g. Aldrich and Zimmer, 1986; Birley, 1985; Hite and Hesterly, 1999). Two main discussions dominate the literature to date. The first discussion focuses on the structural characteristics of networks and discusses the effectiveness of closed networks vs. networks rich in structural holes (e.g. Burt, 1982, 1992, 1997, 1999, 2000, 2005; Coleman, 1972, 1988, 1990). The researchers that stress the importance of structural holes highlight the positive effects of diversity of information and brokerage opportunities in such networks. Researchers that advocate the advantages of closed networks stress the trust facilitating mechanism as main advantage in closed networks. Secondly, there is a relational network discussion between researchers focusing on the benefits of weak vs. strong ties to organizations (e.g. Granovetter, 1973; Uzzi, 1997, 1999).

Specific to entrepreneurship there are many studies that show the positive effect of networks to the development of new ventures. For example Zhao and Aram (1995) show in their study that entrepreneurs who are more involved in networking activities are more successful. As a result of this, researchers are researching the structural and relational network characteristics responsible for this positive relation and find that many contingencies are influencing the relation between networks and entrepreneurial outcome. For example Hulsink and Elfring (2003) find that the effectiveness of networks is dependent on the organizational process. Hite and Hesterly (1999) find that the effectiveness of networks is dependent on the life cycle stages and Groen (2000, 2005) claims that the role of networks in the entrepreneurial process is dependent on the type of technologies the venture is involved in.

When we look at current research we see that much research focuses on the direct provision of opportunities and resources to the new venture by their network contacts. However in this paper we focus not on the direct provision of resources by network contacts but on the

mechanism in which third parties and network ties can be helpful in getting resources from other parties. In entrepreneurship literature we find much evidence on third parties and their influence on new ventures. For example Burton, Sorensen & Beckman (2002) show that the prominence of prior employees is closely associates to the firm's initial strategy and the probability of getting external financing. Deutch and Ross (2003) show how the presence of reputable directors can be used by new ventures as a signalling mechanism. Khaire (2005) proposes that new firms with few financial resources and few avenues to obtain them grow by acquiring intangible social resources though networking. Thus she specifically focuses on the positive signalling effect of affiliating to high status customers. This positive signalling effect of customers is also shown by Reuber en Fischer (2005).

The positive effects of networks and affiliated parties have also been shown in the context of financing. For example Chang (2004) examines how the reputations of venture capital firms and strategic alliance partners have a positive impact on IPO success. Higgins en Gulati (2003) show how affiliations of new ventures impact the ability to attract prestigious underwriters. Stuart, Hoang and Hybels (1999) show how firms with prominent strategic alliance partners and organizational equity investors go to IPO faster and have higher valuations then firms that lack those connections. Shane and Stuart (2002) and Shane and Cable (2002) have shown that new ventures that have direct and indirect relationships with venture investors are more likely to attract venture funding and are less likely to fail. To conclude, many researchers have shown how third parties affiliations and referrals are beneficial to the entrepreneurial process and the acquisition of financial resources.

VC perspective: Networks and venture capital financing

We now turn our attention to the second stream of literature that we focus on, being the literature focusing on the role of networks in the venture capital funding process. Networks and third parties are not only important for new venture teams but also for people that work with new ventures and provide them with resources and information. In this paper we research on this area by focusing on venture capital. Venture capital and its decision criteria have been studied extensively in past research (e.g. Hall and Hofer, 1993; MacMillan and Zemann, 1987: Gupta and Sapienza, 1992, Zacharakis and Meyer, 1998 and Maula, Autio & Murray, 2005).

Within venture capital literature that focuses on networks, many researchers have shown the importance third parties to the venture capital decision process. For example third parties play an important role for generating deal flow. The literature reveals differences in the number of deals that come to VC's by third party. Jugel (2001) found that 46% of the new deals come by third party referral. Vater (2002) found a percentage of 54 %, Wells (1974) a percentage of 61% and Tyebee and Bruno (1984) even find a percentage of 65%. These percentages show how dominant the role of third party referrals is in deal flow next to active search and cold calls. More interestingly, Fried and Hisrich (1994) find that deals that come by third party are more often funded then deals coming without any third party referral involved. Some researcher, have also looked into the characteristics of third parties that VC's rely on for deal flow (Aram, 1989; Maula, 2001 and Stuart, Hoang & Hybels, 1999). For example Aram (1989) finds that business referrals are valued over third party referrals of friends and Stuart, Hoang Hybels (1999) claim that third party referrals are particularly valued in areas where these third parties are perceived to have expertise.

Third parties not only play a dominant role in deal flow, they do also influence VC's in latter stages of the investment decision. For example Fiet (1995) compares the use of third party

informants by business angels and VC's in their decisions. He finds that VC's use formal network sources more often than business angels do. Added to that he finds that business angels prefer to rely on acquaintances instead of close contacts. VC investors however rely heavily upon associates at other venture capital firms, especially for market information. Related to these finding, Batjargal (2005) & Batjargal en Lui (2002) show how the referee-venture capitalist tie, referee-entrepreneur tie, and interpersonal trust between referee and venture capitalist have positive effects on third party referrals and investment decisions of venture capitalists. He claims that it will have positive effects when the aforementioned ties are strong.

The isolated nature of the two literature streams

Having discussed the literature from two perspectives, I want to introduce one question that is of core interest in this paper, namely are there any trade-offs between the two streams of network research as discussed in the previous sections? Because if a new venture can use his network ties to overcome uncertainty at VC's and VC's rely on their turn on their networks to get deal flow and to acquire information during due diligence, could this mean that the one network is more prominent then the other. For example is the strength of tie between new venture and the third party he uses for accessing and informing VC's more important then the tie between VC and the third party involved?

SHORTCOMINGS IN LITERATURE

Although many researchers have focused on the role of networks in financing new ventures, some areas can be identified in which there is still a lack of understanding. For example in the work on networks from a new venture perspective, the vast majority of studies focus on the role of networks in spotting entrepreneurial opportunities (Shane, 2000; Singh, 2000) and the direct acquisition of resources by new ventures using existing network contacts (Jenssen, 2001). However the question of how existing network ties can be used to access (unconnected) third parties and their resources is much less researched (Stuart, Hoang and Hybels, 1999; Shane and Stuart, 2002; Batjargal, 2005). Related to this, current approaches haven't focused on the actual effectiveness of existing network ties and tie strengths between venture teams and the third parties that could help new ventures getting funded. Furthermore, most studies on the role of networks in entrepreneurship fail to take a longitudinal approach (Hoang and Antoncic, 2003), therefore there is still little understanding on the development of networks and how they can be effective in different points in time. Related to that there is a lack of studies focusing on micro processes in venture financing (Wright & Robbie 1998). Mostly the characteristics of a new venture's network are used as an explanatory variable for some kind of outcome variable, thus focusing less on the exact micro processes that cause this specific relation. For example the value of strong and weak ties in acquiring resources are often researched without specifying which resource is acquired or without controlling for the characteristics of the entrepreneur that wants to acquire the resource (Jenssen, 2001).

Not only has the work from the new venture perspective faced shortcomings. The work from the perspective of the VC has many unexplored areas to date as well. For example research on venture capital and venture capital decision criteria often assume a rational actor that collects information, balances it and takes a decision. In this research, the social context in which a VC takes his decision is often overlooked (Maula, 2001). Although some researchers in venture capital decision making have taken into account third party referrals as a dummy in their studies, there is still a lack of understanding on the effectiveness of exact network tie strengths to these third parties. Added to that, research from the VC perspective also lacks

studies that focus on micro processes. This means that these studies often relate the value of third party referrals and networks to IPO or funding decisions (e.g. Batjargal, 2005; Chang, 2004; Higgins en Gulati, 2003; Shane and Stuart, 2002; Shane and Cable, 2002; Stuart, Hoang and Hybels, 1999), however there are many sub processes before taking a funding decision that could all be differently affected by third parties (deal flow, first meeting, due diligence). Added to this, researchers have also failed to relate the third party referrals that VC's use during due diligence to particular types of information, since it can be expected that the type of people used for due diligence depends a lot on the information sought for.

In this paper we will apply network theory to get a better understanding of the role that networks/third parties play in the VC's funding process from both perspectives (new venture and VC). Following the shortcomings in literature, there are three main questions we want to study in this paper. (1) Is the role of third parties important in the multiple investment stages (2) If so, do these third parties have existing ties to the VC and/or the new venture? (3) If there are existing ties, to what extend does the strength of the tie between the third party and the VC and/or the new venture matter?

MODEL

In figure 1 an overview is presented of the model we use in this paper to overcome the shortcomings as identified in the previous chapter. What will do is to explore the importance and strength of existing network ties between the new venture team and the third parties involved and between the VC and the third parties involved in the venture capital financing process. By doing this we get a better insight in the importance of existing network ties and tie strengths. Added to that we are able to study the trade offs between the two ties, because as already discussed, existing approaches mostly focus on only one of the two ties.

We will do this in this paper by studying the third parties involved in three early VC investment stages, these stages are (1) Deal flow: We explore which third parties are involved in bringing new deals to the attention of the VC. By this we mean the third parties that are involved in arranging a first meeting between the new venture team and VC. (2) First meeting: We explore how third parties play a role when assisting the new venture team during a first meeting with the venture capital investment managers. (3) Due diligence: We explore which third parties are involved in due diligence. In other words, what kind of people do VC's rely on to provide them with information about potential investments. Since we divide the investment process into multiple micro stages, we are well able to see which ties are most prominent over the different stages, thus getting a better understanding of the role of networks in a longitudinal sense.

One additional dimension we include for the third parties involved during due diligence is type of information. Since we expect that the third parties that VC's rely on differs a lot for multiple types of information. By doing this we contribute to the venture capital literature since relating the type of third parties involved in venture capital decisions to the type of information they provide hasn't been done yet. Based on the venture capital literature, we make a division between three main types of information that actors could provide during due diligence. The multiple types of information we identify are: (1) Information on the technology and legal position: this concerns e.g. checking the quality of the technology and ability to protect the technology. (2) Information on the new ventures business model: e.g. market characteristics, strategy, positioning, pricing and marketing. (3) Information on the new venture team: e.g. background of the team, knowledge level of the team members, the

team's openness to advice, how the team deals with conflict and the level of skills the team members have.

Insert Figure 1 about here

METHOD

To examine our research model, we conducted structured interviews with ten early stage venture capital firms in The Netherlands. When discussing past investments, the VC's were asked to mention the network partners/third parties explicitly involved during the first three stages of the investment process. By this we mean that we focus on those third parties to which the VC had personally spoken to. Data were collected by conducting structured interviews with the venture capital fund managers. Since confidentiality is an important issue in venture capital, the interviews were not taped. However, information on third parties outside the scope of the structured interview was noted as well. Subsequently the data was checked with publicly available sources. In our analysis we combine the data of our structured questionnaire with the additional qualitative information on the third party referrals and information sources noted during the interview. In the questionnaire we asked a wide range of questions on the actors involved in the funding process. This includes information on e.g. an actor's reputation, power position, functional background, economic interest and social network. Tie strength between the VC and the third party was measured by three items derived from Granovetter (1973) (affinity, length of relation and contact frequency). The affinity between third party and new venture was scored by the VC as well. In this way we are able to create overviews over actors involved during the venture capital funding process and the ties between them. In this way we can identify potential patterns of network configuration that are most effective over the funding process.

During the interviews we discussed 20 funded propositions and 5 unfunded propositions with the VC's. Of the 20 funded propositions we studied the whole investment process. The 5 unfunded propositions are all examples of propositions that didn't manage to arrange a meeting with the VC because of the third party referral involved. We asked the VC's to come up with these unsuccessful third party referral examples in order to create variation in the successfulness of third parties involved in deal flow. This lead to a sample of 15 cases in which there was a third party referral involved deal flow. Ten times this third party referral was successful, however in five cases the VC's gave examples of third party referrals that didn't lead to a first meeting (as just stated, we asked for examples in which the third party characteristics were the main cause to not meet with the venture in 5 cases). During the interviews we also collected in depth information on third parties that the VC's consulted during due diligence (when this stage was entered for the specific proposition!). For those 20 proposition that entered due diligence, we asked the VC's to come up with one example of someone that played an influential role in their due diligence process. This lead to a sample of 19 third parties that played an influential role in the due diligence process, since in one of the cases the VC didn't consult any third party during due diligence. Of these 19 third parties, 5 provided information on technology, 12 provided information on the business model and 8 provided information on the team.

RESULTS

Deal flow

The first stage of the venture capital investment decision in which we explore the role of third parties is deal flow. However before we discuss the actual third parties involved we will discuss some statistics collected during the interviews to give some more background on this stage of funding. To start with we found that the number of deals the VC's in our sample screen every year ranges between 50 and 600, on average VC's receive 196 requests for financing every year. Related to the topic of this paper we found that the percentage of deals that comes to VC's through third parties ranges between 20% and 90%. On average, in about 51% of the deals that reach VC's there is a third party involved. This means that in more than half of the cases it is a third party and not an entrepreneur that is responsible for the initial connection to VC's! Next to these statistics we also discussed the most important sources of deal flow of VC's. Of the ten VC's we interviewed, six indicate their network as the most important source of deal flow. Two VC's see new venture teams coming directly to them as dominant source of deals and two VC's see active scouting as most important source of deal flow. There are many reasons why VC's prefer deals that come through their networks or third parties as opposed to deals coming through other channels. In the following summary we show some quotes we collected during the interviews that show the advantages and importance of deals coming through third parties. The summary shows a variety of reasons why third parties can play a positive role in getting access to new deals.

Quote 1	"I don't look at deals that come by mail by definition. Problem with email is that many entrepreneurs send around their business plans without having checked our basic investment criteria."
Quote 2	"When deals come by mail I am a bit sceptic, because then I know that at least 10 other VC's have seen as well. This takes away the exclusivity of the deal, which is something that we value a lot. "
Quote 3	"When a deal come by a third party, say a corporate finance house, it shows that the entrepreneur is willing to let other people help him. We often meet entrepreneurs that don't have much knowledge on financing, but who did not consult any professional in financing before coming to us. This looks to us as being very unprofessional"
Quote 4	"I can surely say that third party referrals are very important to our deal flow. Looking the propositions that reach us, I can say that we have talked to many entrepreneurs that we wouldn't have talked to when there was no third party involved"
Quote 5	"When looking at our portfolio, we see that most of the firms we invested in came to us through our networks. We have hardly funded ventures that came to us outside our network. I think I can say that the quality of the ventures that contact us directly is much lower".
Quote 6	"Since our focus is on the region, we take the tips we get from third parties

	very serious. When we don't do this they will probably don't come to us in the future."
Quote 7	"The investment community is rather small; everyone knows pretty well where a particular VC is looking for. So when we get tips of other VC's, we know that it will be within our scope of investment."

Although the quotes show that third parties can be beneficial to new ventures in connecting to VC's, the success of a third party referral is obviously very much dependent on the characteristics of the third party involved. In this paper we focus on two of these characteristics of the third party involved, being their network ties to the VC and to the new venture. During the interviews we identified 15 third parties that were involved in deal flow. In ten cases this led to a first meeting with new venture team and in five cases it didn't. In table 1 we give an overview of the people involved in connecting VC's to new deals and their tie strengths to the VC and the new venture. Added to that we also indicated whether the third party referral led to a first meeting.

Insert Table 1 about here

Table 1 gives some interesting insights in the importance of network ties for deal flow. First of all it shows that in all the successful referrals, there was an existing tie between the VC and the third party. Also, when looking at the unsuccessful third party referrals, the table shows that in three of the five cases the VC didn't have an existing tie to the third party. This result clearly indicates that an existing tie between VC and third party has a positive effect on the chance that a third party referral will lead to a first meeting. When looking at the strength of ties between VC and third parties during deal flow, the table clearly shows evidence that stronger ties are more favorable over weak ties between VC and third party.

When looking at the tie between third party and new venture, the table shows evidence as well that a strong tie between third parties and new ventures is as well favorable to access VC funds. For the successful third party referrals, the VC's indicated that the ties between third parties and new ventures were stronger then for the unsuccessful third party referrals

First meeting

The second stage in which we wanted to explore the role of third parties is during the first meeting. On average the VC's in our sample meet 69 new propositions a year, varying between 25 and 125. During the interviews we found evidence that the role of third parties is very small during this stage. Although third parties can play important roles when connecting entrepreneurs to the VC, this effect does not hold during the first meeting.

Quote 1	"To come back to the role of networks in our financing process, I can say that in this stage networks hardly play a role. A third party might have helped in arranging a connection to us, however once in our first meeting it is up to the entrepreneur himself."

Quote 2	"In this stage we want for example find out if the entrepreneur is a salesman. He can have a brilliant technology, but when he cannot sell it's useless to us"
Quote 3	"When we first meet the entrepreneur, we want to find out what kind of guy he is. Very important in this is that their must be a click between us and the entrepreneur, simply said we must like the entrepreneur "
Quote 4	"When an entrepreneur is in mostly the basic characteristics of the deal are OK. During the meeting I mainly want to find out if the guy is the one that can build the company, since execution is the most important to any idea."

During the first meeting it is really about the new venture team itself. Before meeting the new venture team the VC already makes sure that the basic criteria of the deal are matching their criteria (market size, scalability, focus, proprietary technology etc.). During the meeting with the new venture team it is really about the team itself and the VC's indicate that third parties do not play a role. During the first meeting the VC's main focus is on the characteristics of the new venture team e.g. their first impression, coach ability, openness, integrity and the fact that the team has a consistent story.

Due diligence

The last stage in the decision process before deciding to invest is due diligence (DD). During due diligence the VC wants to decrease uncertainty as much as possible by checking the information they posses about the proposition. Whereas in latter stage investments the due diligence work is often done by external firms, due diligence in early stage investing is often done by the VC himself. There are two main reasons for this. First, the VC doesn't want to rely on external judgment to base an investment on. However there is also a more practical reason for this, being the costs of due diligence. Since the investments in early stages are usually lower then in latter stages, the size of the investments in early stage high-tech new ventures often don't justify the relatively high costs of an external due diligence.

During due diligence the VC makes use of a variety of information sources like public available information, network contacts and other third parties. In this paper we focus on third parties as an information source during due diligence. Again we state some quotes we collected during our interviews that show the importance of third parties as an information source. On average the VC's we interviewed indicated that on average that they contact 6,3 third party informants during the due diligence stage. However the number of third parties contacted (outside the venture capital firm!) ranges between 0-20.

Quote 1	"I once invested in a company that I had hardly spoken to. I met the entrepreneur myself only once. For the rest of the due diligence I completely relied on an other venture capital firm, since it was a syndicated deal."
Quote 2	"We once invested in a venture without doing due diligence myself, since a friend of mine assured me that everything was OK. The venture went bankrupt in 4 months, so I will never invest without conducting my own due diligence

	again!"
Quote 3	"When other VC's want to co-invest, this is a very important signal to us"
Quote 4	"During due diligence we always call 5 (potential) customers, because to us this are the most important stakeholders to us that determine the success of a firm."
Quote 5	"We prefer to conduct our own due diligence. Most of the knowledge we need to judge proposition we have in house, however especially for technology we rely on our network of contacts"
Quote 6	"For this proposition it was very important that the professor was enthusiastic about the technology, otherwise I think we would not have had invested"

Third parties are an important information source during due diligence, and in this paper we want to focus in depth on the importance of network ties to these third parties. However before we continue to discuss the network characteristics of third parties involved during due diligence, we want to highlight again that we relate the information provided by the third parties to three types of information. These three types are (1) information on technology and legal issues regarding the technology (2) business model information and (3) information on the new venture team. During our interviews we collected in depth information on 19 third parties that played an important role in a VC's decision to invest. We will subsequently discuss the importance and presence of network ties between third party and VC and third party and new venture for the 3 types of information areas.

Technology information

When we asked the VC's for the most important third party involved in their investment decision, they came up with five third parties involved in technology due diligence. In Table 2 we summarize the characteristics of these third parties. In three of these five cases the VC hadn't an existing relationship to the third party. Therefore table 2 seems to indicate that an existing tie to the VC is not really needed for a technology information source to be influential. The table indicates as well that a tie between third party and new venture doesn't have a favorable affect in order to be more influential. In three of the five cases the VC's relied on a third party referral that wasn't connected to the new venture team in any way. To summarize it seems that for technology information existing ties between the third party and VC and the third party and new venture don't matter.

Insert Table 2 about here

Business model information

During our interviews we found 12 third parties that provided important information on the business model. In Table 3 we give an overview of our findings. When we look at the tie between these information sources and the VC, it seems to be that VC's tend to rely on people that they have existing relations to. Added to that they tend to rely on people that they know very well, so have strong ties to. One exception to this is the role of customers as a source of information. In two cases the VC contacted and relied heavily on someone they didn't know

beforehand and in both of these cases this was a customer. Therefore is seems that customers have a special role in the due diligence process, since network ties seem less important for them in order to be influential. When looking at the ties between the third party referrals involved in providing business model information and the new ventures, we see that in eight of the 12 cases they have a tie. When looking at these eight cases, the strength of tie doesn't seem to play a big role. In four of the 12 cases they hadn't even any tie, so the tie between new venture and a third party information source doesn't seem to be very important for the provision of information on the business model.

Insert Table 3 about here

New venture team information

The third and last type of information we identified was information about the new venture team. During the interviews we identified eight third parties that provided information on the new venture team. As can be derived from Table 4, the finding for the tie between third party and the VC is similar to the finding on business model information. In six of the eight cases the third party had a strong tie to the VC, indicating support for a favorable effect of a strong and existing tie. In two cases however, the VC relied on someone they didn't know beforehand. Again in both cases this was a customer, indicating again a special role of customers in the due diligence process. When we look at the tie between the venture team and the third party, Table 4 shows that in all cases the third party knew the venture team. This is evident since this is the reason why the VC contacts the third party in the first place. There was no case in which the VC indicated that the third party and the new venture knew each other "very little", indicating support for the claim that the VC wants to rely only on third parties that are strongly tied to the new venture.

Insert Table 4 about here

CONCLUSIONS & IMPLICATIONS

Before discussing our contributions to literature and practice we shortly summarize our findings. In table 5 we give an overview of our results. First of all we find that the role of third parties in the venture capital funding process is most prominent for deal flow and during due diligence. When delving into the findings from a new venture perspective we see that there are two events in which a tie between the new venture and the third party has a positive contribution to the financing process. First it seems that a strong tie between the new venture and the third party referral has a positive effect when using this third party to get access to venture capital funds. Secondly our findings show that a strong tie between the new venture team and third party is favorable when this third party is consulted by the VC regarding information about the team during due diligence. For the other events in the venture capital investment decision, our results don't show evidence of positive effects of ties between the new venture and third parties.

When shifting to the findings from a VC perspective we find that VC's tend to rely on strongly tied third party referrals for deal flow. During due diligence however we find a

mixed pattern. For technology information an existing network tie between VC and the third party consulted by the VC doesn't seem to matter. However for business model information and team information we find evidence that VC's rely on strongly tied third party referrals.

Insert Table 5 about here

Our approach to explore the role of third parties over the venture capital investment process adds to network literature in several ways. First of all, by focusing on the third parties involved over the venture capital funding process, we give more insight in the role that networks and third parties can play in order to get access to resources of unconnected actors. Previous studies fail to focus on this mechanism and mostly focus on the direct provision of resources by network contacts. By taking this approach we also add to the status and legitimacy building literature since it shows how and when third parties can be used to signal status and legitimacy. For example our results show (see table 5) that the signaling effect of strong ties third parties is most prominent when accessing funds and for due diligence on the team. However for sourcing technology information and business model information by VC's we don't find this positive signaling effect of new venture network ties to third parties, since the VC value their own network ties far more for these types of information. A related contribution to network theory is our focus on studying the ties between three actors (the venture, the third parties and the VC). By studying the ties between 3 actors we could also study tradeoffs in the network of entrepreneurs and other stakeholders (VC's) that are often overlooked in literature. Because many studies only focus on dyadic network relations, there is still little understanding on the effectiveness of triadic network relations. Our results clearly show how the importance of the VC-third party and the third party-new venture tie is dependent on the stage of investment. This dynamic importance of ties gives much more insight to the funding process than if we had only focused on one of these ties. A third way in which we add to network literature is that we studied the role of network ties over different stages of the investment process. Our results clearly show how the importance of networks and network ties is different over the stages of the investment process. Therefore we show how important it is to clearly define and focus on particular processes when studying the role of networks in entrepreneurship. When not doing so, one wouldn't do justice to the complexity and importance of network mechanisms on micro levels. A final contribution to network theory is that we go one step beyond the general assumption in network literature that weak ties are important for information and strong ties important to facilitate trust. Up to now, literature showed that weak ties will have a positive effect on the acquisition of new information. However, our results indicate that the effectiveness of certain network ties is dependent on the type of information acquired by VC's during due diligence as well.

This paper also extends the venture capital literature in several ways. First of all we add to the literature by focusing in depth on the social context of venture capital decisions. Although multiple researchers have made claims on the importance of the social context of venture capital decisions (especially in early stage investments), this context is still very much overlooked in prior venture capital research. An additional contribution to literature is that we focus on multiple micro processes in venture capital decision making. Current studies on venture capital deal flow and venture capital decision criteria are mostly conducted by focusing on a certain stage of the venture capital decision process. However there is still much unknown about the dynamics of venture capital decisions and for example the importance of certain decision criteria over the different stages of the investment process. In our paper we do

focus on these dynamic, for example we show that there are two points in which existing network ties play an important role in the funding process. First of all we show that existing network ties play an important role in connecting new venture teams to venture capital funds. Added to that we find that VC's for deal flow tend to rely on third party referrals they have strong ties to. Subsequently we find that networks play a minor role during the first meeting with the VC since it is up to the new venture team itself in this stage. However we find that networks do play an important role again during due diligence. This last result is another way in which we add to the venture capital literature, because we study the role of networks as information source during due diligence in greater detail. Although some studies take into account a third party referral as a dummy variable, there are hardly any in depth studies that look into the nature of network ties to these third parties. Very interesting finding in this respect is that the role of existing network ties during due diligence is different for different types of information. For example we found that for technology and legal information networks ties between VC and third party don't seem to matter, whereas for business model and team information VC's tend to rely on third party informants they have strong ties to.

Our paper has large implication for practice, especially for the practice of entrepreneurship support. For example, since we know more about the types of third party referrals that are most influential over the venture capital decision process, we are better able to select the people that can support new venture teams in acquiring venture capital funding.

LIMITATIONS & FUTURE RESEARCH

A first direction for future research is to extend the research in a quantitative sense. This will enable us to test whether the relations we find in this paper hold statistically.

A second area of future research is to approach the funding process of VC's in a multi dimensional way. By this we mean that we should take into account other characteristics of the actors in the venture capital funding process instead of just the network ties. This is supported by our findings, since for example customers seem to play a special role in the due diligence process which cannot be solely explained by network ties. Although this paper provides a fruitful insight into the role of networks in the funding process, it would be interesting to see how the importance of network ties is influenced by the characteristics of the actors involved. For example it would be interesting to research how the importance of network ties is influenced by for example the strategic, economic and cultural characteristics of the third party referral, VC or new venture. In this way we will be better able to articulate the exact contingencies that influence the importance of network ties. Related to this it would be interesting if the network effects that we find in this paper are a direct effect or whether networks play a more indirect role. For example it could be that network ties don't cause a direct effect on the funding decision, but that networks are having a moderating effect on the perception of a new venture's strategic, economic or cultural capital.

To conclude with we propose one other direction for future research, namely the application of our approach to the acquisition of other resources. It would be very interesting to research whether the role of networks for acquiring knowledge or personnel is different compared to the acquisition of financial resources. By doing so, we will be able to develop networking strategies for entrepreneurs for multiple types of resources.

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FIGURE 1

Analytical Model

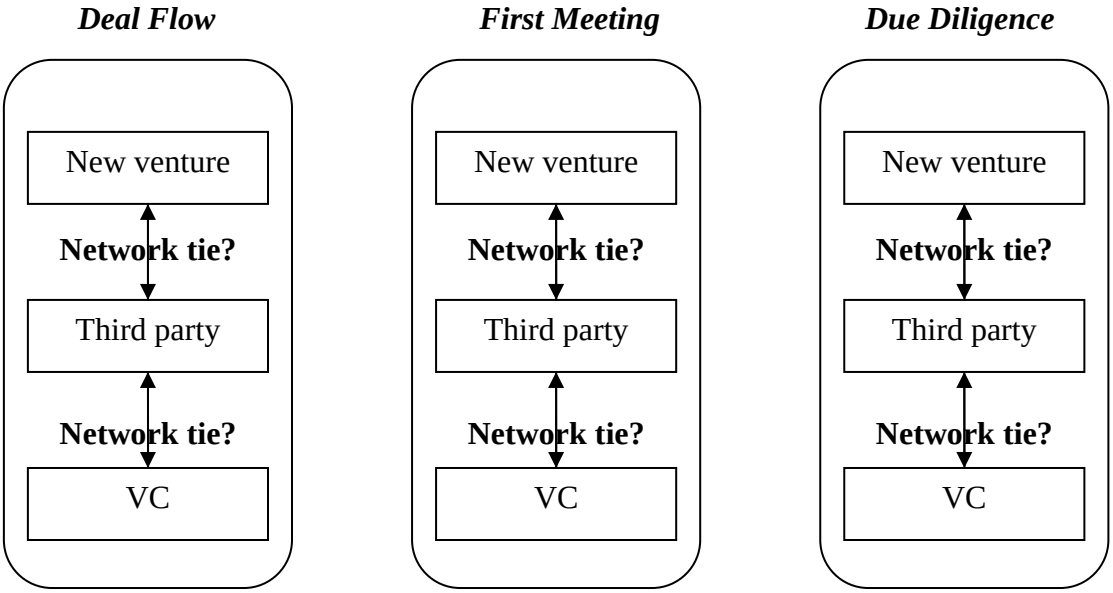

TABLE 1

Third Party Referrals Involved in Deal Flow

Type of Third Party Referral Involved in Deal Flow	**Third Party-VC Tie (Strength)**			**Third Party–Venture Team Tie (Strength)**	**Was the Referral Successful ?**
	Contact length in years	*Contact frequency*	*Contact intimacy*	*Contact intimacy*	*Y/N*
Other VC	10	Monthly	Very well	Very well	Y
Accountant	5	Monthly	Somehow	Very well	Y
Bank	15	Monthly	Very well	Very well	Y
Other VC	2	Monthly	Very well	Very well	Y
Personal network	3	Weekly	Very well	Very well	Y
Accountant	-	-	-	Somehow	N
Other VC	5	Monthly	Somehow	Somehow	Y
Chamber of commerce	1	Yearly	Very Little	Very Little	N
Board member	7	Monthly	Very Well	Very Well	Y
CF advisor	-	-	-	Somehow	N
Bank	5	Weekly	Very well	Very well	Y
CF advisor	7	Yearly	Very little	Somehow	Y
Personal network	2	Yearly	Very little	Somehow	N
Personal network	5	Yearly	Very well	Very well	Y
Consultant	-	-	-	Somehow	N

TABLE 2

Influential Third Party Informants during Due Diligence for Technology Information

Type of Third Party Involved	**Third Party-VC Tie (Strength)**			**Third Party–Venture Team Tie (Strength)**
	Contact length in years	*Contact frequency*	*Contact intimacy*	*Contact intimacy*
Professor	6	Monthly	Somehow	-
Technology specialist	10	Monthly	Somehow	-
Law specialist	-	-	-	Somehow
Technology specialist	-	-	-	-
Technology specialist	-	-	-	Very well

TABLE 3

Influential Third Party Informants during Due Diligence for Business Model Information

Type of Third Party Involved	**Third Party-VC Tie (Strength)**			**Third Party–Venture Team Tie (Strength)**
	Contact length in years	*Contact frequency*	*Contact intimacy*	*Contact intimacy*
Board member	10	Monthly	Very well	Somehow
Director company	5	Monthly	Very well	Very little
Director company	20	Monthly	Very well	-
Shareholder of VC	15	Monthly	Very well	Very well
Director company	4	Monthly	Very well	-
Customer	5	Monthly	Very well	Very well
Customer	-	-	-	Very well
Other VC	10	Monthly	Very well	Somehow
Board member	6	Monthly	Very well	Somehow
Director company	7	Monthly	Very well	-
Consultant	10	Yearly	Somehow	-
Customer	-	-	-	Somehow

TABLE 4

Influential Third Party Informants during Due Diligence for New Venture Team Information

Type of Third Party Involved	**Third Party-VC Tie (Strength)**			**Third Party–Venture Team Tie (Strength)**
	Contact length in years	*Contact frequency*	*Contact intimacy*	*Contact intimacy*
Major of town	12	Monthly	Very well	Somehow
Shareholder of VC	15	Monthly	Very well	Very well
Customer	5	Monthly	Very well	Very well
Customer	-	-	-	Very well
Other VC	10	Monthly	Very well	Somehow
Board member	6	Monthly	Very well	Somehow
Customer	-	-	-	Somehow
Other VC	6	Monthly	Very well	Very well

TABLE 5

Summary of Results

	Importance of Third parties	Importance of Third party-Venture team tie	Third party-Venture team tie (Strength)	Importance of Third party -VC tie	Third party -VC tie (Strength)
Deal flow	+	+	Strong	+	Strong
First meeting	-	-	NA	-	NA
Due Diligence -Tech info	+	-	NA	-	NA
Due Diligence -BM info	+	-	NA	+	Strong
Due Diligence -Team info	+	+	Strong	+	Strong

An investigation on environmental scanning and growth strategy in high tech small and medium sized enterprises

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Abstract

The idea that environmental scanning can be a key factor to sustained competitive advantage calls for the integration of business strategy and environment. Not surprisingly, environmental scanning is widely viewed as the first step in the process linking strategy and environment. The main debate in strategy and environment is nowadays concerned with the primary importance of environmental scanning to strategy formulation and implementation. More specially, effective scanning of the environment is seen as necessary to the successful alignment of competitive strategies with environmental requirements and the achievement of outstanding performance in SMEs. This paper explores the above relationship in the British electronic manufacturing industry. It is based on the empirical evidence and the findings of a survey of 132 Chief Executive Officers' (CEO) views on environmental scanning and strategy in SMEs. It is concluded that, there is a significant relationship between increasing the environmental scanning of the firm, and the success of the firm's performance in small and medium sized manufacturing firms in electronic industry. Accordingly, because of dynamic aspect of electronic industry, obtaining information on several aspects of environmental sectors facilitates alignment between business strategy and environment.

Introduction

Strategies followed by business usually include a plan of action and policies intended to create a competitive advantage in the marketplace. Although much work has been undertaken to analyse and investigate strategy in large corporation, until recently there has been little concern with the environmental scanning in small and medium sized enterprises (SME) (Aram and Cowan, 1990; Foster, 1993; Lang et al, 1997; Smith, 1998). The idea that environmental scanning can be a key factor to sustained competitive advantage calls for the integration of business strategy and environment. Not surprisingly, environmental scanning is widely viewed as the first step in the process linking strategy and environment. The main debate in strategy and environment is nowadays concerned with the primary importance of environmental scanning to strategy formulation and implementation (Walters, 1993). More specially, effective scanning of the environment is seen as necessary to the successful alignment of competitive strategies with environmental requirements and the achievement of outstanding performance in SMEs. This paper explores the above relationship in the British electronic manufacturing industry. It is based on the empirical evidence and the findings of a survey of 132 Chief Executive Officers' (CEO) views on environmental scanning and strategy in SMEs. It is concluded that, there is a significant relationship between increasing the environmental scanning of the firm, and the success of the firm's performance in small and medium sized manufacturing firms in electronic industry. Accordingly, because of dynamic aspect of electronic industry, obtaining information on several aspects of environmental sectors facilitates alignment between business strategy and environment.

Environmental Scanning in SMEs

SMEs increase their chances of success through making a serious attempt to work through the strategic issues embedded in the strategic management model (Wheelen and Hunger, 1998). For SMEs the key point is to focus on what is important-the set of managerial decisions that determines the long-run performance of the firm. The literature review shows that, a number of models have been proposed for strategic management in SMEs (Linneman, 1980; Green and Jones, 1982; Shuman and Seeger, 1986; Aram and Cowan, 1990; Foster, 1993; Berry, 1998; and Beal, 2000). The bases for all of these models is similar in their employed concepts.Before an organisation can begin strategy formulation, it must scan the external environment to identify possible opportunities and threats and its internal environment for strengths and weakness. It has been argued (Gable and Topol, 1987; Goldsmith, 1995) that analysing in strategic management entails both external appraisal (often called environmental scanning) and self examination (sometimes known as doing a strategic audit). Environmental scanning is the monitoring, evaluating and disseminating of information from the external and internal environment to strategists within the organisation. Thomas et al (1993) have found that, there is a positive relation between environmental scanning and profit. Choo (1999) argues that, Environmental scanning is the acquisition and use of information about events, trends and relationships in an organisation's external environment, the knowledge of which would assist management in planning the organisation's future course of action. Organisations scan the environment in order to understand external forces of change so that they may develop effective responses that secure or improve their position in the future (Gable and Topol, 1987). To the extent that an organisation's ability to adapt to its outside

environment depends on knowing and interpreting the external changes that are taking place, environmental scanning constitutes a primary mode of organisational learning.

Most empirical research on environmental scanning has focused on relationships between scanning behaviours (frequency, scope, sources used, and interest) and environmental conditions such as environmental uncertainty, perceived threats and perceived opportunities (Daft et al, 1988; Tyler et al, 1989; Sawyer 1993; Lang et al 1997). While some of the other studies were found that investigated relationships between competitive strategies and environmental scanning (Tyler et al 1989; Jennings and Lumpkin 1992; Yasai Ardekani and Nystrom 1993; Bantel and Osborn, 1995). Tyler et al (1989) in their investigation of the relationship between different environmental conditions and the usage of different types of information sources by executives in formulating competitive strategy, found that: (1) high and low rich information sources were used less under highly changing, unpredictable environmental conditions than under stable, predictable conditions; and (2) low rich information sources (income statements, memos, or letters) were used more than high rich sources (face-to face discussions with workers, customers, or suppliers) under stable, predictable conditions. They also found that the executives in their 28-firm sample used more high rich information sources in formulating differentiation strategies than in formulating low cost strategies. These results suggest that environmental conditions affect the type of sources (low rich versus high rich) used by executives in selecting a competitive strategy (that is, low cost leadership or differentiation). Jennings and Lumpkin (1992) argued that the types of information that CEOs seek differ according to their firm's competitive strategies. This implies that strategy can determine scanning behaviour as well as be affected by it. This perspective deviated from the traditional view posited by Design School proponents that

environmental scanning and analysis are determinants of strategy rather than the products of it (Mintzberg 1994). Jennings and Lumpkin found support for their hypotheses that (1) firms following a differentiation strategy scanned their environments in search of opportunities; and (2) firms following a low cost strategy looked for threats to their survival. However, because the study included firms in only one industry, the generalizability of the results is limited. In a comprehensive study of the scanning systems of 179 small (50 employees) to large (more than 200,000 employees) manufacturing and service firms, among the relationships that Yasai Ardekani and Nystrom (1993) examined was that between firms pursuing low cost leadership and the scope and frequency with which they scanned their environments. Results indicated that firms with effective scanning systems pursuing low cost leadership scanned their environments more frequently and more broadly than those firms with ineffective scanning systems pursuing the same competitive strategy. Furthermore, the findings suggest that firms employing effective scanning systems achieve alignment between strategy and environment. Niv, et al (1998) in their recent research interviewed CEOs in 46 firms in regard to the pattern of the environmental scanning they performed. The results were analyzed to determine the degree of use of information systems by CEOs in their strategic decision making and to seek a link with the firm's success in introducing new products. The study indicates significant differences in the level of environmental scanning and in the use of information systems between firms that were more successful in introducing new products into the market and firms that were less successful. The differences are in the pattern and the frequency of conducting environmental scanning, in the number of computerized applications, and in the number of advanced marketing information systems (Niv et al, 1998). Simultaneously, Sven (1998) presented his work. He argued that, based on theories in

cognitive psychology, psychiatry, organisation theory, and empirical findings from case studies of 4 Swedish organisations, a theory of the nature of spontaneous environmental scanning is developed. The theory covers the cognitive base for this behavior and how it is influenced by organisational factors. The purpose of the theory is to form a fundament to organized environmental scanning.

Other findings indicated that organisational size was not a determinant of the effectiveness of scanning systems (Analoui, 2000). That is, small as well as medium sized and large organisations were able to develop effective scanning systems (Yasai-Ardekani and Nystrom's ,1993; Beal, 2000). More especially, some of findings of Beal (2000) appear relevant to this study of small and medium sized enterprises in electronic industry, it would be useful to review them. Beal (2000) indicated that, there are at least three plausible explanations for his recent research on SME and environmental scanning results. First, the set of questions used to measure scanning frequency may lack content validity. Although constructing the frequency of scanning indices similar to those adopted by Hambrick (1981) and Fahr et al (1984) resulted in reliable indices (Cronbach alphas ranged from 0.74 to 0.87), the indices may not have been content valid. While determining content validity is judgmental, Beal (2000) believes that the set of questions designed to capture CEOs' frequency of scanning constitute adequate coverage of the various environmental sectors scanned competitors, customers, suppliers, manufacturing and product development technology, economies (local, state, and national)-and the frequency (daily, weekly, monthly, quarterly, and annually) with which the sectors are scanned. Second, CEOs of small and Medium sized enterprises (SME) in manufacturing sector, constrained by their involvement in their firms' daily operations, may not have time for frequent scanning of their external

environments. Consequently, environmental scanning may be relatively infrequent. Relatively infrequent scanning should be reflected in low mean values in the frequency-of-scanning indices. The means of five frequency of scanning indices involving elements of the task environment (competitors, customers, technology, suppliers, and the firm, itself) show quarterly-annual gathering of information about these elements. Thus, scanning of the environmental sectors that arguably have the most impact on firm performance and the formulation/implementation of competitive strategy occurs relatively infrequently. This finding provides the most plausible explanation for the non significant relationships found between frequency of scanning and external alignment. Third, the frequency at which CEOs of SMEs scan their environments may not be critical to aligning their firms' competitive strategies with the stage of the industry life cycle in which the firms compete. Other factors such as scope of scanning, accurate assessment of opportunities and threats, and effective use of competitive information may be key. Finally it has been argued (Miller and Cardinal, 1994; Berry, 1998) that, the entrepreneur's strategic awareness and his or her perception of the benefits arising from environmental scanning within the SME will be a significant determinant of the success and survival of the SME in the long term. Berry (1998) in her recent research concluded that,

" the technical entrepreneur's strategic awareness will determine the nature of planning used within the SME. The strategic awareness of the entrepreneur will be heightened by exposure to strategic management techniques within another organisation prior to business start-up or alternatively through contact with individuals who are aware of the benefits strategic planning may bring to the business" (Berry, 1998, p.464).

As a final point, no strategic planning will be implemented in SMEs where the senior managers or entrepreneurs exhibits a lack of strategic awareness.

Sample and data

The sample has been drawn from the 508 small and medium size manufacturing enterprises in electronic industry in the UK. The SMEs targeted for the current study by using British Standard Industrial Classification (SIC). The SIC for the United Kingdom covers the provision of all goods and services and is compiled in accordance with internationally approved standards. In order to frame the sample, two different registers, a) The Authority of the British Industry Vol. 1 (Products and Services), and Vol. 2 (Company Information); and b) Smaller UK Companies Handbook Vol. 1, and Vol. 2, were used. In general 508 manufacturing companies which employed less than 250 employees and have had less than £50 million annual turnover in the last financial year, were selected. The companies were identified using the UK (SIC) based on two criteria: a) having less than 500 employees, and b) having less than £50 million turnover in the last financial year. These two criteria have been used widely in literature in defining the SME (Hertz, 1982; Preston et al, 1986; Smith, 1998). The main research instrument was mail questionnaire. However a sub-sample of 12 managing directors have been interviewed. Data were collected via mail surveys from 132 (for a %27 response rate) CEOs of the SMEs of electronic manufacturing industry in the UK. A personalised cover letter that explained the purpose of the study and provided assurances

regarding the confidentiality of collected data accompanied each questionnaire. Managing directors were urged to personally participate in the survey. In order to minimise response bias, the participants were also provided with pre-addressed envelopes to enable them to return the completed questionnaires directly to the researcher. For the purpose of this study, the first section of the questionnaire investigates the demographic characteristics of respondents. Respondents will be asked about their age, sex, their status within the organisation, experience, education, and functional background. Age is highly correlated with total work experience, organisational tenure, and industry tenure. The second section of the questionnaire investigates the firms method for , and extent of environmental scanning. This examines both internal and external factors affecting the business in order to develop a picture of the managers awareness of the environment in which his firm operates. External environment of the firm consist of two distinguished societal environment and task environment variables. Societal environment include economic, technological, sociocultural, and political legal variables. While task environment includes industry force variables. In contrast, internal environment of the firm consist of structure, culture, and resource variables. For instance each respondent will be asked to indicate that, to what extent external variables drive the company's strategy? In this research the company performance variable was measured by self-reported ratings of the respondents concerning the indicators of achievement of the intended outcomes, financial performance, and implementation of plans within the expected time and predicted cost. A 5 point Likert type scale ranging from 1 (low extent of success) to 5 (high extent of success) was applied. This self - reporting rating of performance is widely used in SMEs strategy research (Gable and Topol, 1987; Rangone, 1999; Analoui, 2000).

Finding and discussion

In order to analyse the data and consequently discuss the results, the collected data was summarised using descriptive statistics. Of 508 distributed questionnaires, surveys were returned from 132 CEOs for a response rate of 27 percent. Descriptive data analysis shows that, majority of respondents (N=116, 88%) were male, while only 12% of respondents (N=16) were female. The respondents' minimum number of total years work experience was 8 and maximum was 42 years. Also, 73% of respondents reported that they have had formal management training. The number of employees of the firms varied from minimum (N=16) to maximum (N=492). As mentioned earlier, we measured the firm size using number of employees and annual turnover of the firms. Accordingly, the amount of turnover of the firms in the last financial year was between £1.25 million to £50 million .

In the first part of the questionnaire we examined the CEOs' perception of environmental scanning as the first step in strategic management process in SMEs. Environmental scanning is the acquisition and use of information about events, trends and relationships in an organization's external environment, the knowledge of which would assist management in planning the organization's future course of action. Organizations scan the environment in order to understand external forces of change so that they may develop effective responses that secure or improve their position in the future. To the extent that an organization's ability to adapt to its outside environment depends on knowing and interpreting the external changes that are taking place, environmental scanning constitutes a primary mode of organizational learning. The CEOs were asked to indicate to what extent internal and external environment

factors affect their firm's strategy. In this regard we have chosen five factors including a) economic trends b) technological changes c) political and legal developments d) social and cultural trends and e) competitors. Analysis of the data show that, majority of the respondents (%91) indicated that technological changes affects too much the strategic decision making of the firms. In contrast, political and legal developments affects the strategic decision making process less than the other factors. The findings show that, the respondents ranked the degree of impacts of environmental factors on the firm's decision making process as follows. 1st priority: technological changes, 2nd priority: competitors, 3rd priority: economic trends, 4th priority: social and cultural trends, and finally 5th priority: political and legal developments. In order to find the impact of environmental forces which influence the SMEs, we tested the five force model (Porter, 1980). The result of the analysis show that, five external forces including bargaining power of buyers (Mean = 3.71, SD = 0.88), bargaining power of suppliers (Mean = 3.09, SD=0.91), rivalry among existing firms (Mean = 3.73, SD=0.99), threat of new entrants (Mean = 3.12, SD=0.95) and finally threat of substitute products (Mean = 3.32, SD = 1.12) influence the strategy making in electronic industry. Accordingly, the respondents were asked to rank the above factors based on their importance on firm's strategy making process. We found that, bargaining power of buyers (62.8%) was the most important factor. Accordingly, rivalry among existing firms (62.1%) was the second priority. Also threat of substitute new products (40.7%) was the third priority. In contrast, threat of new entrants (28.1%) and bargaining power of suppliers (25%) have not strongly influenced the strategy making in targeted firms. As discussed already, the study relies on perceptual measures of the firm performance. In order to measure the firm performance, respondents were asked to indicate on five-point scales, ranging from I =very unimportant to 5=very

important, the degree of importance they attached to each of financial performance indicators. This method widely has been used in previous researches (Beal, 2000). The respondents were further asked to indicate the extent of their satisfaction with their firm's performance along each of the performance indicators. In order to analyse the impact of environmental scanning on firm performance all of the firms that responded to our survey were ranked to three categories based on their performance namely, high performance, moderate performance, and low performance. This method already has been used largely in similar researches (e.g. Campbell, 1993; Smith, 1998; O'Gorman and Doran, 1999). Of all the 132 firms that responded to the survey, 52 were ranked in the top performing quartile (high performance), 41 in moderate performance, and 39 were ranked in the lowest performing quartile (low performance). We excluded the firms with moderate performance and consequently compared the percentage of the high-performer and low-performer firms, which included component in their mission statements. In this study, we examined CEOs perceptions of importance of having formal environmental scanning on the firm performance. Majority of respondents (N=107, 81%) considered formal scanning system as an essential factor in increasing firm performance. While only 8% of respondents (N=10) believed that, having scanning system is not important in developing firm strategies and achieving its objectives. It has been concluded that, high performance firms put more emphasis on formal and co-ordinated scanning system. In comparison, low performance firms put more emphasis on informal and low frequency of environmental scanning. The results of this study show that, high performance firms put more emphasis on formal scanning system than low performance firms. Perhaps, because of the dynamic nature of the electronic industry (Young, 1985) the firms have targeted needed to develop a long term scanning system.

Managerial implications

In this article we have explored the CEOs' perceptions of environment scanning in small and medium sized enterprises. We attempted to shed light on the importance and purposes of environmental scanning and its relationship with firm performance in SMEs in electronic industry. The major implications of this study are as follows:

1. It has been found that, environmental scanning is significantly related to the firm performance. Therefore, planning and implementing environmental scanning is a strategic activity in SMEs. In order to apply the strategic management system in the firm and benefit from it, it is particulary important to consider the environmental scanning activity as a base of strategic management.

2. The environmental scanning were being used for different reasons. There are different benefits from having formal scanning system for SMEs. In this regard, scanning system is necessary for formulation and planning business strategies, increasing profit and growth rate of the firm, and developing the firm's adaptability with unexpected environmental changes in turbulent marketplace. Therefore it is recommended to the practitioners and SMEs' managers to establish and develop a dynamic and formal and particularly a sustained and controlled environmental scanning system.

3. Finally, although by and large, increasing firm performance is positively related to having scanning system, but the blind adoption of such systems used in large firms, is perhaps inappropriate for SMEs. In this respect the technical entrepreneur's strategic awareness

can play a significant role in determining the nature of scanning system used within the SMEs.

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Appropriation of value in Biomedical research outcome at Public Research Organisations

by

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Abstract

Transactions on biomedical research outcomes bring into play strategies that are determined by leveraging resources into quasi-markets and on options based on expectations. To govern such transactions, the choice of appropriate governance structures and the governance of interaction are all too often in remittance of risk and uncertainty. Organisation and communities are prompted by issues concerning intellectual property (IP) to underwrite information, which is inherently fraught with difficulties of discerning ownership and quantifying qualitative business variables. Against that backdrop, we enquire on the mechanisms underpinning value dissipation and value appropriation of biomedical research outcomes to make proposition on the organisational antecedence to innovation. It is a preamble study with the view to developing a meso-level framework to describe mechanisms of value appropriation of upstream biomedical (non-invasive) research at Public Research Organisation. Its underpinning is largely based on the availability appropriability regimes and viability of organizational governance decisions and *how the choice of organizational governance form affects both the creation and appropriation of economic value*.

Keywords: value appropriation, knowledge protection, quasi-rents, networks, innovation.

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I. Introduction

Opportunities to generate and appropriate economic rents from biomedical research and development (R&D) exist because of competitive imperfections in factor or product markets. This can be achieved by utilizing isolation mechanisms, such as those protecting knowledge assets. Value isolating mechanisms impose constraints on information diffusion and can take many different forms, including patents, copyrights, non-compete clauses, and so forth. They are means of protecting information and used as a tool by economic actors to prevent, or at least delay, duplication of its intellectual assets. This, in turn makes it possible to earn (temporary) monopoly rents, and also ancillary profits (such as licensing and routes to public funding). As a practical matter, knowledge protection has been traditionally linked to the notion of appropriability (Arrow, 1962; Nelson and Winter, 1982; Zander and Kogut, 1995), which continues to be relevant (Arora, 1997; Pitkethly, 2001; Nieto and Pérez-Cano, 2004; Durack, 2004; Hurmelinna *et al*., 2007). However, the capacity of appropriability mechanisms (efficacy) to create temporary monopoly rents and other benefits for a firm (efficiency) contends with a well established view that knowledge emanating from research exhibit certain specific properties: uncertainty, inappropriability and indivisibility (Nelson, 1959; Arrow, 1962, Lipsey and Carlaw, 1998). As a result, it is commonplace that appropriability attempts are inherently fraught with issues concerning valuation, particularly at the early phases when decision-making is under conditions of uncertainty about future prospects.

Fundamentally, the ability to realize rent-generating potential poses problems concerning the assembly of necessary resources and to appropriate at least some of the rents that will be generated when they take advantage of these opportunities (Alvarez and Barney, 2004). These involve issues of ownership and control that require the distinction between underlying knowledge, intellectual property (IP) assets and endowed rights, IP rights, (IPR) (Pitkethly, 2001). With the growing complexity of technological innovation that is spread over different stages in a value chain, appropriation is aggravated by the likelihood that many patents covering these technological components may be controlled by many different owners and can thus turn into IP roadblocks. The transaction associated costs has attracted concerns in biomedical research, where Heller and Eisenberg (1998) call this ‘the tragedy of the anti-commons’.

Against that backdrop, appropriation concerns and coordination requirements have become powerful concepts in IP management by jointly describing the need to manage the creation and safeguard the appropriation of value (Tomkins, 2001). Competition, in turn, invokes an emphasis on the renewal of IP assets in accounts that takes heed of the increasingly discontinuous nature of innovations (Bartlett and Ghoshal, 2002; Zahra and Nielsen, 2002; Lovas and Ghoshal, 2000; Markides and Geroski, 2003). The use of organizational forms such as distinctive use of networks and increasing employee mobility, further prompts issues concerning knowledge mobility and network stability (Pisano, 1990; Kale *et al*., 2000; Teece, 2000; Sakakibara, 2002; Dhanaraj and Parkhe, 2006).

Appropriability has thus been identified as a strategic success factor for organisations that produce research and development (R&D). It includes the establishment of an effective an environmental factors, known as an

appropriability regime, which can in turn facilitate taking profit from innovations (Teece, 1986: 610; Brockhoff, 2003; Hurmelinna *et al*., 2007).

Under such dynamic conditions and the rise of the university-industry collaboration, the management of IP assets and IPR deriving from research universities and research centres funded by public funds (collectively Public Research Organisations or PRO) have evolved from processes of (i) an "Open Science model", in which PROs did not retain or enforced certain types of IPR, through (ii) a "Licensing Model" in which the PROs started to retain, protect and commercialise inventions based on their discoveries, essentially through licensing the IPR to industry or to start-up companies, and into (iii) the "Innovation Model" in which the licensing model has been supplemented by a active collaborative research with industry and a pro-active involvement in the creation of spinout companies (Roper *et al*., 2004; Siegel *et al*., 2003; Lee and Win, 2004; Gloet and Terziovski, 2004; European Union, 2004). All three models are in use at PROs to strategically manage spill-over, and in turn provide a forum to acquire funding, incentive mechanisms and diffusion, both with regard to research findings in general and to particular innovative technologies that are ready for practical application. Within that remit, research at Universities has been acknowledged to be conducted within different frameworks of knowledge production systems, and 'in the context of application' (Gibbons *et al*, 1994; Huff, 2000; Nowotny *et al*, 2001; Kurek *et al*., 2007).

Our study analyses the issue of appropriability and in particular of mechanisms carried out to earn quasi-rents in biomedical research outcomes. This work is mechanisms to organize rent generation and appropriation along three dimensions (1) the extent to which activities and the desired contributions are amenable to codification (*ex-ante* uncertainty); (2) the extent to which alternative uses of investment made to support the activities involve opportunity losses (the degree of asset specificity); and (3) the ability to assess the true quality of actual delivered performance of activities (*ex post* information asymmetry). The article is organised as follows: Section II establishes the background of the problem and framework for the enquiry, as well proposition that were enquired on. This is followed by a description of the sample of specialist and the empirical methodology followed in section III. Subsequently, we present our findings and discuss the main conclusions drawn from this in Section IV and suggest some directions for future research.

II. Background

II.I Biomedical Knowledge and IP

Recent advances in biomedical sciences have changed the way in which innovation occurs. In what has been termed 'the information paradigm', the basis for appropriating value in biomedical-related information features static and dynamic elements, of which anticipated future prospects is augmented by an increasing degree of complementarities, applicability and centrality of biomedical research knowledge and disease processes, or opportunities for medical intervention from a functional perspective (Kost, 1995; Semsarian and Seidman, 2001; Massoud and Gambhir, 2003; Nunn, 2008; Blasberg, 2003; Jaffer and Weissleder, 2005; Gross and Piwnica-Worms, 2006). The dynamic conditions of upstream R&D is fitting to Eisenhart's (1989) notion of high velocity

and D'Aveni's (1994) concept of hyper competition, where advancements are increasingly of a discontinuous nature. As a result, simultaneous innovation results in the fragmentation of IPR that is networked (Rahnasto, 2003; Varian *et al*, 2004), and held by multiple owners. A recognition of this hold-up problem and, also of previous acknowledgment that know-how transfer underpins technological progress, enterprise growth and renewal, both inside and outside a firm (Harrigan and Dalmia, 1991; Appleyard, 1996; Zucker *et al*., 1996), has prompted the use organizational forms such as 'networks' to access new technologies and their associated know-how to improve innovation capacity (George *et al*, 2002, Hagedoorn and Duysters, 2002). As a result, task characteristics have been shown to influence appropriation concerns, as more complex and uncertain tasks lead to increasing contracting difficulties (Heller and Eisenberg, 1998; Anderson *et al*., 2000). Under the strains of technology and regulatory, pre-clinical development have less than a 1 percent chance of commercialization (Rothaermel and Deeds, 2004). Tomkins (2001) described two similar management problems in relationships, alliances and networks, which he labels 'the generation of trust' (i.e. the management of appropriation concerns) and 'the mastery of events' (i.e. the coordination of activities). This resonates with previous findings the outcome, behaviour and social control are often equated with the conceptions of governance (Adler, 2001; Ouchi, 1979) and are useful mechanisms for both managing appropriation concerns and coordinating interdependent tasks. The network context of biomedical research brings into play the appropriation of IP assets emerging at the interstices of communities and networks of practice in upstream biomedical value chains (Scherer *et al*., 1959; Mansfield *et al*., 1981; Mansfield, 1986; Levin *et al*., 1987; Scherer and Ross, 1990; Arora, 1997; Grindley and Teece, 1997; Arundel and Kabla, 1998; Cohen *et al*., 2000; Arundel, 2001; Ducor, 2000; Tomkins, 2001; Cohen *et al*., 2002; Graham *et al*., 2002; Hertzfeld *et al*., 2006). Under such condition, coordination becomes imperative in the consideration of market failure (disclosure dilemma) or fears of opportunism (consequences of appropriation of knowledge by an alliance partner).

Within that premise, Beugelsdijck and Cornet (2001) suggest a useful distinction between two types of knowledge spillover that is also useful in our context of study: rent-based spillovers mediated through market mechanisms, and pure knowledge spillovers which result from un-priced knowledge exchange. For this study, our interest is in the coordination of IP assets shaping both types of knowledge spill-over and their management (i.e. identification, development and exploitation) and how they facilitate the appropriation of value (Dietz and Bozeman, 2005). It is premised on the consideration of market failure (disclosure dilemma) and fears of opportunism (appropriation of knowledge by an alliance partner) and seeks to investigate how PROs deploy governance alternatives as a framework for appropriation by asking the following research question:

1. How do available and effective means to protect intangibles and innovations facilitate the appropriation of value in upstream R&D?
    a. How does the choice of appropriation instruments strengthen the protection of IP assets?

    b. How the organisational structures impinge on appropriation efforts?

To help answer these questions, we start by presenting available methods discussed in the extant literature and subsequently deduce our propositions.

II.II Appropriation

Under the open, licensing and innovative models of University appropriation, economic actors can appropriate value in their biomedical research outcomes by participating in continuous innovation, which enables them to acquire and maintain a position of technological leadership (Levin *et al*., 1987; Harabi, 1995; Brouwer and Kleinknecht, 1999; Arundel, 2001; Cohen *et al*., 2002; West and Iansiti, 2003). By default, it can be assumed that scientific actors at PRO specialising on a subject-matter have expertise in that field. Coupled to bounded rationality and when scientific actors through specialisation are able to comprehend the underpinning of their subject area, the complexity of technology also becomes a viable mechanism of appropriation (March and Simon, 1958; Brouwer and Kleinknecht, 1999). The tacit nature of relevant knowledge underlying an intellectual asset implies that complexity serve an appropriation role due to tacitness, causal ambiguity, or social complexity (Barney, 1991; Nonaka, 1994). By virtue of their expertise, scientific actors may also be in possession of complementary assets critical for innovations and that has been shown to present a forum for appropriating value (Teece, 1987; Cohen *et al*., 2002; Nieto and Pérez-Cano, 2004; Galende, 2006). Fundamentally, it is both the choice and method of disclosure that may determine the effects of an appropriability regime on disclosed information. Nonetheless, as the decision to disclose information is often made early in the life of the information and under conditions of uncertainty, the true effect amongst the different mechanism often becomes known at later stages. Against that backdrop, there is an established view industrial secrets are of greater use as opposed to say patents as a protection mechanism (Harabi, 1995; Brouwer and Kleinknecht, 1999; Arundel, 2001; Cohen *et al*., 2002; Davis, 2001; Hannah, 2005). However, as we shall come to discuss, this may not always the case. On the one hand, protection methods allow economic actors to prevent, or at least delay, duplication of its intellectual assets, which in turn makes it possible to earn (temporary) monopoly rents, and also ancillary profits (such as licensing). On the other hand, the current IP regime does not depart from its implicit function to serve as an organisational role of: (i) acting as an incentive system for innovation; (ii) packaging IP assets; (iii) diffusing technical information; and (iv) controlling IP assets.

Ultimately, it is the use of IP asset in innovation and issues associated with its use that determines the due efficiency of an appropriability regime. According to Pitkethly (2001), the appropriation of value can be view along three dimensions (Figure 1):

----------Insert figure 1----------

- Legal appropriability: value increases as its associated IPRs grow stronger because of a pronounced broadness of its asserted claims if the broad claims are enforceable. As a result, it is awkward for inventors who have to “work around” the patent; thus it deters imitation.

- Strategic appropriability: value increases as a firm becomes more strategically effective at configuring the pattern of strategic resources necessary to market a product successful in the competitive arena of the value chain stage. Therefore, beyond legal appropriability and control over critical complementary assets, strategic appropriability is an essential consideration to competitive positioning within a given value chain.

- Competitive position. Value increases as a firm becomes more capable within the competitive arena of a value chain stage of achieving a favourable position. Thus there is a historic element as value in use is moderated by the previous business success of a firm or productive entity.

Among available and effective means of appropriating value, formal private property rights, especially patents, copyright, and trade secrets have been among the most studied mechanisms (e.g. Jain 1996; Arundel & Kabla 1998; Arundel 2001; Pitkethly 2001; Knight 2001; Kelley & Rice 2002; Cohen *et al*. 2002; Gallini & Schotchmer 2002; Hannah 2005). For highly complex sectors such as the biomedical field, the tacit nature of knowledge is in itself a means of appropriation (Polanyi 1966; Lippman & Rumelt 1982; Nelson & Winter 1982; Dierickx & Cool 1989; Barney, 1991; Zander & Kogut 1995; Teece 1988; 1998; Saviotti 1998). There is also the use of lead-time (Levin *et al*. 1987, 1988; Lieberman & Montgomery 1988; Schoonhoven *et al*. 1990; Mueller, 1997; Makadok 1998; Coerderoy & Durand 2004; Carow *et al*. 2004), which can be instrumental in both private and public domain. Time-critical claims to originality and authorship of knowledge, within the remit of both formal and informal rules governing such claims can also create a route to public funding for coming first. In the private domain, this is also critical form of appropriation, because IP erodes over time through circumvention, duplication and/or obsolescence.

Human resource management and contracts are also a distinct means of appropriation, securing IP rights explicit terms (Rousseau & Wade-Benzoni 1994; Baughn *et al*. 1997; Liebeskind 1997; Boxall, 1998). Finally, the use of practical and technical means of concealment such as encryption and firewalls are widely used both in private and public sectors (Davis, 2001; Hannah 2005). These are common for the protection of genomics and bioinformatics information, where it is commonplace to combine an open science model to click-wrap licensing.

The combination of these forms in an appropriability regime underpins the protection of IP assets and innovations, their profitability, and the increased rents due to R&D (Teece 1984, 1986, 1988; Cohen & Walsh 2001; Harvey and McMeekin, 2004). Their selection of an appropriate regime requires a distinction between IP assets and IPR to delineate ownership and control of underlying IP assets through legal enforcement and credible commitments. Under certain conditions, the type of IPR and a combination of other available methods may be required to attain sufficient protection. In particular, the network context of biomedical research also brings into play the appropriation of IP assets emerging at the interstices of communities and networks of practice in upstream biomedical value chains (Scherer *et al*., 1959; Mansfield *et al*., 1981; Mansfield, 1986; Levin *et al*., 1987; Scherer and Ross, 1990; Arora, 1997; Grindley and Teece, 1997; Arundel and Kabla, 1998; Cohen *et al*., 2000; Arundel, 2001; Ducor, 2000; Tomkins, 2001; Cohen *et al*., 2002; Graham *et al*., 2002; Hertzfeld *et al*., 2006). Under such condition, coordination becomes imperative in the consideration of market

failure (disclosure dilemma) or fears of opportunism (consequences of appropriation of knowledge by an alliance partner).

Summarised, a decision on which protection method to select depends on factors such as:

- the institutional framework (Kortum and Lerner, 1999; Granstrand, 1999; Hall and Ziedonis, 2001; Pitkethly, 2001; Cohen *et al*., 2002; Hurmelinna *et al*., 2007);
- the national and international legal system (Ordover, 1991; Kortum and Lerner, 1999; Shapiro, 2001; Cohen *et al*., 2002; Graham *et al*., 2002; Hurmelinna *et al*., 2007);
- the structure of the industry in which (Scherer *et al*., 1959; Mansfield *et al*., 1981; Mansfield, 1986; Levin *et al*., 1987; Scherer and Ross, 1990; Arora, 1997; Grindley and Teece, 1997; Arundel and Kabla, 1998; Cohen *et al*., 2000; Arundel, 2001; Cohen *et al*., 2002; Graham *et al*., 2002; Hertzfeld *et al*., 2006);
- the dimensions of technological knowledge (Arora, 1997; Pitkethly, 2001; Nieto and Pérez-Cano, 2004; Durack, 2004; Hurmelinna *et al*., 2007; Hertzfeld *et al*., 2006);
- characteristics specific to innovation strategies (Levin *et al*., 1987; Arundel and Kabla, 1998; Cohen *et al*., 2000 and Cohen *et al*., 2002; Arundel, 2001; Galende, 2006) and organisational resources (Maurer and Zugelder, 2000; Hurmelinna *et al*., 2007; Galende, 2006; Hertzfeld *et al*., 2006).

III. Research model and propositions

A determination of what can and should be appropriated requires an initial assessment of what rights are protectable through disclosure and what information qualifies as a trade secret. At PROs, several factors determine who owns the underlying IP assets and what right can be acquired. These factors include whether

1. There are express or implied agreements to assign ownership
2. The inventor is employed by the PRO
3. The inventor made the invention within the scope of their employment
4. Where and when the invention was made.

The attributes of knowledge affect the organization and governance of transaction on information and has become a major challenge of appropriating biomedical information based on three key decisions: (i) whether or not to file for a patent; (ii) whether to market the invention to an existing firm or not; and finally (iii) how (temporary) monopoly rents and ancillary profits are to be structured. These decisions must be based on sound information about the market, the uniqueness and usefulness of the invention and/or technology, the likelihood of being able to obtain patent protection, factors related to the inventor, and the potential paradoxically impact of the of patenting on the institution's responsibilities.

Under the open, licensing and innovative models employed at PROs to manage their IP, a useful distinction is provided by Beugelsdijck and Cornet (2001), who distinguishes between rent-based spill-over mediated through market mechanisms and pure knowledge spill-over which result from un-priced knowledge exchange. In order words, disclosure may serve to signal and thereby reduce informational asymmetry between firms and outsiders, such as investors (Shapiro, 2001; Long, 2002). Disclosure may also serve multiple functions, for instance add value to the exploitation of undisclosed IP assets by making it readily exploitable to those who desire the underlying IP assets (Hargadon, 1998, 2003; Kodama, 1992). On that basis, the framework for the present study is the process by which research outcome (information- input) can be appropriated along three dimension (Strategic, legal, competitive) to acquire (temporary) monopoly rents, and also ancillary profits (figure 2).

----------Insert figure 2----------

Implementing IP strategies focuses attention on the actual process of IP creation, development and protection (Hanel, 2006). First we distinguish between organisations. Differences in organisational context, and contrasts between the types of R&D being conducted in the different types of PROs, suggest our first set of propositions:

Proposal 1: IP management practices will differ between university-based and research centres funded by public funds.

Proposal 2: IP management practices will differ between university-based PROs depending on which IP model they adopt.

Proposal 3: PROs will implement incentives for the creation and identification of IP which reflect the nature of the host organisation and the IP model being adopted.

As suggested earlier, however, different types of PROs in different settings are likely to devote differing levels of resources to IP protection and development. For example- University based PROs may find it difficult to invest the level of resources necessary to protect their IP effectively and may adopt alternative commercial strategies to maintain their technological leadership (Blackburn, 2003; Bigliardi *et al*., 2006). This leads to us to make proposals on the use of appropriation mechanisms:

Proposal 4: Use of formal IP protection methods will depend on the organisational background of the PRO

Proposal 5: PROs will use specialist services to support their IP protection and exploitation strategies. Use of these services will reflect the nature of the host organisation and the IP model being adopted.

Inter-organizational innovation networks are providing opportunities to exploit superior resources that reside beyond the boundary of the firm (George *et al*, 2002, Hagedoorn and Duysters, 2002). The appropriability

regime in an innovation network thus influence PROs appropriability regime, and is influenced by, network stability. Research has shown that equity often plays a critical role in enhancing both the appropriability environment and the stability of such relationship by mitigating the competitive dynamics and opportunistic behaviour that can lead to premature dissolution of alliances (Beamish & Banks, 1987; Park & Russo, 1996). In the context of this research, our focus is on joint asset ownership and we enquire on how they ensure equitable distribution of value in stable network, processes that enhance reputation and multiplexity not only induce stability in a network but also contribute to trust and openness within the network. This approach associates appropriability regime with networks, where it has been found that the strength of the appropriability regime and the stability of the network are mutually reinforcing and will have a reciprocal relationship (Dhanaraj and Parkhe, 2006). Thus, we propose that:

Proposition 5: Innovation appropriability in an innovation network will positively impact knowledge mobility in the network.

Proposition 6: Innovation appropriability will positively impact the stability of innovation networks.

Proposition 7: Stability of innovation networks will positively impact the strength of innovation appropriability.

Ex-ante codification (uncertainty), asset specificity (opportunism), and *ex-post* monitoring (information asymmetry)

Given that appropriability can not be measured directly, we enquire appropriation using a framework characterised along three dimension- *Ex-ante codification, asset specificity and ex-post information asymmetry* (figure 3).

----------Insert figure 3----------

Upstream biomedical R&D is epitomised by scientific exchange of information that is often tacit and non-proprietary. This type of knowledge is based on their expertise (Brockmann and Anthony, 2002; Dyer and Hatch, 2004; Howells, 1996; Roberts, 2000), of which wider legal definition is as follows:

> Information, including a formula, pattern, compilation, program, device, method, technique or process, that:
>
> (i) derives independent economic value, actual or potential, from not being generally known to, and not being readily ascertainable by proper means by,

other persons who can obtained economic value from its disclosure or use, and

(ii) is the subject of efforts that are reasonable under the circumstances to maintain its secrecy.

Know-how transfer underpins technological progress, enterprise growth and renewal, both inside and outside their own firm (Harrigan and Dalmia, 1991; Appleyard, 1996; Schrader, 1991; Zucker *et al*., 1996; George *et al*, 2002, Hagedoorn and Duysters, 2002). It plays a crucial role in the pooling of assets and as an organizational level activity and portrayed as a 'network approach' to innovation (Hankasson, 1990; Bower, 1993; George *et al*, 2002, Hagedoorn and Duysters, 2002; Coombs and Metcalfe, 2002). Previous work on the know-how transfer has focused on decision making cues founded on the expectation of reciprocity (Dutton and Jackson, 1987; Pfeffer and Salancik, 1978). Expanding on this view, recent work shows that the effects of different contextual cues, such as competitiveness, social relationship, boundaries within or across firm have a summative effect upon the expectation of reciprocity and know-how transfer (Kackra and White, 2008).

In the context of this study, we are concerned in whether the flow of information is amenable to *ex-ante* codification (uncertainty), or becomes the subject of asset specificity (opportunism), and whether it can be monitored *ex post* (information asymmetry). By definition, know-how knowledge is tacit and as such difficult to codify (Schrader, 1991). At the same time, its is not often subjected to formal bars. Rather, it is knowledge embedded in an individual's concrete expertise (Hansen, 1999; Polanyi, 1966), and may not be documented from available sources. As a result, the appropriation of value in know-how requires an investment of time and resources to curtail an economic that may be uncertain and difficult to specify or value, *ex ante* (uncertainty) or to monitor and enforce *ex post* (information asymmetry) (Appleyard, 1996; Pfeffer, 1981; Schrader, 1991). Its transfer also may serve to establish a competitor (opportunism) with respect to exploitation of the underlying IP asset- know-how information. In other words, exclusive control over know-how information is difficult to maintain *ex post* monitoring.

Spill-over can somewhat be control when know-how is made the subject of transaction. Confidentiality of the know-how information is typically one of the conditions under which trade secret information is transfer. However, if such trade secret information is not properly monitored, marked and otherwise kept secret by the recipient/licensee, there is a clear potential for its loss to third parties or spill-over. It creates a situation where no distinction can be drawn between rent-based spill-over mediated through market mechanisms and pure knowledge spill-over which result from un-priced knowledge exchange (Beugelsdijck and Cornet, 2001). In acknowledgment of this problem, organizational and transaction cost theorists argue that information and know-how transfers are best handled within a firm's boundaries, where the transaction costs associated with know-how exchange may be lower than between firms (Allen and Cohen, 1969; Tushman, 1977; Von Hippel, 1987; Zucker et. al., 1996). The distinction between IP assets and IPR further emphasises that appropriation mechanism within corporate boundaries serves a better means of protecting information. For example, the *SNP consortium* achieves this by filing patents to maintain information as a pre-competitive resource using an open

science model. Patents are filed as evidence of the date of discovery, prior to releasing information, but are later abandoned and ensuring a specific depiction of – copyright- to serve its intended purpose.
This leads us to propose that:

Proposal 8: Internally deployed mechanism better serves the purpose of appropriating value in upstream R&D knowledge/ information prior to transfer.

When the know-how is explicit, proprietary, such as is the case with patent, an exclusive right of limited duration over a new, non-obvious invention of industrial application, is granted in return of publication of the invention. Here, the distinction between underlying IP assets and IPR presents an opportunity to refer specifically to a particular embodiment on which exclusive rights is to be sought and to different embodiments may be referred to in the underlying IP asset. In preparing a patent application, some of the knowledge becomes codified and its potential becomes clearer- an example of *ex-ante* codification. An effect of *ex-ante* codification is that the knowledge attribute of information about the underlying IP asset may mean that information asymmetries between managers-scientist and manager-investors (as well as rivals) may persist well after knowledge is codified in a patent application. In order words, the knowledge creation process begins with tacit knowledge, which implies that lead-time can serve as an asset accumulation or appropriation means supported by the scientist and for that matter serve as an isolation mechanism to keep technologies from rivals (Nonaka, 1994; Polanyi, 1962; Dierickx and Cool's, 1989). Moreover, a disclosed inventive step linking different embodiments can be viewed as signals of future economic performance, for which an open reflection of codified knowledge representing an underlying tacit and complex knowledge may be critical to subsequent innovations or to commercialization (Lippman and Rumelt, 1982; Ahuja and Lampert, 2001; Long, 2002). The tacitness of this information at the early stages of appropriation ensue that value is retained up until the decline of information asymmetric with rival. On that, we propose that

Proposal 9: The combination of legal enforcement (trilateral) and credible commitments (bilateral) serves a greater purpose of appropriating value.

Fundamentally, disclosure serve the purpose of signalling (Long, 2002), and given the informational asymmetry between PRO and outsiders, PROs need to signal their expertise and use the IPR system to do this. Patents, in particular, are costly to acquire and undergo an external quality check, hence they act as good signals, allowing firms to raise finance or attract talented employees. On the hand, know-how has been shown to play a role in leveraging business resources (Teece, 1987; Cohen *et al*., 2002; Nieto and Pérez-Cano, 2004; Galende, 2006). The signal effect of disclosure presents a forum to collaborate with others. The profitable transfer of ideas from where they are known to where they represent more innovative possibility conjure value creation and the appropriation of value, as well as quicken the pace of innovation (Hargadon, 1998, 2003; Kodama, 1992). On that note, we propose that:

Proposal 10: Know-how transfer, predicated on appropriation regime will positively impact value creation

Know-how has been acknowledged to flows best through trusting communities (Adler, 2001), where strong social relationships between individuals are often associated with the transfer of complex knowledge (Hansen, 1999; Szulanski, 1996; Tsai and Ghoshal, 1998). In view of the foregoing, we propose that

Proposal 11: Know-how transfer, predicated on appropriation regime will positively impact the stability of partnership

The effect of rival's patent gives an advantageous position to the detriment of the focal firm, with 'spill-over' effects, when a breakthrough by a rival firm triggers greater technological opportunity and provides information on which the focal firm can build. Strategically, the possibility of technology spill-overs is increased since, before a patent can be granted, the inventor must make public detailed technical information about the invention, including claims of novelty. Therefore information asymmetry between inventors is reduced, which Scotchmer (1991) describes using the phrase 'standing on the shoulders of giants' as a means to describe the phenomenon of an inventor who achieves the last stage in a breakthrough. This can play a role in strategically appropriation to carve the way for asserting a competitive position even where others have contributed many of the fundamental building blocks of the technology. Thus, we propose that:

Proposal 12: Legal appropriation has a positive impact on strategic appropriation

This type of activity is reminiscent of the innovative model and participation can serve the purpose of allowing PROs to play a part in broader technology-exchange agreements between large firms, also known as 'patent pools' (Baumol, 2002). This not only provides PROs in the patent pool with a degree of protection against firms outside the technology agreement, but also counters the effect of creating a 'patent thicket' (Shapiro, 2001).

Proposal 12: Legal appropriation has a positive impact on competitive positioning

Within the framework of open, licensing and innovative models, there are therefore several possibilities to appropriate vale in research outcomes.

IV. Conclusion and future work

It was implicit in our analysis that the mechanism of appropriation and capacity of certain appropriability mechanisms can take several dimensions. This is in acknowledgement that knowledge emanating from research exhibit certain specific properties: uncertainty, inappropriability and indivisibility (Nelson, 1959; Arrow, 1962, Lipsey and Carlaw, 1998). Therefore appropriability serves to enable to the distinguishing between the governance of choice and interaction by way of legal enforcement and credible commitments as a mechanism of modulating rent-based spillovers mediated through market mechanisms, and pure knowledge spillovers which result from un-priced knowledge exchange (Beugelsdijck and Cornet, 2001).

The next logical step in our analysis is to builds theory from the framework looking at the mediation of open, licensing and innovative models deployed at PROs to manage IP assets. Starting point for the theoretical base of

the study is a process model of entrepreneurial processes based on social system theory, which is used in the research program of Nikos (Groen, 2005). This will be combined by insights from technology dynamics (Rip and Groen, 2001). Actions of actors involved in the development networks will be analysed on the basis of the four function model underlying the social system theory (goal attainment, pattern maintenance, adaptation, integration). The combination allows for a study of strategic, cultural, social, economic and technological value creation aspects of business development processes (Groen, *et al*, 2002).

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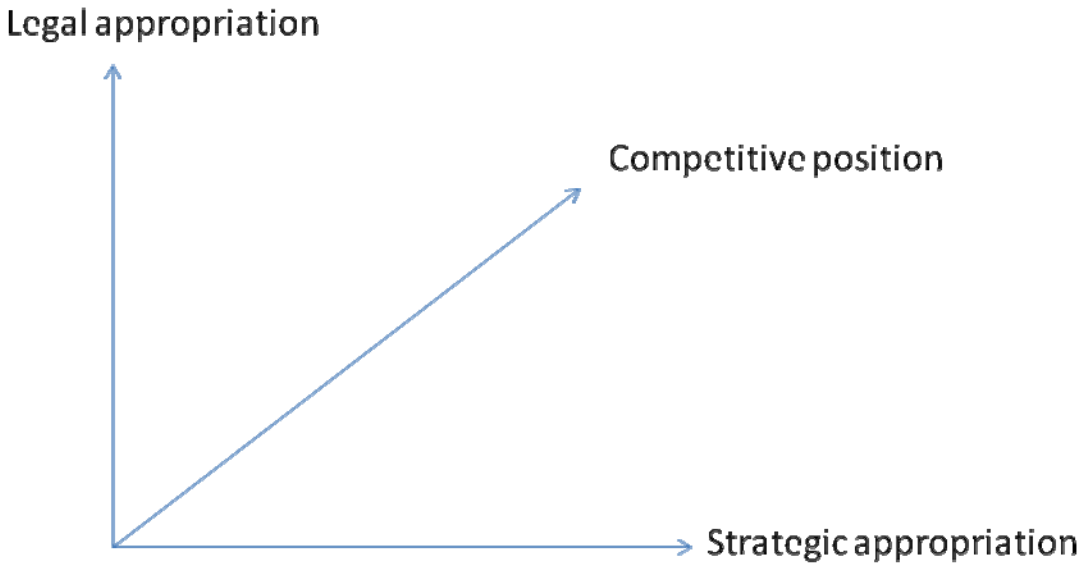

Figure 1: The dimension of appropriation (Pitkethly, 2001)

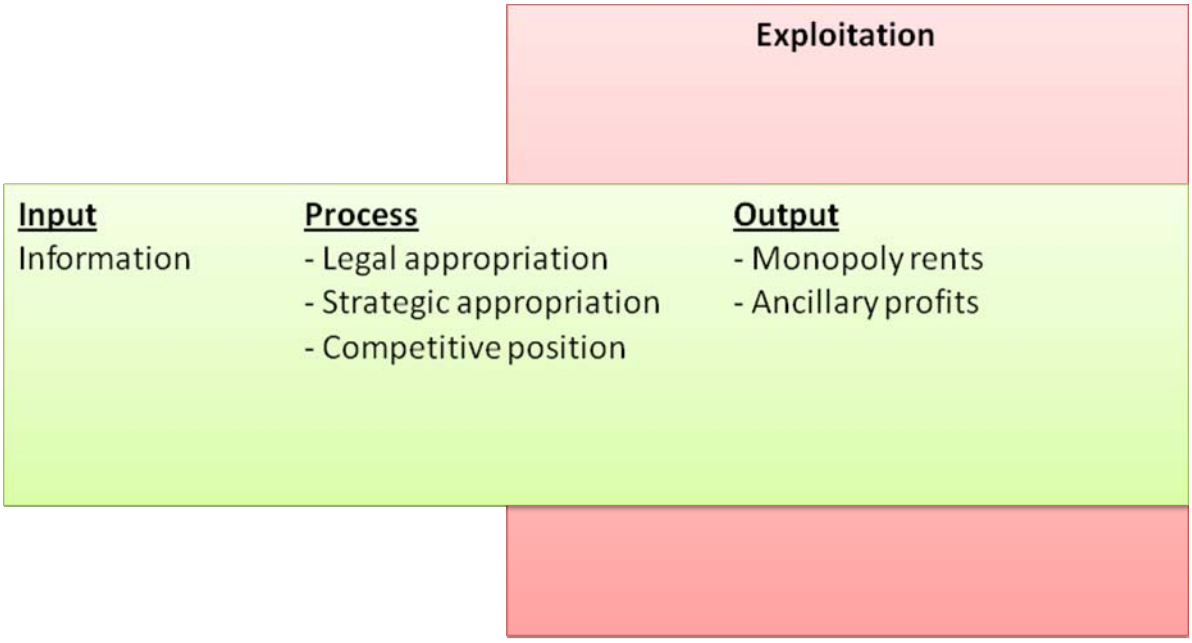

Figure 2: Research framework dimensions of appropriation

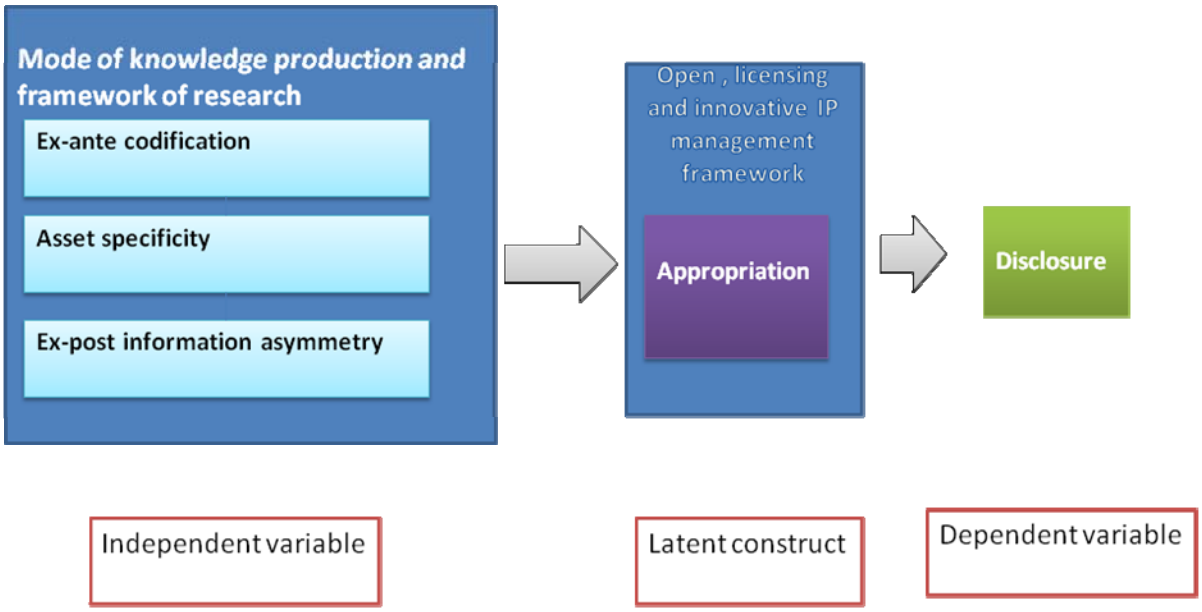

Figure 3: Research Model

The model of analysis proposed in this study aims to test the influence on IP of three proxies characteristics of knowledge (ex-ante codification, asset specificity and ex-post monitoring) that is development within the framework at Public research institutes (Mode 1, 2, and 3). The principal aim is to look at their effect on appropriation in view of three PRO models of appropriation (open, licensing and innovative models)

The article concept below is based on my PhD project regarding the characteristics of brokers. It represents the basis of the first article of four.

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Discern the invisible: SME network across Design and Technology

INTRODUCTION

Over the past decades, alliance networks have proven to be vital to firms. While most of the attention in the literature has been paid to the alliance activities of large multinational corporations, especially small and medium sized enterprises (SMEs) seem to benefit from the opportunities associated with strategic partnering. In their effort to survive and overcome resource scarcities small and medium sized enterprises are increasingly looking for competent partners that provide them with complementary assets and resources. In today's dynamic environment no company can seem to afford to go it alone. Many studies in the SME field have traditionally concentrated on the importance of involving suppliers, customers, research institutes and external professionals into the SME firm's operations. Organizations have been argued to benefit from the ideas, resources and knowledge of external partners. In particular SMEs are too small to have all the resources needed to compete in today's marketplace. Porter (2000) argues that much of competitive advantage lies outside a given company or even outside its industry. Firms in various industries indeed increasingly interact (Hagedoorn, 2002) and they are becoming part of growing networks. In particular in high-tech sectors, technological dynamics are so fast that almost no single firm is able to keep up with their rapid changing environments on their own (Duysters, 2001). Small innovative firms even tend to rely more heavily on technological developments outside the firm than large firms in their efforts to obtain new knowledge (Hicks and Hedge, 2005). Smaller firms have undoubtedly less resources of their own than large firms, but they generate more innovative output than expected. Their relations with others provide information about opportunities in their environment and enable them to exploit knowledge spillovers (Audretsch and Lehmann, 2005).

The growing importance of networks requires that SMEs thoroughly understand its characteristics, so they can use this knowledge to their own advantage. Although SMEs are believed to provide vital energy and stimulate growth

(Heilbroner, 1984; Schumpeter 1934) and recently regain popularity as topic in literature and policy-making programs (Audretsch and Thurik, 2001; Shane and Venkataraman, 2000; OECD, 2000), theory regarding SMEs and networks is still underdeveloped (Pittaway et al, 2004). Until now most research concentrates on personal networks of SMEs. There is a lack of empirical research concerning structural aspects of the network as a whole (Shaw, 2006) and in particular on network structures that span sectors (De Jong et al. 2005; Hagedoorn, 2002). We therefore take a social network perspective in order to describe the structural network characteristics of a SME network, in particular at network and subgroup level.

We will examine SME network data between design en high-tech industries in the Netherlands. The acknowledgement of the importance of design in product development has been resulting into an increase of efforts of various parties to establish co-operations between design and high-tech organizations. By this study we aim to gain a better understanding of these efforts and to reduce the bias in the literature towards large companies and their alliance networks.

Examining the actual network of these SMEs will provide insight into the connectivity and efficiency of SME networks. These characteristics are likely to be different for networks of various industries. In this paper we will use the concept of ‘small worlds’, as used in the field of graph theory (Cowan and Jonard, 2004; Watts, 2000), to judge overall network efficiency. As shown in the work of Verspagen and Duysters (2004) the concept unites two well-known perspectives in social network theory; the perspectives regarding social capital and structural holes (Walker et al., 1997). We will therefore investigate whether the constructed network can be classified as a highly connected, a highly fragmented or a small world. The efficiency of the actual network can be compared to other industry networks and thus can be valued. Furthermore we will examine the structure of the network in terms of sub-communities. Of interest is to investigate how sub-communities relate to building social capital, bridging

structural holes and small worlds. Such an investigation will enhance the theory of small worlds.

The study will also provide insights to regional politics. According to the EU being a knowledge economy is the way to stay competitive in the world. The EU stimulates transnational co-operations between companies, research institutions and universities in order to boost knowledge transfer, innovation capacity and eventually economic welfare in the EU. Goals of national programs are derived from the overall goal. The South of Netherlands concentrates on being a top-technology region in which new products and services of economic value are created (OP-Zuid, 2007). Value should be created by adding an opinion, identity or experience to products and services (Innovatieplatform, 2005). However parties can find each other insufficiently. Government stimulates the funding of intermediaries to overcome these market imperfections. Special attention is prearranged to research for SMEs and entrepreneurship. Regarding these goals it is interesting for politics to receive ideas on *how* co-operations can be stimulated best. For that they need to know how organizations cooperate at present. Is knowledge transferred in an efficient way, are there partnership concentrations and who is involved in co-operations.

Our study contributes to the existing literature in the following ways: First, it is one of the few contributions that takes an inter-sectoral approach by considering the existing social network of SMEs between two different sectors, i.e. design and high-tech industries. Second, it is the first attempt to actually construct the Design-Technology network in a social network way. No such data was available before in the Netherlands. Third, by highlighting the general structure of the network across these sectors, the study identifies the opportunities and constraints faced by the members of this network. This generates significant scientific and managerial implications. Network theory regarding small worlds will be enhanced as well because our insights contributes to the still infant field that studies the efficiency of partnerships in SME networks.

This paper is structured as follows. In the literature review section we provide a brief overview of the social network perspective and we introduce the field in which the research takes place. Next, the methodology used to explore the SME network is described. The research question is then addressed in section 4 and 5. We will end with the main conclusions and a discussion of the findings.

THEORETICAL BACKGROUND

Social network theory; a structural approach

The history of modern technological development shows that innovation is above all a process in which large and small companies need to cooperate. Firms realize this; various industries are showing increasing interaction among firms. A large part of interactions can be classified as strategic technological alliances among large firms (Hagedoorn, 2002). Due to their growth, these alliances have been the focus of most research. Interactions among SMEs have not been investigated much, although their importance in change processes was already recognized by Schumpeter (1934). Today most governments seem to recognize the pivotal role played by SMEs. They are generally considered as the backbone of society (EC, 2003) and the drivers of exploration and exploitation of opportunities (Shane and Ventaraman, 2000).

Literature that does investigate SME networks has traditionally concentrated on personal networks and their influence on their competitive position and ultimately success (O'Donnell et al., 2001). Networks are viewed as a strategic way to get access to resources and reduce costs in order to seize opportunities in an increasingly turbulent market. The same tendency is seen in overall network literature. This stream of research based on the resource-based perspective (Wernerfelt, 1984; Williamson, 1991; Combs and Ketchen, 1999), sees firms as

the motor of change and focus on reasons for alliance formation. It is concerned with determining why and when networks are formed.

How networks are formed has been less frequently subject of research, particular in the context of SMEs. Such research concentrates mainly on with whom a firm cooperates. Not the firm, but its various social relations are the focus of attention. The network is seen as endogenous; a factor of influence on a firm as well as a result of a firm's own influences (Schumpeter, 1934). Theory based on the network perspective builds on the general notion that economic actions of firms are influenced by the social context in which firms are embedded and that actions can also be influenced by the position of actors in social networks (Gulati, 1998). Contrary to the resource-based view, it takes into account the idea that a network has its own nature and creates opportunities for firms. Still, SME research does not focus on entire networks and amplifies the underlying processes dynamics (O'Donnell et all., 2001). Little attention has been given in SME literature to entire networks, the underlying processes dynamics and to cooperation as a support strategy to discover and exploit opportunities (Shaw, 2006; Hanna and Walsh, 2002; O'Donnell et al., 2001; Johannisson, 1997).

In order to understand the characteristics of the network a deep understanding of social network processes (Gulati and Gargiulo, 1999; Gulati, 1998). Social network theory describes these social dynamic processes between parties (Granovetter, 1973; Scott, 2000). The social network theory emphasizes that the social environment has an influence on the structure of the network in general, the kind of relations that are formed and the kind of resources that are exchanged. The theory is centrally concerned with questions related to with whom a firm collaborates (Scott, 2000)[1].

[1] Granovetter's paper "the strength of weak ties" of 1974 drew attention to the theoretical orientation giving quantitative comments on the structure of networks.

A few concepts associated with network theory are well-known: strong and weak ties (Granovetter, 1973) and structural holes and social capital. Being connected to others automatically involves the building up of social capital. Putnam (2000) describes social capital as a firm's ties and the norms of reciprocity and trustworthiness that arises from them. He argues that social capital can be divided into bonding and bridging capital, because the strengths of relations to others differ. Strong ties are related to bonding capital; weak ties are related to bridging capital (Fernandez and Nichols, 2002). This understanding portrays the two social network perspectives present in network theory. The first social network perspective emphasizes the importance of bonding capital (Coleman, 1988; Walker et al., 1997) the other bridging capital; structural holes (Burt, 1992; Walker et al., 1997). The central debate in this literature is focused around the basic arguments stemming from Burt's (1992) structural hole argument and Coleman's (1988) closure argument. Burt (1992) suggests that firms that who are able to build bridges between previously unconnected dense, i.e. redundant, parts of the network (Burt, 1992; Walker et al., 1997) will likely enjoy brokerage advantages based on access to non-redundant high yield information (see also Rowley et al., 2000). Alternatively, Coleman (1988) argues that being part of a densely knitted (redundant) network brings important advantages because of the degree of intimacy and trust in these densely connected areas.

There is ambiguity within the academic literature regarding the appropriate kind of social capital in various fields of industries. Research suggests that both forms of social capital have to be present within networks, because firms want to efficiently absorb knowledge as well as create novelty (Gilsing et al., 2006; Ahuja, 2000; Cohen and Levinthal, 1990). This idea is in line with the work of March (1991). In order to grow companies depend on both creating new possibilities and exploiting what is already known. O'Reilly and Tushman (1996) compared this to the eyes of the god Janus who had two sets of eyes. One pair for looking behind and one pair which focused on the issues ahead. In the context of SMEs, network literature conveys that the focus should not be on

getting more and more, strong relations, but also on diversity in relations (Zahra and Hayton, 2004). It has been argued that the most successful organizations are those that are ambidextrous in nature in the sense that they are successful in both exploiting existing competencies and also in exploring new innovations (Sadowski et al, forthcoming).

The theory of small worlds can be seen as a model that unites the two perspectives (Verspagen en Duysters, 2004). A small world is a part of a network in which a couple of actors are relatively highly connected, but also have a considerable amount of relations outside the connected group. A small world combines also the best of both perspectives. Cowan and Jonard (2004) define a small world as an identifiable region of space of structures in which knowledge diffusion is much more complete than elsewhere. Having high levels of social capital is beneficial for local knowledge diffusion and exploitation. Having also a relatively high portion of bridging capital that span structural holes is beneficial for global knowledge diffusion between various groups.

Hypothetical network structures;
Theory and Concepts of Small Worlds

In the work of Watts (1999) the small world model is explained by describing two extreme worlds first. The caveman world is “one, completely connected group. In such a world everybody you know, knows everybody else you know and no one else”. When a stranger enters the group, this person has to get acquainted with only one other person of the group in order to get fully connected with the total group. A cavemen world can be seen as a representation of the pure social capital perspective. On the other extreme, the Moore graph, “everybody lives isolated and interact via computers.” Even if two persons in this world would engage in a personal connection, this world would still stay highly disconnected.

The Moore graph can be related to the structural holes perspective of Burt (1992).

A small world is a network in which the two extreme worlds find an optimal balance. In a small world clustering of actors is high, but at the same time the characteristic path length between actors is relatively short[2]. In addition to high levels of bonding capital, there are just enough bridging relations to compose a balance.

In terms of advantages, a small world obtains the best of both social capital perspectives. In a Moore graph the network has a random local structure, but short paths between actors. New knowledge in such a world travels fast at first. But the process slows down relatively fast when the knowledge which is to spread reaches high levels of complexity. In a caveman world the network is locally highly structured, but path lengths are long. Diffusion of new knowledge is slower than in the Moore graph, but the process continues longer, and knowledge can more fully exploited. Small world networks show advantages of both: because this part of the network has relatively short path lengths, diffusion in the early periods is relatively fast; because of local clustering, knowledge exchange continues longer than it does in random worlds (Cowan and Jonard, 2004).

In reality social networks will have characteristics of both worlds. Local clustering and path length will be intertwined, but when can we speak of the presence of a small world? To trace what small world ratio is present in actual networks we need to know more about how many bridging relations are present in an overall network. To find that out we can make use of the concept shortcuts. In graph

[2] Average path length is the average number of steps separating two randomly chosen actors in a network. Characteristic path length is the median of average path length of all actors in the network.

A cluster can be determined by the number of actual relations in a part of a network divided by the maximum relations possible in that particular part. Clustering at the level of the network as a whole is defined as the average of clustering of all parts in the network (Watts, 1999).

theory bridging relations are described as shortcuts. Shortcuts connect two actors which otherwise would be separated. It is represented by parameter Φ, the fraction of bridging relations in a graph that are shortcuts. Path length and clustering size can be contrasted with the concept of shortcuts. As shown in figure 1, lines of path length and clustering size are drawn as a function of parameter Φ. The graph shows the path from many shortcuts to very few shortcuts, i.e. the path from a strict social capital perspective to a strict structural holes perspective, in which the variables clustering and path length have different slopes. Note that the lines are not predictions, but theoretical calculations representing levels of intensity regarding ‘random partner seeking’.

At low levels of Φ (many shortcuts) high levels of path length en clustering are shown. This corresponds to the caveman world. At high levels of Φ (few shortcuts) the opposite is shown. The latter corresponds to the Moore graph. We can see that for rather low levels of Φ E [0.01, 0.1] path length and clustering diverge in a most optimal manner; characteristic path length is short, the amount of clustering is relatively high. In other words, an actual network has small world properties when at low levels of Φ, local clustering is much larger than the theoretical Moore graph and characteristic path length approximately equals the theoretical Moore graph values (see Watts, 1999, for more details).

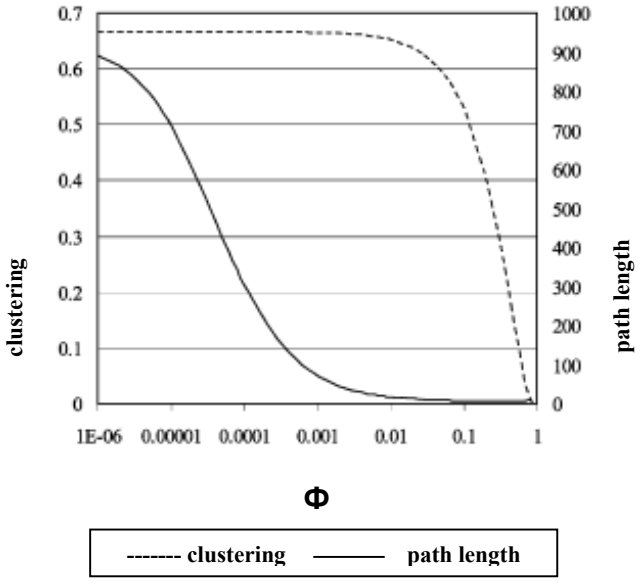

Figure 1. Length and clustering contrasted with parameter Φ, the fraction of bridging relations in a graph that are shortcuts.

This section describes shortly the theory of small worlds and it additionally illustrates the possibility to model the processes related to social capital and structural holes. The concept of shortcuts to determine the ratio of bonding and bridging capital in a network is useful for our research; parameter Φ can be seen as a degree of presence of the structural holes in the overall network formation.

Research question

The presence of small worlds provides insights into connectivity and efficiency of a network. As shown in the previous section the small world of a certain network can be mathematical constructed. Such a construct provides some benchmark against which we can compare values of the actual practice. Empirical research will enhance our knowledge about the ratio of social capital and structural holes present in various fields of industries. How do the structural network characteristics of actual networks as a whole look like? Ambiguity about the appropriate kind of social capital that should be present in networks can be diminished.

Our first research question is how actual networks compare to the hypothetical network structures mentioned in social network theories. As in the work of Verspagen and Duysters (2004) we will look if the actual network is one with high levels of bonding capital, high levels of bridging capital or if it can be classified as a small world. The efficiency of the actual network can be compared with other industry networks and thus we will be able to put a value on the relative efficiency of the whole network. Of interest is to see if the networks of SMEs are different in social network terms compared to large firms or other sectors.

Our second research question will address the structure of actual networks in terms of sub-communities. In reality multiple small worlds can occur in a network as well as none. If more local cores exist, subgroups will probably be formed around these cores. Studying sub-communities will provide more in-depth knowledge about the way bonding and bridging capital are balanced. Our second research question is to what extend are subgroups identifiable within the actual network. A sub-question to this is the extend to which subgroup identities are useful to describe at least one possible core of the emerging field. Such detailed information will provide insights into the involvement of subgroups in building social capital as well as bridging structural holes. SMEs operating in a network with multiple cohesive groups will face different network efficiency and opportunities than when they operate in a more polarized network structure.

RESEARCH DESIGN

Research setting

This study will construct the network of SMEs in design and high-tech industries in order to see their particular structure design. We will look into inter-firm relations of so-called transitory alliances; direct relations between two and three

actors. We define a transitory alliance as a particularly short-lived non-equity alliance that focuses on completing narrowly defined tasks in a very short time frame. These kinds of inter-firm relations are established in dynamic industries because equity-based alliances do not deal effectively with turbulent environments (Duysters and de Man, 2003).

The design and high-tech industries are dynamic environments. These sectors become more and more important in modern economy (Jacobs, 2005). Recent government studies in the Netherlands and Great Britain emphasize the importance of the creative industries[3] of which the design sector is a part. The design sector is part of the creative industries and ascribes to our research. It is a sector which shows the necessity to cooperate in order to develop meaningful products. The creative industry is known for its short product cycles, risky projects and fast changes in production processes. Their social network is built on the principles of collaboration, participation, exploration and exploitation (Hartley, 2005). Furthermore it is a sector which mainly consists of SMEs which not have been subject of much research regarding networks.

Design becomes increasingly important to high-tech products. The Southeast Netherlands is a top technology region of Europe which also shows a concentration of design firms. In this region design is seen as ‘business creator’; involved in developing and exploiting new ideas. Designers in this region are asked to join firms at a very early stage of the innovation process (TNO, 2005).

The region itself has a high concentration of elite knowledge and cooperation between a wide variety of organizations: SMEs, whole education and research stream, large-scale industry and knowledge institutions

[3] The creative industries are a wide-ranging industry including:
- Art & heritage sector: plastic arts, stage arts, musea, cultural festivals
- Media and entertainment: television, radio, publishing, film, music industry, popular festivals
- Creative business services: fashion, design, games, architecture, advertising.

Creative activities are defined as innovative activities that create value by adding a meaning, identity or experience to products or services (Innovatieplatform, 2005; DCMS, 2001).

(http://www.hightechindustries.org). The Southeast Netherlands will be the starting point of our research.

Methodology

To get closer insights into the network of the design and high-tech industries in the Southeast Netherlands, a survey was conducted. People working in the field of design and/or technology were invited to participate in the research. The fields design and technology were not specified in the survey, because the aim of the study is to investigate the network between the industries, not to compare them. It was up to respondents to decide how they interpret these fields and their own work. The aim was to map the most important work relations between people who are active in the fields. Of special interest were the roles of strong and weak ties.

Respondents were asked to mention the names and organizations of at most ten of their Dutch business partners who had an important (qualitative) influence on their business performance the last five year. To identify the strong and weak ties respondents were asked to rank the persons they mentioned. Partners who were most important to their business results during the last five years had to be put at the top of the listing. In addition, they had to specify the role of the partner (customer, supplier, advisor, college of other company, researcher) and the kind of influence of the partner (innovation/knowledge, marketing, organization, finance) on their business performance. The extra information about organization names and the content of relations enabled us to describe the most important work relations in the network in various ways, not only in this article, but also to the field itself.

The limitation of five years was added to get insights in the present state of affairs since the industries are dynamic environments. Only Dutch partners are

considered because the network would get too wide spread and fragmented. Besides the studies interest goes out to the area of Southeast Netherlands. The survey will include questions that provide relevant background information of participants. Other background information will be gathered by desk research.

The survey was initially sent to a selected group of people involved in design as well as technology. The respondents were asked to give the names of business partners with whom they have the aforementioned relationship. E-mail addresses of people listed or organization names were asked for. If e-mail addresses were missing, a search for e-mail addresses was performed on the internet or inquiries were made. Everybody who was listed in the response also received an invitation to fill in the survey. Several waves have been set in motion to collect data. This snow ball technique[4] is developed to identify hidden members and relation patterns (Hanneman and Riddle, 2005). In case of the design and high-tech industries, especially designers are a rather hidden population. Some work in firms, some work as part-time freelancer, some have their own firms. This technique was a useful way to get a clearer picture of their network and relations.

Sample and Data

Since the population is a rather hidden one, it is hard to say something about the representativeness of the sample for the total group of people in the fields. For the initial sample set we selected organizations from a chamber of commerce list and further specified our sample on basis of internet company descriptions. We chose to send the owner or managing director the invitation, since they play a leading role in SMEs (MacGregor, 2004). It was important to carefully select the first sample set. A homogeneous sample set was needed, meaning when set in motion the ‘snowball’ was not send in a certain direction.

[4] The snowballing technique is developed to identify hidden members and relation patterns (Hanneman and Riddle, 2005). Especially designers are a rather hidden population. Some work in firms, some work as part-time freelancer, some have their own firms.

We started sending out the questionnaire in January 2007. The results represent the network between design en high-tech industries and correspond to the database at July 29th 2007. At this point there were 468 names in the database. 405 persons received an invitation to participate (63 names were mentioned in the last wave and have not been mailed yet, 16 e-mail addresses were not available for the remaining persons, 16 people were mailed in the first wave, but whished not to participate). 109 useful responses were obtained (26,9% of the invited people, 23,3% of the total). The results reported in this paper are based on the database consisting of these respondents.

Social network analysis is used to answer the research questions. To draw the network a “rankedlist” was made to import the data in UCINET 6, a social network analysis tool. The names mentioned in the questionnaire have been entered in a meaningful order. When using a rankedlist the data can be saved as a valued network in which the program assigns tie strengths, values, based on the ordering.

The results are used to describe the structural characteristics of the network and not to make statements. A macro analysis requires complete network data; the presence of all relations of the whole population. We would need a 100% response rate to collect the complete network information. Such information can not be realized when using questionnaires and therefore hard statements about structural characteristics can not be made. However the response rate is sufficient to be able to draw a clear picture of the actual network.

How the actual network between design and high-tech industries compares against the theoretical model is described below.

RESULTS

The network between the high-tech and design sector can have various structures. Note that we do not compare the two industries, but look at the network between them. The high-tech sector as well as the design sector is known for its creativity. Exploration of knowledge is important; relations with people who have relatively unfamiliar knowledge play an important role when generating ideas. Presence of bridging capital between the two industries would not be strange. On the other hand, local collaboration is important in both fields too. Interactions with other fields such as design may still be preliminary, suggesting that a more loosely connected network will be present. What feature does the actual network show?

To answer the first research question and find out how the actual network between design and high-tech industries compares against the theoretical model we made calculations for the fields together. The calculations for the actual clustering coefficient (γ) and the characteristic path length (L) between connected actors are shown in table 1. We had to dichotomize and symmetrize the valued data in order to be able to calculate values that are comparable with the theoretical values. Furthermore when considering the network, we concentrated on the parts of the network that are connected. Results are therefore related to the principal component of the network (440 actors).

				Actual		Caveman		Moore graph	
	Φ	N	K	L	γ	L	γ	L	γ
Actor-level	0,149	440	2,523	6,059	0,178	62,093	0,473	8,993	0,006

Table 1. Network statistics of the network between design and high tech industries

When putting these values in a graph we see how the network structure compares to the benchmarks of the random network with varying Φ. Figure 2 shows how the theoretical lines contrast with the clustering coefficient and the characteristic path length (the dots) of the actual network. The theoretical graph shown in figure 1 is based on a random chosen network size and average number of direct connections of actors. Also, the underlying model assumes that the amount of connections of actors do not differ too widely from each other. In real cases these assumptions may just not be present. Consequently, for a certain observed value of Φ, path length and local clustering values of an actual network may be positioned off the theoretical curves.

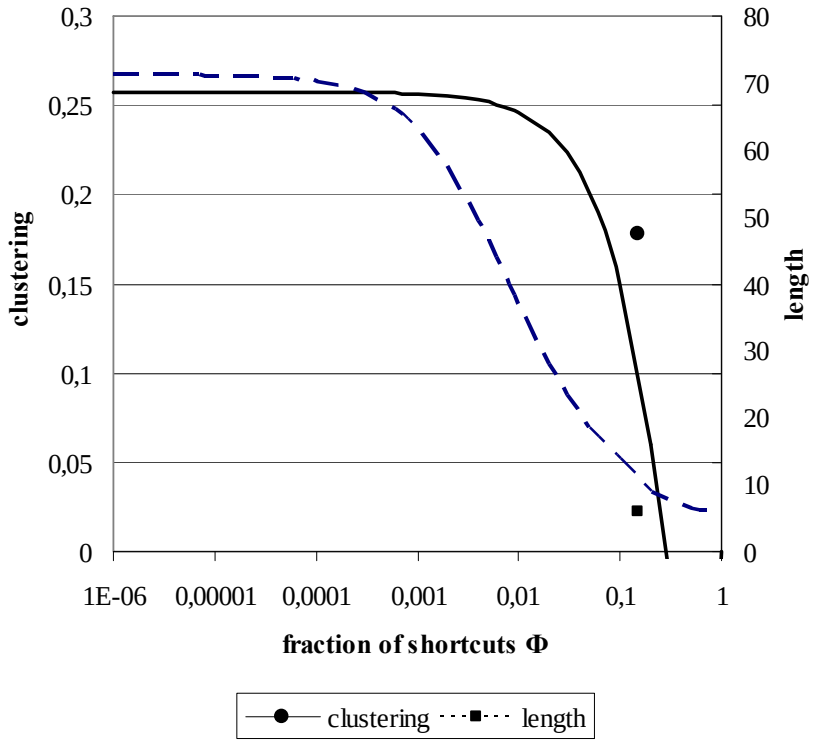

Figure 2. Network benchmark contrasted with statistics actual network (principal component)

We observe that the value for L is below the theoretical curve. This indicates that network length is smaller than in a random network. Clustering is somewhat

higher than the benchmark value. Hence, we conclude that there is a tendency for strong bonding capital.

So, is the network characterized by a small world in which distinct clusters are weakly connected to each other? The high value for clustering indicates that social capital is important in the field. On the other hand path length is below the Moore value, indicating a tendency for strategic partner seeking in line with the structural holes perspective. In other words, the social capital perspective and the structural holes perspective are united in this network. Consequently we can conclude that the network between design and high tech industries shows small world properties. The low path length indicates the presence of efficient knowledge flows, high clustering of efficient knowledge exploitation.

Subgroups in the network Design and High-tech SMEs

The actual network seems to contain a few people with high connectivity. We do not know yet how these people are structured at a sub-level. Does the network indicate that multiple sub-communities (small worlds) are present? In other words do these people represent two distinct industries or not. There is evidence that the industries increasingly interact. Design is becoming more and more important in product development. Technology has to look good in order to be sold. Furthermore qualitative research reports that the network of design is very fragmented; loosely connected (Innovationplatform, 2005). A clear segment may not exist within the network. The boundaries of the two sectors may be not as sharp as expected.

The hypothesis can be examined by identifying subgroups in the total network. A visualization of the network, showing how subgroups are related to each other in the network, is possible. The network structure can be visualized by making a 3D contour sociogram. Local connectivity will be paired with higher density levels. A

contour sociogram is based on) density values present between closely connected actors. By using the bivariate distribution of points concentration of actors can be identified (Moody, 2004). Figure 3 presents the 3D contour sociogram for the principal component of the network. To get a clear insight only the main component (440 actors) instead of the total network (468 actors) was taken into account.

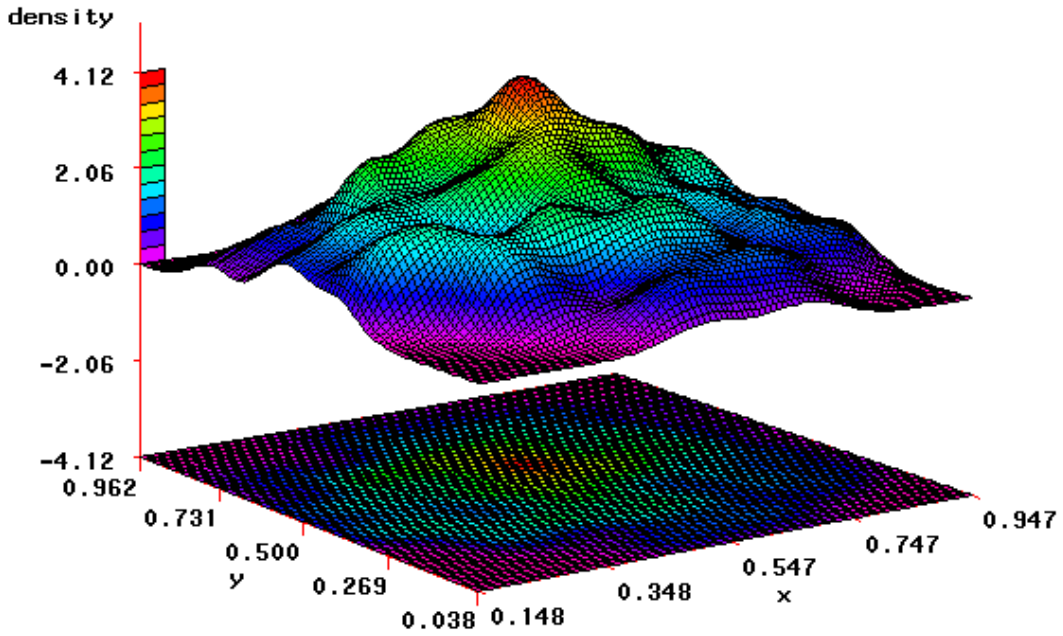

Figure 3. 3D contour sociogram (principle component)[5]

The 3D contour sociogram shows a rather evenly spread network with one prominent hill[6]. This result indicates that the network between high-tech

[5] The 3D contour sociogram is based on the Kamada-Kawai layout of nodes. This layout considers the graph-theoretic path distance between nodes as a base for the geometric (Euclidean) distance (Kamada and Kawai, 1989).

[6] The lambda set approach can also be used to define the subgroups as in the work of Verspagen en Werker (2004). The approach looks at the whole network and focuses on the connections in the network, which, if removed, would result in a disconnected structure (Hanneman and Riddle, 2005). It shows the implication for the network from a macro-perspective. The identified sub-structures will have no overlap, in contrast of other concepts. Finally, lambda sets will identify sub-structures which have high connectivity between the members. We used the approach to check our results of the 3D contour sociogram.

industries and design contains one group of closely connected people. The question that remains is who are the key members in the core of this group. The next step is describing position of subgroups to the core of the field. The actual structure of subgroups will be discussed in more detail in the next paragraph.

Describing the network of Design and High-tech SMEs

We know something about the efficiency of the overall network, but can we also say something about which relations contribute to overall efficiency. We will have to examine what the origin is of those people that make up the closely connected group in the network. Since the people within the actual network can have activities in design as well as high-tech industries it is difficult to investigate the efforts into building bonding and bridging relations in relation to industry.

An alternative is to see if the origin of relations can be related to profit, non-profit and education organizations. It would be interesting to know to what extend these labels are useful for describing the core of the emerging field, since these groups are focal point of EU and national knowledge stimulation programs (EC, 2006). Do the groups put in equal effort into building relations or are some groups more dominant than others in the closely connected group? Figure 4 presents the composition, at various connectivity levels, of the network in terms of the division into profit, non-profit and education groups. This labeling was enabled by considering the organizations in which actors work.

The composition at density level 0 corresponds to the main component in total of the network. It can be observed that at this point the component consists

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To see if our results are robust, The lambda set approach was also performed for the total network. The result was a single lambda set shrinking instead of multiple lambda sets emerging. In other words, the people who remain closely connected when more and more ‘edge connections’ in the network are being removed, take shape of a single group which becomes smaller and smaller. The presence of a single lambda set demonstrates that there are no clear boundaries between the design and high-tech industries. De results support the results of the 3D contour sociogram.

approximately 70% of profit organizations. The other two groups measure 20% (non-profit) and 10% (education). This division remains rather constant for the lower density levels.

The interesting feature in figure 4 is the increasing role of non-profit and education persons in the evolving density levels. These results reveal the division present in the hill in figure 4. One may conclude from this that the more closely connected the actors get, the more prominent non-profit and education relations become. Among the most well connected people in the network are relatively more people who work for non-profit and education organizations. This prominent feature is interesting from a governmental point of view, trying to create a “triple helix” consisting of firms, governmental institutions and educational organizations. The bias however seems to be too much towards non-profit and education organizations. More firm involvement might however be desirable.

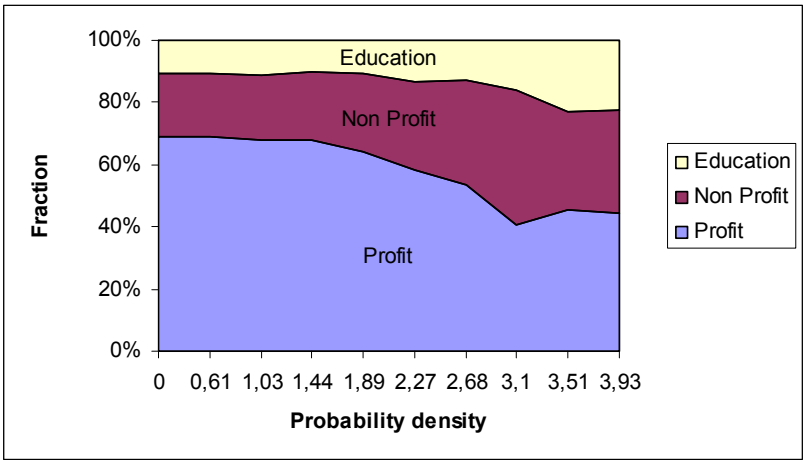

Figure 4. The evolution of the composition of sub-groups in the principal component

Conclusions and Discussion

This paper has undertaken the analysis of a SME network by making use of the theory of small worlds. It has argued that small worlds unify the best of two worlds; the theory of social capital (bonding capital) and the theory of structural holes (bridging capital). Both densely connected local environments and partnerships with interesting parts outside the local environment are needed to realize efficient knowledge flows. In a small world connectivity among local actors remains rather high; allowing the processing of complex information in the network. On the other hand ‘average’ path length is not very large; there is no impediment to the efficient spread of knowledge and information in the network. Understanding characteristics of the network, the presence of bonding and bridging capital, will enable SME to use this knowledge to their own advantage.

The theory of small worlds provides a useful way of representing bonding and bridging capital. A single parameter shows, by measuring the number of ‘shortcuts’ in the network, local clustering and average path length. Subsequently the range of ‘small worlds’ as defined by Watts (2000) can be identified. When comparing the actual network between design and high-tech industries with the theoretical optimal configuration of Watts, the actual network can be classified as one in which a small world is present. Bonding and bridging capital are balanced in a more optimal way than in a random network. It can be concluded that this formerly invisible network is a relatively efficient means of knowledge transfer and exploitation.

Furthermore an in-depth look at the way bonding and bridging capital are balanced reveals that the field does not seem to be divided into multiple small worlds. The analysis focused on studying sub-communities and was operationalised by means of identification of cohesive subgroups at various levels of density. Visualization of the results shows a single core group in the network. This indicates that only a single densely connected group of people may be found in the field. The alternative would have been that the network breaks up into various sub-groups, embodying different sides in the industries, but this is

not supported by the data. A further understanding of the characteristics of the network is enhanced by describing this core group of people. It was found that non-profit as well as education actors were overrepresented in the core of the field.

Together these results show structural characteristics of a SME network. Structural network characteristics provide background information on the current way of co-operating between organizations. The practical questions stated in the beginning of the paper: is knowledge transferred in an efficient way, are there partnership concentrations and who is involved in co-operations, have been answered. The results will be useful for regional politics to improve their interventions in the economic structure of the region. The questions are also interesting for SMEs, because it gives them an idea of where to turn to for knowledge in general.

Regarding the limitations of this study, we have little information on the representativeness of our sample for the total group of people involved in design and high-tech industries. A possible source of bias may be that the persons in the initial sample and first two waves have the advantage of being among the first mentioned. They have had more chance of being mentioned more often. Another possible source of bias is that the invitation to participate in the survey was signed by ourselves. Respondents might consider ourselves to be associated with a particular group, non-profit, and hence this may influence the willingness to participate in the survey. We have no opportunity to test the representativeness of the ‘invisible’ network sample against a more objective source of information. Therefore we can say little about the impact of this.

In policy terms this paper has brought about interesting findings. The triple helix between companies, governmental institutions and educational institutions seems to be well present in this network. Despite the positive results, policy makers may reflect on these findings in terms of improving the efficiency of this

network even more. In order to provide even more policy implications, future research might replicate this study for other SME networks in order to be better able to compare the relative efficiency of SME networks. Furthermore, future research might focus on performance differentials of different network structures.

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Summary

The Development of High-Technology Firms: An Entrepreneurship in Networks Approach

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Principal Topic

From social network theory, the entrepreneurial process involves accumulating scarce resources, building reputation, finding partners and attracting clients, knowledge, suppliers, etc. from the environment (Autio, Yli-Renko & Salonen, 1997; Brush, Greene & Hart, 2001; O'Farrell & Hitchens, 1998; Birley & Cromie, 1988). This practice among start-up firms has been widely reported and evidenced in entrepreneurship literature. The value of networks as an integral part of entrepreneurial success is widely acknowledged; however, there is considerable confusion and disagreement as to the role particular network characteristics play in the performance of emerging firms (Johannisson, 2000; Rowley et al., 2000) and especially as to what network characteristics are most advantageous in a firm's early stages (Hite and Hesterly, 2001). The aim of this paper is to examine to what extent the characteristics of structural and relational patterns of networks explain differences in performance?

Methodology/Key Propositions

We collected data from some 45 high technology ventures operating in Microsystems and nano-technology industries to examine our research question. This data was collected through face-to-face interviews with founding entrepreneurs of the firms and was conducted in the micro/nano cluster centered around Albuquerque, New Mexico.

Results and Implications

This research contributes theoretically to work in the areas of entrepreneurship in networks, early stage development of high tech firms and the role of networks in the development of new ventures. It offers a longitudinal perspective on the network development of high technology ventures and thus contributes to a more comprehensive understanding of this process. From a practical perspective the outcomes of this research will be beneficial to organizations providing support to emerging firms in high technology industries.

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Coaching versus mentoring: Are there any differences?

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Coaching versus mentoring: Are there any differences?

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Abstract

This paper focuses on two major concepts in entrepreneurship training, namely coaching and mentoring. A study of these concepts reveals at least two schools of thought: (1) coaching and mentoring are two parallel, distinct activities that can be used to support each other and (2) coaching and mentoring are not separate activities – coaching is considered part of the mentoring activity *or* mentoring part of the coaching activity. Data from 36 university-based training programmes and 450 coaching and mentoring cases at 7 Swedish universities were analysed. We used a check-list to gather information on 21 items linked to these four distinctive groups: (1) Structural issues (mission, form, and task), (2) Process issues (connection to programme content, meeting environment, problem solving, assessing the opportunity or idea, operative role, confidentiality, and networking), (3) Relationships (extent, meeting, initiative, homework, documentation, and follow-up) and (4) Character of the coach and mentor (background and experience, engagement, integrity, social skills, and role or ethics).

Coaching and mentoring differed markedly, for example, in mission, problem-solving, and use of generalist versus specialist competence. Similarities occurred in the areas of opportunity or idea assessment, meeting environment, operative role, and confidentiality agreements. The authors are convinced that the coach and the mentor have different roles for supporting the young individual to be a better entrepreneur. Coaching and mentoring are parallel activities that complement each other.

1. Introduction

Today, entrepreneurship is considered a highly relevant skill, to be developed through lifelong learning. Fostering an entrepreneurial mindset and providing training and educational activities - starting with basic education - will contribute greatly to economic growth. So policy initiatives that focus on promoting entrepreneurship in European countries have multiplied in number over the past decade (Benneworth, 2007; Kirwan et al, 2008). We have also witnessed a broadening of the entrepreneurship concept; it no longer focuses solely on encouraging new start-ups but is concerned with other businesslike situations, such as in the academic and public sectors.

Promoting entrepreneurship can be done in various ways - but according to the literature, these issues seem to be important in most entrepreneurship support situations (Klofsten, 2008):

- Inspiration of entrepreneurial behaviour and promotion of attitudes toward change.
- Provision of skills and tools germane to business development.
- Development of skills to handle environmental relationships with customers, financiers, and other stakeholders.

Crucial to the entrepreneurship training process is the use of coaching and mentoring (Sullivan, 2000; Regis et al, 2007). Regardless of whether it is called coaching or mentoring,

many young entrepreneurs in all types of work environments are looking to improve their skills, personally *and* professionally. Choosing to work with a skilled coach or mentor can help individuals achieve their goals and increase their effectiveness in the particular job or task with which they are involved (Evered and Selman (1989).

Over the years, coaching and mentoring have been well covered in numerous articles and books with a wide range of aims and scopes; for example:

- 'Coaching and mentoring for employee development' (Minter and Thomas, 2000)
- 'The teacher as a coach' (Fiet, 2000)
- 'Coaching executives' (Bane and Kopelman, 1997)
- 'Organisational mentoring' (Murray and Owen, 1991)
- 'Mentoring for network development' (Higgins and Kram, 2001)
- 'Learning and mentoring' (Sullivan, 2000)
- 'Web-based mentoring for women' (Packard, 2003)

What emerges in a comparison is that both functions involve pairing a junior individual with a senior one outside the junior's direct chain-of-command. Murray and Owen (1991) viewed coaching as the core of the mentoring process while Regis et al (2007) considered coaching to be a process where the mentor contributes to increase the specific knowledge and the "protégé's comprehension about navigating in the corporative world" (p. 8). But the tendency is to use them interchangeably with a high degree of overlapping (Coenders 2001).

2. Aim and scope

In a longitudinal qualitative analysis, this article discusses two major concepts in entrepreneurship training, namely coaching and mentoring. We are particularly interested in differences, similarities, and interrelationships between the two processes. We believe there is a strong theoretical and practical value of studying the coaching and mentoring processes in entrepreneurship training. The theoretical rationale is that there are relatively few longitudinal studies of coaching and mentoring processes in general and on entrepreneurship training in particular. Numerous of books and articles have been written on coaching and mentoring, but most of what has been published emanates from consulting and tends to be anecdotal and practical. There seems to be no consensus on what the differences (or similarities) between these functions are or how they might be interrelated.

From a practical viewpoint, coaching *and* mentoring are strong tools, which enable young entrepreneurs to address various thoughts, opportunities, ideas, and business-related issues in a personal way with a senior colleague. More systematic qualitative research in this field would help us to better understand the processes of coaching and mentorship (i.e., relationships, matching skills, and time and resource issues) and allow us to raise relevant research questions and develop practical tools to improve those processes.

3. Method and data

The data analysed below come from the Entrepreneurship and New Business Programme

(ENP) for training individuals to start new technology-based or knowledge-intensive businesses. The model was developed at the Centre for Innovation and Entrepreneurship (CIE) at Linköping University, with the help of a network of local enterprises. This programme has spread to many districts in Sweden and, in recent years, been internationalised. Since the beginning of 1994, 55 programmes have been carried out, which have resulted in more than 500 new businesses and a dozen or more new business areas within established organisations. Today, these firms and organisations employ over 2,000 people. The ENP programme was previously analysed and data were published in various articles (i.e. Klofsten, 2000 and 2008).

Coaching *and* mentoring have been crucial to support young entrepreneurs, and both functions are used as parallel and complimentary activities in the ENP programme. The major goal of activities has been to support entrepreneurs in developing their first business plans; the activities themselves are test planks on a more general level where various business issues could be addressed. The design and content of the ENP programmes support and develop the entrepreneur, the idea (technology), and the environment (company) in parallel.

When recruiting participants for the programme, two factors have been important: *(i)* whether the participant can realistically devote the time that is needed to the training programme and has the drive and spirit to be an entrepreneur and *(ii)* whether the entrepreneur has a venture idea, on which a business plan can be developed. As will be shown later, both factors strongly affect the coach and mentor's interaction with the young entrepreneur.

In this study, we used data from 36 of the 55 ENP programmes carried out so far. The 36 entrepreneurship programmes cover 450 coaching and mentoring cases at 7 Swedish universities. Data were collected from these main sources:

- 360 written evaluations of participant's judgement of the training programme where comments of the coaching and mentoring could be commented upon.
- Documentation from meetings in 520 coached projects.
- 60 personal interviews with participants.
- 40 personal interviews with mentors.
- Other programme documents, such as protocols for choosing award winners of best busienss idea and business plans.

We analysed coaching and mentoring using a check-list to gather information on 21 items linked to these 4 areas: (1) structural issues (mission, form, and task), (2) process issues (connection to programme content, meeting environment, problem-solving, opportunity or idea assessment, operative role, confidentiality, and networking), (3) relationships (extent, meeting, initiative, homework, documentation and follow-up), and (4) character of the coach and mentor (background and experience, engagement, integrity, social skills, and role or ethics).

4. Analysis and discussion

The table below shows that there are similarities *and* differences between coaching and mentoring. Concerning structural issues, the coach and mentor are there to guide and support

the entrepreneur, often in a situation where the individual is stuck and can't see how to commercialise an idea. The entrepreneur gets feedback that someone else believes in the idea. Both roles aim to support the entrepreneur in creating a business-oriented platform for long-term survival and growth where fragments are put together.

But coaching and mentoring also have structural differences. Coaches work much closer with the training programme's programme management, which monitors them to a higher degree than mentors. A coach is also responsible for assuring that participants really put theory learnt at the different workshops into practice. The coach will also check that the young entrepreneur uses the mentor and stays focused. A coach has process thinking and is at the same time keen on what's going on in the entrepreneur's mind. The mentor is given more freedom to act and transfer personal experience and advice based on similar business situations.

There are several process-oriented issues to consider. When a coach or a mentor becomes involved in an entrepreneurship training programme, it is clearly stated that financial involvement in any of the businesses being supported is not allowed during the programme. So neither can have an operative role in entrepreneurs' businesses; the balance between involvement and non-involvement is a difficult one. During entrepreneursship training, it is very important that the entrepreneur and not the coach or mentor is in the driver's seat. This rule creates a neutral arena of positive leaning, which encourages openness and avoidance of particular financial interest. Through their relationships with the business world, the coach, and especially the mentor, is expected to support programme participants with contacts and act as door-openers – providing access to resources the young entrepreneur doesn't have. Neither the coach nor the mentor should assess the opportunity or idea - their task is to support what the entrepreneur has in hand. It's up to the entrepreneur to decide to take the idea further or close down the project.

The process that the coach is acting from and the work task given to the participants are strongly connected to the content of the entrepreneurship training programme (workshops and other educational activities). The coach provides guidance whereas the mentor suggests experienced-based solutions. A mentor also has the mandate to process questions not directly connected to the programme content. When meeting a coach or a mentor, the young entrepreneur has the opportunity to discuss various questions, to be able to realise personal goals. It is not uncommon that the discussion turns to issues not directly related to the business; some could deal with sensitive matters such as family issues or personal relationships.

Table: Similarities and differences between coaching and mentoring

Item	Coaching	Mentoring
Structural issues		
Mission	Make the idea more concrete and understandable - develop a first version of a business plan	Improve the quality of the first business plan – create a foundation for doing profitable business
Form	Process orientation	Situation orientation
Task	Develop a structure and a platform through guidance	Transfer personal experiences of doing business and solve specific problems
Process issues		
Connection to programme content	Strong connection	Weak connection
Meeting environment	Neutral	Neutral
Problem solving	Guidance	Suggest
Assessing the opportunity or idea	No role	No role
Operative role	No	No
Confidentiality	Orally agreed	Orally agreed
Networking	Door opener	Door opener (more active)
Relationships		
Extent	Scheduled meetings	Non-scheduled meetings
Meeting	Individually	Individually or in groups
Initiative	Schedule based	Demand driven
Homework	Yes – a natural part of the process	No demand - not a natural part of the process
Documentation	Yes – a natural part of the process	No demand - not a natural part of the process
Follow-up	Yes – a natural part of the process	No demand - not a natural part of the process
Character of the coach and mentor		
Background and experience	Generalist	Often a specialist with a background in a particular industry
Engagement	High	High
Integrity	High	High
Social skills	High and credible	High and credible
Role (ethics)	Neutral and independent	Neutral and independent

There are several differences between coaching and mentoring in the relationships with the individual. The coach takes the initiative to meet the individual and at the start of a programme a schedule is handed out. In this particular case there are three meetings during the half-year programme. Each meeting takes about 1-1.5 hours and there might also be sporadic mail or telephone contact between the meetings. To get the most out of the meetings it is important that the participant has done the homework and that the coach documents and follows up the development and progress of the entrepreneurs continuously. The coach will support the programme leader with status reports based on the documentation from the coach meetings. A participant is expected to initiate meetings with the mentor at least three times during the training programme. Sometimes the mentoring meetings are organised in smaller groups of participants due to efficiency reasons – good mentors are busy people. To limit the mentor's administrative work, homework between meetings, documentation, and a follow-up procedure are not required.

When recruiting coaches and mentors it is crucial to get people who show engagement, integrity, and a high level of social skills. The meeting between the participant and a coach or mentor might be the only moment where the young entrepreneur meets a person in a business situation who does not have a personal interest in the project and is in a totally neutral arena. This can lead to the entrepreneur opening up in a way that normally would not occur. A coach should preferably be a generalist with a business-minded approach. The mentor should be a generalist with a background in a particular industry and have the ability to work in-depth with the entrepreneur's business issues. The mentor's experience of industry complements the process skills of the coach.

5. Conclusions and practice

This paper focuses on two important concepts in entrepreneurship training, namely coaching and mentoring. Particular interest was paid to differences and similarities between these processes and how they are interrelated. We based the analysis on various structural, process, and relationship issues and issues dealing with the personal character of the coach and mentor. We have shown that there are differences and similarities connected to all four of these functions. These major conclusions were drawn:

- There are structural differences between a coach and mentor, and they are related to mission, form, and task. There are notable process differences due to their connection to programme content and problem solving. The relationship with a coach is to a larger extent schedule based and meeting the mentor is demand driven. Coaching is based on generalist competence whereas mentoring comes from a specialist. Since coaches have several tasks, in relation to the entrepreneur and to programme management, their work is similar a project manager's, but with no decision-making responsibilities, only guidance.

- Similarities are due to process items such as opportunity or idea assessment, meeting environment, operative role, and confidentiality. The extent of the relationship is basically the same and there are similarities when it comes to personal engagement, integrity, social skills, and role (ethics).

The authors are convinced that the coach and the mentor have different roles for supporting the young individual to be a better entrepreneur. Coaching and mentoring are parallel activities that complement each other.

Another angle of this subject is if differences exist between the sexes in coaching and mentoring entrepreneurs. An ongoing debate in Sweden is why women start so few firms and why few firms started by females expand. Perhaps coaching and mentoring processes could be developed and become important tools to better support the female entrepreneur.

A crucial factor in all coaching and mentoring processes is to respect the individual drive and engagement of the entrepreneurs. The more active the entrepreneur is in relation to the project, the more easy and efficient coaching and mentoring will be. Experiences from CIE's ENP show that the entrepreneur's active participation makes the work between the coach and mentor more synchronised. The success of coaching and mentoring is highly dependent on the relationships created with the entrepreneur.

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European University-Based Entrepreneurship Training programmes: Best Practices

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European Entrepreneurship Training programmes: European Best practices

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Abstract

The aim of this paper is through a qualitative study to determine how efficient academic entrepreneurship training occurs in an academic environment and how these programmes are structured and organised. Data from 20 different university training programmes at 12 European countries were analysed. We used a check-list to gather information on these items: Promoter, programmes, target groups, key objectives and contents, actors involved, timing and budget, funding structure, staff involved, and support services. Data were collected via interviews with project managers and people in leading positions in the training organisations; secondary data such as documentation, strategic plans, brochures, and evaluation reports were also collected.

Among other things, the results show that entrepreneurship training usually occurs in co-operation with regional actors, that the main targets are graduate and post-graduate students, and that they are financed by various resources – mostly of public origin. There seems to be no one best way of organising entrepreneurship training programmes. Major implications of this study are to address clear training objectives and to base the content of programmes on specific characteristics of the local or regional environment. It is also important *(i)* to anchor the initiative in the university curriculum and *(ii)* to set up a networking group of regional actors to facilitate creation of the entrepreneurship process.

1. Introduction

The demand and supply of entrepreneurship training in Europe has expanded greatly in the last decade. Universities and business schools are setting up various initiatives, such as compulsory courses, electives in entrepreneurship in general programmes, and further-education courses for executives. Moreover, entrepreneurship has become a key word in public policy, and several initiatives sponsored by the public sector under the 'umbrella' of entrepreneurship address different but not always congruent tasks.

To address the complexity of this domain, these five issues of entrepreneurship training need to be clarified:

- Fragmentation of entrepreneurship training: On the market, there are numerous initiatives that aim to promote entrepreneurship training. This variety yields various design methods influenced by (i) context, (ii) who is delivering the training, and (iii) for what purpose. Another consideration is that entrepreneurship as a concept is based on multidisciplinary approaches involving anthropology, economics, management, psychology, and sociology (Brush et al, 2003);

- Numerous actors are involved in promoting and executing entrepreneurship training:

  Today entrepreneurship is a popular subject and is considered one of the main pillars behind successful regional development. On the market, different actors – private and public – play a crucial role in promoting and supporting entrepreneurship, using the growing sums of financial resources dedicated to this task (Ylinenpää, 1997).

- Numerous and varied targets for entrepreneurship training:

  The potential targets of entrepreneurship training are many. So participants include a wide range of individuals, from primary school students to an executive in a large corporation. This highlights the importance of designing specific training programmes that address a specific target group of participants (Gibb, 1990, Klofsten, 2008).

- Expectation from training:

  Research has shown that goals behind entrepreneurship training are not always clear (Bergek and Norrman 2008). Sometimes, expectations are linked to a combination of outcomes, such as learning, networking, awareness, number of start-ups, growth, and wealth creation. The combination of outcomes generates a controversial system of impact assessment and programme audits that influence the expectation framework (Fayolle, 2005).

- Combination of various training methods:

  Entrepreneurship training is supplied to improve competence and management skills of, for example, young start-up entrepreneurs, employees, and leaders of various organisations, large and small. Methodologies used vary from traditional classroom teaching, human touch training (i.e. coaching and mentoring), and networking (Kirwan et al, 2008; Carroli et al, 2006). What combination of methodologies is best is still unclear, and the value chain of training is still controversial (Westhead and Storey, D, 1996).

Despite large numbers of studies in this field, we need more knowledge of various approaches to entrepreneurship training. An analysis of existing and emerging training initiatives that aim to improve the entrepreneurial skills of students, executives, and other potential participants might shed light on how training methods could be improved (Pittaway and Cope, 2007).

In this study, we are particularly interested in comparing practices on entrepreneurship training at various European university environments. Previous Swedish case studies by Klofsten (2000 and 2008) addressed several success factors in entrepreneurship training that emphasise the need to use a holistic approach that includes factors such as the firm, the entrepreneur(s), and the business environment. These success factors could be exploited in the following items that represent our framework of analysis: type of promoter or organisation in charge, type of programmes, target groups, key objectives, actors involved, timing and budget, funding structure, staff involved, and support services provided. We want in this study to enlarge the sample to a European level. The aim of this paper is through a qualitative study to determine how efficient academic entrepreneurship training occurs in an academic environment and how those programmes are structured and organised.

2. Method and sample

This paper has selected 20 case studies of university and business schools of entrepreneurship from 12 European countries (Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Poland, Spain, Sweden, and the UK), based on these criteria:

- The programme has been in operation for at least 2–3 years;
- Data on the programme and achieved results are available;
- The programme is situated in one of the EU 27 countries.

The programmes were chosen so that they were fairly evenly spread throughout the EU 27 countries. The nature of the subject required a qualitative based approach, and broad, open questions were employed to encourage the respondents to narrate more freely (Yin, 1989). Interview probes were used to clarify statements and their meaning and to elaborate on the participant's experiences and judgement of the entrepreneurship training processes and its impact.

Data were collected via telephone interviews (average 1 hour in length) with project managers and people in leading positions in training organisations; secondary data, such as documentation, strategic plans, brochures, and evaluation reports, were also collected.

As a basis of good practices analysis, we used the nine operational items addressed in the introduction:

- Promoter (organisation responsible for the programme/s)
- Programmes (number and typology of programme/s delivered)
- Target groups (people participating in the programme/s)
- Key objectives (what the organisation intends to achieve with the programme/s)
- Actors involved (regional/national/European actors involved in the programme, as sponsors *and* supporters)
- Time issues (duration of programmes)
- Funding structure (financial sources used to run the programme/s)
- Staff involved (people involved in the delivery phase and its professional provenance)
- The content and services provided (e.g., incubation and seed financing together with the traditional training packages).

During the interviews, all respondents were very positive and open, and there was no problem to pinpoint specific items. Neither were there problems in communicating and using the nine items as a basis for data collection. The authors encountered no problems with a prestige bias where respondents over-emphasised their own institutions' ability to deliver outstanding entrepreneurship training.

3. Brief analysis

In this section, data and results are organised per the above list. In brief:

Promoting organisations

Entrepreneurship training seems to be organised and delivered in one of two ways:

- Devoted staff within an existing university's faculty deliver training, and the entrepreneurship programme is embedded within the university curriculum (gives course credits).
- An independent business unit created by the university itself or in co-operation with external regional actors provides entrepreneurship training. The entrepreneurship programme is independent of the university curriculum (gives no course credits).

Target groups

Main target group of entrepreneurship training are:

- Undergraduates: students currently enrolled in a bachelor university programme.
- Graduates and post graduates: students graduated from a bachelor programme(graduate) or from a PhD/Master programme (post-graduates).
- Would-be entrepreneurs: people committed to becoming entrepreneurs.
- Public bodies: regional or national public organisations involved in policy design or decision making process.

Key objectives

The main objective of entrepreneurship training is to increase the number of start-ups by students or staff. Entrepreneurship is the process of organising a new business venture, and goals are measured as number of new firms started, survival rate, and growth. Some universities have developed clear objectives linked to awareness raising and attitude change to promote entrepreneurial behaviour amongst students and staff. The same could be said about promoting the post-incubation stage where the target is established and growing businesses.

Actors involved

Most training is done in co-operation between the university and external organisations. The promoting organisation, which often is an entrepreneurship centre, an internal incubator, or an external relation office, delivers entrepreneurship training using external resources from, for example, early-stage investors, science parks, and sometimes, other universities.

Funding structure

Almost all training programmes are financed by various governmental funds sponsored by EU, regional, and national agencies. Some universities use internal resources, which means in-kind financing (professor time). Other funding sources could be private donors, and although this type of financing is less frequent, it seems to be growing. Fees from participants or other donors from financial private sector are still rare.

Staff involved

Practical experience in starting and managing a firm is considered crucial for leaders of entrepreneurship-training programmes. So the most common configuration is for university staff (professors) to run the programmes together with experienced entrepreneurs or people with general business experience.

Content and services provided

Most universities provide coaching, mentoring, and networking services with financial external investors (banks or early stage investors), incubators, and industries. A growing trend is for universities to own their own incubator facilities and provide training through that type of organisation. Seed capital or Informal venture capital department for start-ups is also becoming more frequent.
Entrepreneurial behaviour and awareness-raising activities mainly consist of modules embedded within an existing university credit-based educational programme (eg, bachelor programme) that allows students to familiarise themselves with entrepreneurial issues and to generate an interest in more advanced and focused training activities. Some universities have introduced short courses to promote an entrepreneurial spirit amongst all types of staff and to focus on issues such as IPR (Intellectual property rights) issues, idea development, and how to write contracts with external partners.

Time issues

Length varies among the initiatives that support entrepreneurship training. In general, embedded programmes at universities, curriculum stretch over 1 semester (as part of a master or bachelor programme) or 1–2 years (in a master programme). Programmes not embedded in university curricula have different lengths, generally ranging from 3 to 6 months.

4. Discussion, conclusion, and practice

There seems to be no straightforward recipe or guideline for universities aiming to develop an infrastructure to promote entrepreneurship. Each case selects and promotes entrepreneurial training initiatives according to local needs and the specific circumstances where the university is based (c.f. Autio and Klofsten, 1998). Developing the new entrepreneurial role of universities seems to be dependent on internal aspects (decision and management functions at different levels) *and* extramural ones related to co-operative arrangements with local end regional actors engaged in promoting entrepreneurship and regional development (Gibb and Hannon, 2006).

In countries or regions where industry's general demand for delivery of university research is low, governmental funding could stimulate universities to promote the process of developing new knowledge-based industry. In this framework, the university's role is to promote and stimulate start-up creation from academia and undergraduate, starting with awareness activities. Universities can adopt original designs and activities, arising from other experiences around the world, entirely separate from the local context. In the other situation – in which special R&D-related efforts are devoted – the process of transitioning from traditional industry to R&D-intensive and knowledge-based industry is based on the potential of local companies and local competencies; the role of universities is to track need and evolution of the local context. In the first framework, university is the leading company and the main actor of the new asset in a specific context, in the second one, it is one of the main actors – but in a hub with companies and public authorities (c.f. Carroli, et al, 2006).

Our analysis found a large variety of programmes in relation to the locations and contexts where universities are based. This means that the context impact on university programmes is both a stimulus for shaping the programme portfolio according to regional emerging needs *and* a starting point for designing the university role in promoting regional strength. Entrepreneurship training programmes and, more generally, the university's role in promoting regional economic growth and development should take advantage of the valorisation of regional economic advantages and strength.

It has also been shown that there is no one way of organising entrepreneurship training. Here we see independent units (i.e. external relations office) devoted to entrepreneurship support, and in other cases entrepreneurship training activities being operated through a unit (i.e. centre for entrepreneurship) within an existing faculty or institution. In some cases, no difference is made between entrepreneurship training and education. This might be an important issue for future discussion related to the three levels of entrepreneurship support, which are addressed in Klofsten (2008). Here we are talking about: (1) the creation of an entrepreneurial culture throughout the whole university. From this viewpoint, entrepreneurship should permeate all activities at the university: its research, the curriculum, and external activities, (2) the teaching of specific courses where entrepreneurship is the main subject of study, and (3) specific training programmes for individuals who intend to start their own businesses. It is most productive to allow all of these instruments to work together in parallel and enrich each other. For example, an entrepreneurial university culture and a selection of courses in entrepreneurship would most likely influence attitudes positively toward starting businesses and, hopefully, their quality. Training entrepreneurs can provide a valuable contribution to courses in the form of case studies and lectures given by entrepreneurs who have participated in previous programmes and activities.

Another observation is that there is a potential for expanding the target of entrepreneurship training programmes. Most programmes seem only to target graduate and postgraduate students. Despite the need of promoting entrepreneurship on a large scale to create an entrepreneurial climate, most universities in this study overlooked undergraduates and public bodies as possible target groups for their programmes.

Almost all organisations analysed are running their training programmes in co-operation with other regional actors – meaning that entrepreneurship training is not done in a vacuum. To facilitate co-operation and avoid duplication of actions, it might be fruitful to set up a networking group of regional actors involving all types of stakeholders with the mission to promote entrepreneurship and regional development. Such networks could be set up and managed by the university (hub model) *or* by other actors within the triple helix (Etzkowitz, 2005).

Most entrepreneurship training programmes are financed by public sources. It might be interesting to show if such programmes could be financed on a commercial basis (i.e. participants paying a fee to take part or through an equity arrangement in the start-ups emanating from the training programme).
How such arrangements would effect the recruitment of participants and the quality of the programmes might be an interesting subject to study.

Finally, a major implication of this study is to address clear objectives of all type of entrepreneurship training (c.f. Bergek and Norrman, 2008). Questions should be raised, such as *(i)* Who should be selected and on what criteria? *(ii)* How should target groups be reached? *(iii)* How should results be measured?
It is also crucial to anchor an initiative in the university organisation and at the same time be active in networking with regional actors and potential stakeholders to facilitate the creation of the entrepreneurship and regional development process (Lundström and Stevenson, 2005).

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Primarily incomplete!

A Comparative Study on Strategic Performance Management of Dutch Firms

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Abstract

Strategic performance management (SPM) has become an important vehicle for business management in today's turbulent business environment. SPM has in recent years attracted much research interest from the side of both scientists and policy-makers. This interest is warranted because of the fundamental transformations (e.g. increased competition, changes in the regulatory environment, the impact of technology, growing globalization, shifts in customer behaviour and expectations) in industrial systems created a challenging business environment, which prompted firms to call for insight into their business activities and operational performance at all times. The growing importance of these changes has further intensified the need for alternative strategic control and performance measures to allow businesses to stay competitive and profitable. The performance measures should provide a complete picture of a firm's progress towards the achievement of its mission and goals. The study addresses the need for an efficient SPM and operational Performance Measurement System (PMS) for assessing business performance to cope with continous changing business circumstances, to develop systematic strategic tools/approaches that shape and measure a firm's capability for continuous competitiveness, to innovate and renew themselves business-oriented climate, which potentially determine the success of the firms. Both the popular and scientific literature indicate that there is evidence that SPM is now implemented (in use) in approximately 70% of medium-to-large firms in the US and Europe, as well as in many governmental departments. There is however, much unjustified belief in the assumed potential offered by the implementation of SPM in Dutch firms. Most studies are anecdotal, case studies, speculative and less based upon empirical facts or solid business management theory. Much work has been carried out on the design and deployment of SPM, but relatively little attention has been paid on the impact of SPM on firms' results. The paper aims to investigate on an empirical basis whether SPM yield the benefits and/or disbenefits, as predicted by the literature, for Dutch firms. And to provide an insight into the reasons behind the implementation of SPM, as predicted by the literature, because each of the reasons for implementing SPM should yield particular benefits or disbenefits. The overarching analysis framework of this paper is based on SPM, because particular attention is paid to the lessons from the strategic performance management literature for measuring the successes (and failures) of Dutch firms. Much empirical studies provide mixed evidence on the strategic benefits from the implementation of SPM. Various literature sources, case studies and practical experience show that firms that have implemented SPM obtain better financial and non-financial results, and improve more their overall quality than competitors or comparable firms that are less SPM-driven over a longer period of time. But, other literature sources reported that SPM has failed through incorrect identification of non-financial indicators, poorly defines metrics to address the requirements of all the stakeholders, wrong and too little or much measurements, use the metrics ineffectively, no clear existence of the link between non-financial and the expected financial results and no clear interactions (correlation(s)) among the benefits, disbenefits and reasons behind the implementation of SPM. The research will deploy sophisticated statistical tools (exploratory factor analysis and multiple regression analysis) to assess systematically the business activities success and (and failures) after implementing SPM in practice.

1 The Role of High-Tech SMEs: Introduction

In today's competitive business world, enterprises are challenged to continually innovate and improve the quality of their products and services to stay ahead of the extreme – often global - competition in which the combined pressures of economic liberalization, technological change and shifts in regulatory systems lead to a complex action space. The world of business environments in a modern economy (e.g., increased openness and globalization) have changed dramatically the way of pursuing business (Spence, 2004), and depends nowadays heavily on the performance in generating utilizing new knowledge, innovations and technologies. This holds even more so in the high technology industry which is usually characterized by an extremely volatile, dynamic and uncertain business climate. High technology firms operate in a volatile environment with continually changing technologies, markets, and business strategies, and shifting consumer needs for products and services. The trend in this high technology sector is that – next to large multinationals corporations - small and medium-sized enterprises (SMEs) emerge and grow continuously thus increasing their employment, while large firms tend to decline in number (down-size and focus on their core activities) and to cut their employment (Tether and Storey, 1998). High-tech firms are the most active forces of the dynamics in SMEs. Policy makers increasingly view high-tech SMEs as key contributors to industrial innovation performance, technological change and economic growth (Jones-Evans and Klofsten, 1997; Bommer and Jalajas, 2002).

High-tech SMEs are creating and implementing technological innovations (a major source of developing the high-tech industry) and represent a powerful medium for the creation of new jobs. The increasingly vital role of high-tech SMEs in innovation - in both regional and national economic and social development and (international) competitiveness - has been widely acknowledged in the economic and entrepreneurship literature (Pavitt, 1990; Berry and Taggart, 1996; Oakey, 2007; Cooper and Park, 2008). High-tech SMEs are designed to be flexible and innovative and are often built around a successful innovative product (Trumbach et al., 2006). However, the death rate of high-tech SMEs is higher than that of large enterprises due to capital scarcity and their small scale, high-tech SMEs are frequently confronted with great challenges in an ever-increasingly fierce, global competition, in combination with fast changing customer demands, de-regulation and blurring industrial boundaries, shortening product life cycles and discontinuous technological changes. High-tech SMEs operate thus in a continually changing business environment; the competition is often so intense that there is no breathing space for relaxation and strategy development (Sureshchandar and Leisten, 2005). The above sketched uncertainty, whether in terms of competition, technology advancements or business cultural (Sureshchandar and Leisten, 2005), warrants the design of a valid and suitable model on firms that shows how firms are performing and that offer the means to improve their performance and to support (control and manage) them better in the challenging business environment in order to enhance their performance by remaining viable and to realise competitive advantages associated with their human capital. As uncertainty increases in the external environment, firms are finding it also increasingly difficult to reach consensus on long-range decisions (Cokins and Paladino, 2007). The growing importance of these changes has further intensified and supported the need for efficient Strategic Performance Management (SPM) and a related Performance Measurement System (PMS) (Davis and Albright, 2004) to encourage businesses to stay competitive and profitable (Zeng and Zhao, 2005). SPM offers opportunities for not only managing human capital, but also for acquiring a competitive advantage. SPM is often seen as a sine qua now necessary for executing an effective business strategy (Mohrman and Mohrman, 1995), because it affects current and future performance of a firm (Millett 1998), offers aids and knowledge to evaluate and monitor how a business performs, and provides reliable and robust steering measures at both the top (macro) level (Critical Success Factors,

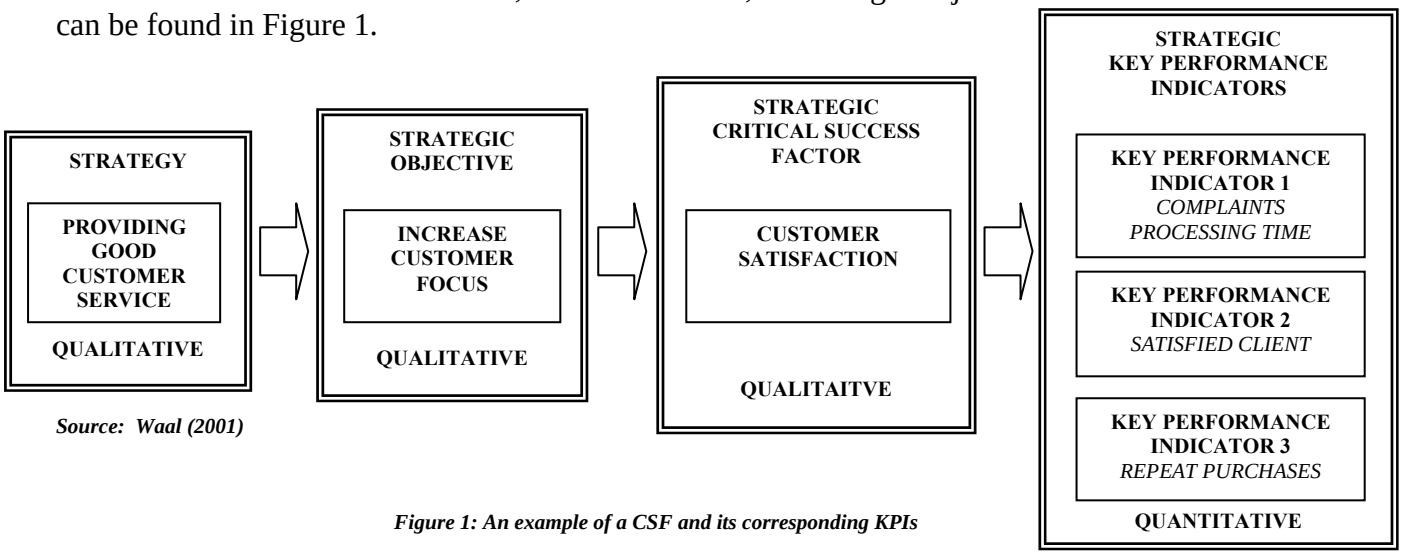
CSFs) and at the operational (micro) level (Key Performance Indicators, KPIs) that are in tune with the manifold circumstances of high-tech SMEs. In conclusion, in a turbulent and discontinuous economic development, concrete and operational measures to study, investigate, analyse and improve business performance are a perquisite for high-tech SMEs' sustainable growth and development. According to Sureshchandar and Leisten (2005), in an environment of rapid change and fierce competition attemping to measure and manage performance is obligatory. Such measures should efficiently and effectively address all facets of a firm's business excellence (Sureshchandar and Leisten, 2005). This is in line with Bourne's et al. (2003) notion that firms have to focus on a wider range of stakeholders, and have to pay attention to all important drivers of business performance.

Against this background, the present paper aims to review the current state-of-art knowledge on SPM, with a particular view to the high-tech SME sector. A systematic framework will be offered to position various contributions from the recent literature and to create a frame of reference for our comparative studies. The empirical part consists of a summary of findings from a previously undertaken study on corporate firms, followed by dichotomic comparison of the success of SPM strategies of large firms and SMEs. The paper will be concluded with an outline of future research in the SPM area.

2 Strategic Performance Management

2.1 2.1 Prefatory remarks

Strategic Performance Management (SPM) is "*a continuous process where steering of the organisation takes place through the systematic definition of mission, strategy and objectives of the organisation, making these measurable through critical success factors and key performance indicators, in order to be able to take corrective actions to keep the organization on track*" (Waal, 2001). Firstly, firms have to formulate a strategy and a mission: *what do we want to accomplish* and *how can we achieve that mission?* In order to make a firm's strategy concrete and tangible, strategic objectives need to be formulated, so that it becomes clear which activities have to be undertaken in order to implement the organization's strategy. Whether o not objectives are being achieved can be monitored with the help of leading indicators that are expressed in the form of critical success factors (CSFs) and key performance indicators (KPIs) (lagging indicators). A CSF provides a qualitative description of an element of the strategy in which the organization has to excel in order to be successful. The CSF is quantified and operationalized by means of a KPI. The use of CSFs and KPIs enables the measurement, and thus control, of strategic objectives. An illustration can be found in Figure 1.



Source: Waal (2001)

Figure 1: An example of a CSF and its corresponding KPIs

Faced with a turbulent business environment (e.g., increasing globalization and competition), Figure 1 shows that providing good customer service is critical of importance for a firm's success (Waal, 2001). Firms have to acknowledge the critical importance of being customer-oriented throughout the organization. A customer service focus assists firms to provide better products and services and thereby increasing customer satisfaction and in turn enhances their competitiveness. The number of customers that repeatedly buy products or services reflect whether customer service is satisfactory. An important activity that helps to keep customers satisfied is to respond quickly to complaints ('complaint processing time') and their needs (Waal, 2001). Firms have to avoid poor service levels and offer the best service levels to satisfy customers. It is therefore critical for firms to inculcate consumer needs and wishes into their firms' strategy and to implement effective SPM to improve customer service. If performance indicators that measure the execution of the strategy and the creation of value are not included in the SPM process, it will not be transparent whether strategic objectives and value creation are being achieved (Waal, 2001). If organizations cannot define the overall performance of their organization, they cannot measure or manage it (Armstrong and Baron, 1998). To link the company's long-term strategy to the day-to-day operations an operational Performance measurement system (PMS) has to be designed (Kald and Nilsson, 2000). PMS may be defined as: the formal process of collecting data and tracking information (information-based routines and procedures) by managers used in SPM to maintain or alter pattern in organizational activities (Simons, 2000; Waal, 2002). There are numerous, major methods and movements type of SPM to regularly increase the performance of firms (e.g., shareholder value, human resource accounting, activity-based costing, knowledge management scorecards). The currently most popular PMS method in business practice is the Balanced Scorecard (BSC), created by Kaplan and Norton (1992, 1996a, 2001a,b). It is a strategic management system that uses CSFs and KPIs for translating an organization's mission and strategy into a balanced set of integrated performance measures (Ho and Chan, 2002; Brignall, 2002). The performance measures provide a complete picture of an organization's progress towards the mission and goals (Ho and McKay, 2002). The BSC contains a diverse set of performance measures, a combination of non-financial measures (leading indicators) and financial measures (lagging indicators) organized according to four distinct perspectives, namely financial performance, customer relations, internal business processes, and the organization's learning and growth activities (Kaplan and Norton 1992; Lipe and Salterio, 2000). Figure 2 gives an illustration of a supply chain BSC framework.

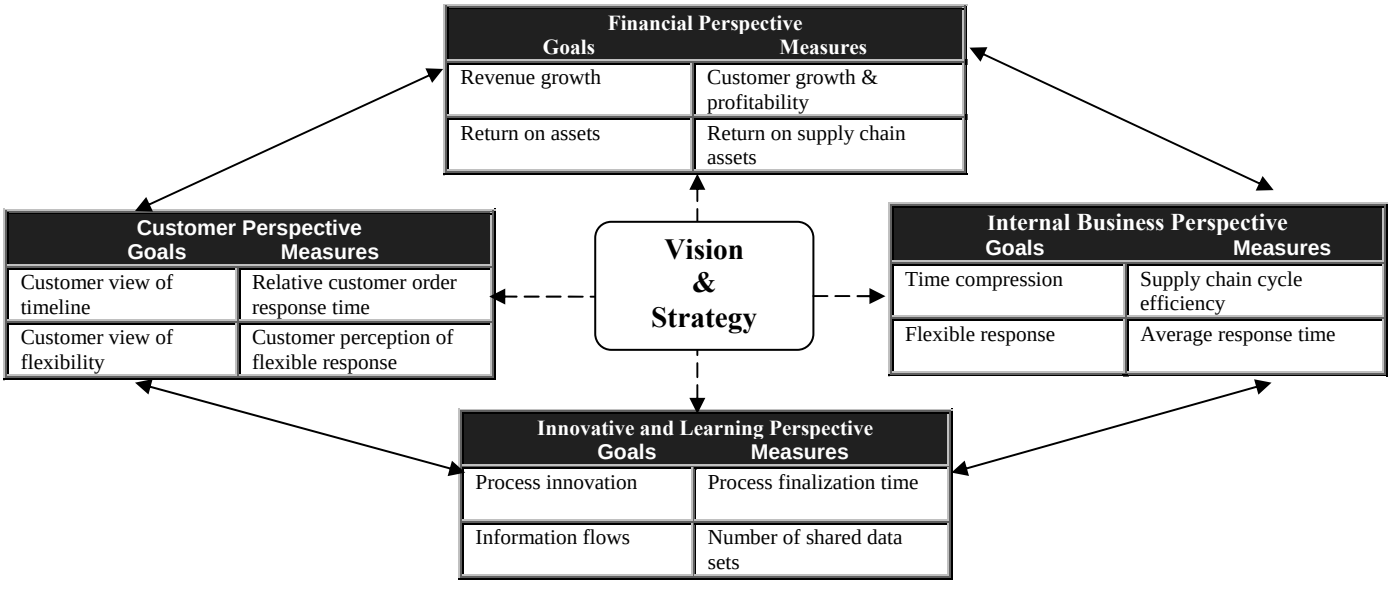


Figure 2: An example of the balanced scorecard

The BSC adopts four main angles to get a balanced overview of the organization's performance (Waal, 2001), to offer an understanding of where the organization was and where it is going, and to check whether the organization's strategy execution is still on track. The BSC essentially follows a linear one-way approach (Kaplan and Norton 1992), it assumes the following causal relationship: it starts with the learning and growth perspective and culminates in financial results outcomes (Brignall, 2002). This research does not only concentrate on the BSC tool, but on all types of measurement tools, and therefore the more general term SPM is used in this research.

2.2 SPM and high-tech SME

SPM has become a critical and an increasingly important (systematic) guidance (process) for business management in today's unpredictable, dynamic business world. SPM can be used (Kaplan and Norton, 1996b; Chow et al., 1998; Zairi and Jarrar, 2000; Niven, 2002; Andersen et al., 2006) e.g., to perform health checks throughout organizations; to clarify and translate vision into operational strategy; to communicate and link strategic objectives and business measures; to set targets and align subsequent strategic initiatives; to enhance strategic feedback and learning; to monitor the overall performance of the organization; to set strategic direction and use measurements to ensure adherence to this direction; to use performance levels to conduct detailed operational planning of activities and processes; to develop cost estimates for products and services based on past performance history; to base production planning on up-to-date performance data; to establish early warning through monitoring of key indicators (leading indicators); to influence and alter employee behaviour to promote desired changes; to establish incentives through focusing on specific performance indicators and using performance data as basis for bonuses and rewards; to improve project evaluations; to use performance data as a communication tool for providing feedback; and to check the effectiveness of past decisions and plans. The question is: has this broad coverage of SPM been experienced successful in practice by high-tech SMEs? SPM have recently gained much interest, yet solid empirical-quantitative research is scarce, and on high-tech SMEs in particular. Both the popular and scientific literature indicates that there is evidence that SPM is now implemented (in use) in approximately 70% of medium-to-large firms in the US and Europe, as well as in many governmental departments (Silk 1998; Rigby 2001; Neely et al., 2004; Marr et al., 2004). Various literature studies and case-studies (Hronec, 1993; Lynch and Cross, 1995; Lingle and Schiemann, 1996, 1999; Kaplan and Norton, 1996b; Atkinson et al., 1997; Armstrong and Baron, 1998; Waal, 2001; Lawson et al., 2003) show that organizations that have implemented SPM obtain better financial and non-financial results, and improve more their overall quality than competitors or comparable organizations that are less PM-driven over a longer period of time; these organizations are labelled as High Performance Organizations (HPOs)[1]. But are high-tech SMEs indeed HPOs as defined in the recent business economics literature? Most studies are anecdotal (Neely et al., 2004), case studies, speculative and less based upon empirical facts or solid business management theory and focus on research in large firms in general, and not high-tech SMEs in particular. Further, much work has been carried out on the design and deployment of SPM, but relatively little attention has been paid on the impact of SPM on firms' results in general (Bourne et al., 2000; Neely and Bourne, 2000; Neely et al., 2004). There is also a lack of empirical evidence of the successes and failures of SPM within the high-tech SMEs. The evidence is more generic in nature and not specific to the high-tech SMEs. Thus, there is little empirical

1 A High Performance Organization (HPO) is an organization that achieves financial and non-financial results that are better than those of its peer group over a longer period of time; they have a) high-quality management; b) openness and action orientation; c) long-term orientation; d) continuous improvement; and e) renewal and high-quality employees.

evidence that high-tech SMEs implement SPM to gain a competitive advantage and to stay profitable. SPM tools within the high-tech SMEs are limited. Moreover, several practitioners and academics (Covin and Slevin, 1989; Smith and Fleck, 1987; Berry and Taggart, 1996) have argued that SPM is inappropriate for firms operating within the turbulent environment such as high technology industries where conditions change so fast that environmental forecasting becomes meaningless and (long) strategic planning is of questionable value.
The gap in the literature is the perception of high-tech SMEs regarding SPM, because these firms tend to over-emphasise the purely technological side of their business and neglect other key strategic issues (Knight, 1986; Oakey, 1991); the day-to-day activities are less standardised and more complex. The understanding and application of SPM concepts by high-tech SMEs is unknown. It is therefore important to ask whether the SPM concept is useful for analyzing and insuring future financial performance – or other achievement indicators - in organizations in general (Norreklit, 2000; Haas and Kleingeld, 1999) and high-tech SMEs in particular. It is essential to know whether the implementation of SPM in various firms and organizations will yield the benefits - or maybe even the disadvantages – as predicted by the literature. Most likely, modifications to existing SPM are required in order to support the emerging flatter, decentralised, flexible, and team-oriented structures often characteristic of high-tech SMEs. Robinson (2004) also mentions that, despite recent empirical research, little is actually known about the specific reasons why high-tech SMEs or normal organizations have implemented SPM, because (each) reason(s) for implementing SPM can bring along automatically particular advantages or disadvantages. There is also little known about the question whether particular SPM advantages can bring along automatically other specific advantages (e.g., a link between non-financial and expected financial results) and disadvantages. Therefore, a critical review whether the SPM concept is a valid model in firms is certainly warranted. Clearly, empirical studies provide mixed evidence on the strategic benefits from the implementation of SPM. Much research offers no convincing support, or at the best mixed evidence. This calls for further investigation into the actual benefits of SPM within high-tech SMEs. Therefore, the present paper will present empirical research to add insight into the reasons behind the implementation of SPM, advantages, disadvantages and experiences of SPM in high-tech SMEs in practice (see for a general framework model Figure 2).

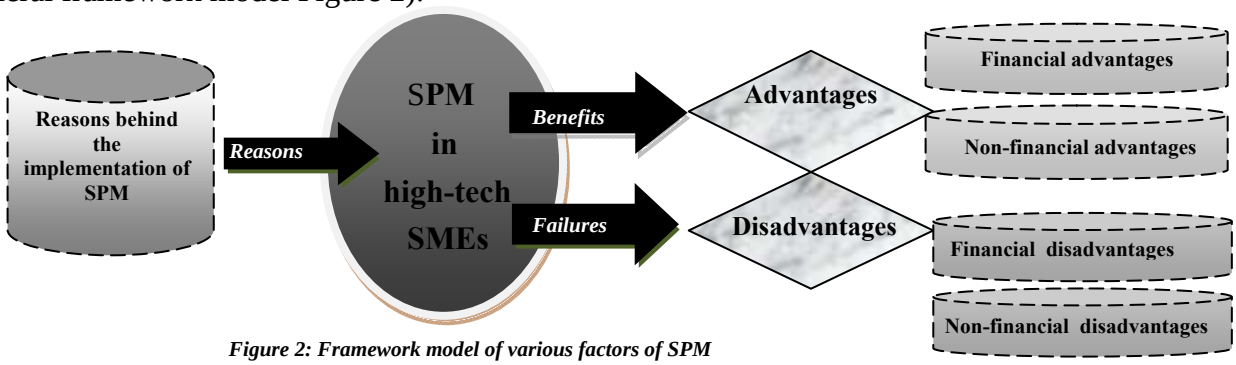


Figure 2: Framework model of various factors of SPM

3 Previous Results: SPM in Big firms

3.1 Approach previous study

Recently, a major study on SPM among major business firms in the Netherlands and Belgium was carried out (Kourtit, 2007). After a review study to extract relevant items from various management and scientific literature studies, a survey questionnaire was designed. The questionnaire consisted of three sections, namely advantages (3 financial and 22 non-financial items), disadvantages (8 items) and reasons (15 items). The variables were measured on two levels, namely ordinal and interval scales. In the case of the ordinal scale a

five-point Likert type scale ranging from 1 (not) to 5 (very) (for advantages and disadvantages) and from 1 (very) to 5 (not) (for reasons) was applied. The aim was to test whether identified items in the literature are experienced in practice by 17 big firms (4 à 5 interviews per organization) - and their employees (52 respondents) - operating in different branches and/or industries and located in the Netherlands and Belgium. The research instrument was a self-structured questionnaire administrated in a personal interview within the participating organizations.

3.2 Dimensions of SPM

The research used the 'common factor analysis' (CFA) based on a 'Maximum Likelihood Method' as a multidimensional analytical tool, because the aim was to identify the underlying factors as a set of independent components, to avoid an overwhelming amount of data and to operationalize the experienced items. We make a distinction here between advantages, disadvantages and reasons. The analysis of advantages results in a four-factor structure, the disadvantages in a two-factor structure and the reasons in a two-factor structure.

- **Advantages**

The analysis of advantages results in a four-factor structure, namely Result-Orientation (RO), Clarity (CI), Internal Quality (IQ) and External Quality (EQ). The results of the CFA for the advantages are summarized in Table 1.

Table 1: Overview of the four-factor structure for the advantages

CFA for the advantages	
Factor 1: Result-Orientation (RO) Increase in profit Higher operational efficiency Better decision-making Better management of the organization Reduction in costs More effective management control Increase in revenue Better achievement of organizational goals Better focus on what is important for the organization	**Factor 2: Clarity (CI)** More clarity on the part of personnel regarding their contribution towards achievement of the strategy and goals Better focus on the achievement of results Better understanding by personnel of the strategy More clarity on the part of employees about their roles and goals
Factor 3: Internal Quality (IQ) Higher pro-activity Greater commitment of personnel Stronger process orientation Better strategic alignment of organizational units	**Factor 4: External Quality (EQ)** More effective communication on organizational strategies Higher employee satisfaction Strengthened reputation of the organization as a quality firm Higher quality product/service Better strategic planning process More accurate quality performance information

The Factor RO can be viewed as a focused learning process and improvement factor with a continuous provision for making objectives SMART (Specific, Measurable, Achievable, Realistic and Time (when to achieve the set objectives)). The second Factor CI can be viewed as process clarity and an accountability factor with a continuous thinking-process, which translates the strategies into focus, points and clearly identifies individual activities (responsibility), and which also stimulates the participation of personnel. Next, the Factor IQ can be viewed as process participation and communication to inform people about the business's performance. A factor with a learning- and thinking process of making people more aware of and providing a better understanding of the business direction, processes, and to encouraging them to be more engaged, concerned, and cooperative. Finally, the Factor EQ can be viewed as communication process and managing the real value drivers "behind" new business factor with a continuous strategic planning process combined with learning- and

thinking process for value-creation. This means that this factor uses specific concepts (taxonomy) that everyone is expected to know, enhancing the reputation of the organization, and getting more focused discussions with regard to what is important for the organization and its shareholders and how it is doing as an organization.

- **Disadvantages**

The analysis of the disadvantages results in a two-factor structure, namely Internal Miscommunication (IM) and Uncovered Information (UI). The results of this CFA for the disadvantages are summarized in Table 2.

Table 2: Overview of the two-factor structure for the disadvantages

CFA for the disadvantages	
Factor 1: Internal Miscommunication (IM)	**Factor 2: Uncovered Information (UI)**
Too much internal competition	Too many performance indicators
Too much financial information	Too aggregated performance information
Too expensive and too bureaucratic	Insufficient strategic information in the system
	Too subjective and unreliable performance indicators

The Factor IM can be viewed as component that causes misunderstandings and unnecessary discussions. The Factor Uncovered Information (UI) can be viewed as a component that leads to a meaningless discussion and unclear focus on the business.

- **Reasons Factors**

The analysis of the SPM reasons results in a two-factor structure, namely Understand Strategy (US) and Clarity and Openness (CO). The results of this CFA for the reasons behind the implementation of SPM are summarized in Table 3.

Table 3: Overview of the two-factor structure for the reasons

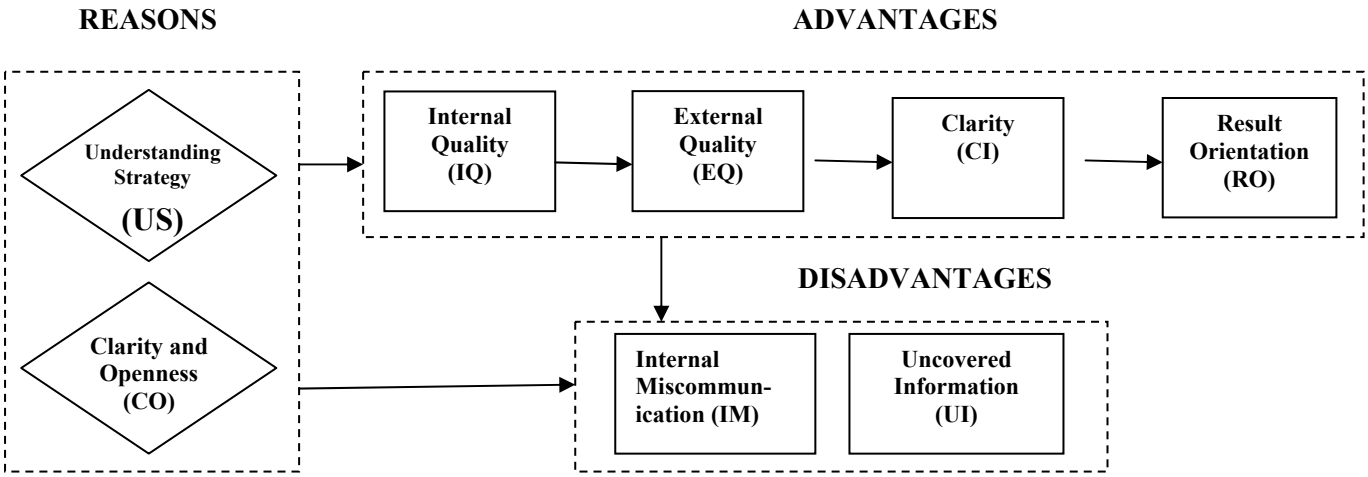
CFA for the reasons behind the implementation of SPM	
Factor 1: Understand Strategy (US)	**Factor 2: Clarity and Openness (CO)**
Strengthen involvement in the strategy	Describe mission, strategy and goals of the organization
Better control and 'obedience'	Improve performance of the organization
Create clarity in the responsibilities of organization parts	Tune the behaviour of personnel on the strategy
Manage increases in the complexity of the organization	Communicate the strategy to everyone
Improve quality	Translate the strategy to the operational level
Strengthen the responsibility of personnel	Couple reward to strategy
Better measure the performances of organization parts	Create a better focus on the strategy
	Obtain a better understanding in knowledge and skills of people

The Factor US can be viewed as a learning process and a component that leads a member of an organization to clear up and understand the strategy better and to show the opportunities and what is good for them, their organization and the society. These opportunities changed their image from're-active' to 'pro-active' (e.g., stimulated a stronger team spirit) and have a better focus on the business (e.g., performance and results). The Factor CO can be viewed as an effective communication approach to measure better the performance of organization parts, to create clarity in the responsibilities of organization parts and to illuminate particular attention points better.

In summary, these results show that the big firms have experienced various benefits that can be attributed to the introduction in practice of SPM, as described in the management and scientific literature. The introduction of SPM has had a positive impact on the financial and non-financial performance of firms, but firms experienced the financial advantages frequently indirectly. The indirect increase in financial performance was mainly due to the non-financial advantages (e.g., higher operational efficiency, better decision taking, and better management of the

organization) and depends on various external factors (e.g., rapidly growing markets, increased competition, impacts of technology, shifts in customer expectations and economic growth). It turns out that the SPM advantages: RO, CL, IQ and EQ do not significantly differ from each other. This suggests there is no particular advantage that plays a dominant role in the experienced advantages of SPM. However, the SPM disadvantages: IM and UI turned out not to be experienced or less than expected by the majority of the respondents. Finally, results show that the organizations experience in practice various reasons behind the implementation of SPM, as described in the management and scientific literature. This suggests there is no particular reason that plays a dominant role in the decision to implement SPM. If various reasons behind the implementation of SPM and the advantages and disadvantages factors are inserted in a schematic overview, a testable 'conceptual model' can be created (see Figure 3).

Figure 3: Conceptual model of experienced advantages, disadvantages and reasons behind the implementation of SPM and the relationship among these factors



This conceptual scheme was originally developed in a previous study (Kourtit, 2007) to analyze and develop the concept so as to better reflect the impact (benefits and failures) and reasons behind the implementation of SPM in practice. The model shows that reasons for implementing SPM yield or creating particular advantages and disadvantages. Furthermore, the various SPM advantages can automatically bring along particular disadvantages. Finally, particular SPM advantages can also automatically bring along other particular advantages, starting with the IQ and culminating in RO. This will be further discussed in subsection 3.3.

3.3 Direct effect between the factors

Now that it has been established that the "self-constructed" questionnaire can be used for measuring experienced in practice the advantages and disadvantages and reasons behind the implementation of SPM; the question is now: are relationships exist between the given dimensions for improving organisational performance? Using multiple regression analysis can next test the two assumptions, namely:

1. There is a positive relationship between reasons behind the implementation of SPM and advantages and disadvantages.
2. There is a positive relationship between the advantages, which links actions across the, IQ and EQ, CI and RO advantages. Whereby achieving IQ advantage (e.g., greater commitment of personnel) leads to create or improve CI advantage (e.g., higher employee satisfaction)) that then leads to create or improve EQ advantage (e.g., higher quality product/service), which in turn leads to strengthen RO advantage

(e.g., increase in revenue, reduction in costs).

Ad1: Direct effect advantages and disadvantages and reasons

In the conceptual scheme it is presumed that reasons, the exogene variables, behind the implementation of SPM are related to advantages, endogene variables.

Reasons (exogene variable)	Standardised Bètacoëfficiënt (β)	t	Sig.	Result
US reason (exogene variable)	-.046	- .476	.636	Rejected
CO reason (exogene variable)	-.379	-2.820	.007	Rejected
Model 1	**F**= 4.391	**R²**= .119	**P**= .018	
Endogene variable: RO advantage				
US reason (exogene variable)	-.361	-2.669	.010	Rejected
CO reason (exogene variable)	-.070	-.518	.607	Rejected
Model 2	**F**= 3.995	**R²**=. 107	**p**= .025	
Endogene variable: CI advantage				
US reason (exogene variable)	-.115	-1.059	.295	Rejected
CO reason (exogene variable)	-.641	-5.907	.000	Rejected
Model 3	**F= 19**.386	**R²**=.424	**p**= .000	
Endogene variable: IQ advantage				
US reason (exogene variable)	-.122	-.919	.363	Rejected
CO reason (exogene variable)	-.381	-2.869	.006	Rejected
Model 4	**F**= 5.048	**R²**=. 139	**p**= .010	
Endogene variable: EQ advantage				

Table 4: Multiple regression results for the relationship between advantages and reasons

Table 4 summarizes the regression analysis. It indicates that the CO reason behind the implementation of SPM, the exogene variable, has a negative effect on (the endogene variables): *RO advantage*, because of the high cost of labour-intensive work, other additional costs and the abstract cascading of the strategy; *CI advantage*, because reports that support understanding and clarify the execution of the strategy do always not reach employees on the operational level, there is insufficient cascading of the strategy to the operational level; *IQ advantage*, because some managers monitor only historical data, the high rush in business, too low qualified and insufficient capacity of the (right) people, no alignment between the performances and the strategy and alignment of organizational units and less motivated personnel through a culture change in the organization; and *EQ advantage*, because customer satisfaction is not always measured (well), the reputation of the organization is only regulated on a high level, monitoring quality through the delivery of a physical product instead of also the delivery of knowledge as a result and value creation depends on how people deal with SPM. Finally, the US reason, exogene variable, does not bring along automatically endogene variables RO, CI, IQ and EQ *advantages*. The conceptual model suggested that each reason for implementing SPM (or creating an advantage) can yield particular disadvantages, but the regression analyses, in table 5, show that the models are statistically insignificant, which indicates that the data does not confirm the hypothesized models.

Reasons (exogene variable)	Standardised Bètacoëfficiënt (β)	t	Sig.	Result
US reason (exogene variable)	-.088	-.625	.535	Model 1
CO reason (exogene variable)	-.234	-1.663	.103	Statistically
Model 1	**F**= 1.774	**R²**= .030	**p**= .181	insignificant
Endogene variable: IM disadvantage				
US reason (exogene variable)	.269	1.930	.060	Model 2
CO reason (exogene variable)	-.176	-1.263	.213	Statistically
Model 2	**F**= 2.346	**R²**= .051	**p**= .107	insignificant
Endogene variable: UI disadvantage				

Table 5: Multiple regression results for the relationship between disadvantages and reasons

Finally, the conceptual model also suggests that there is a mutual correlation between the advantages.

Advantages (exogene variable)	Standardised Bètacoëfficiënt (β)	t	Sig.	Result
CI (exogene variable)	.273	2.189	.033	***Accepted***
IQ (exogene variable)	.285	2.088	.042	***Accepted***
EQ (exogene variable)	.252	1.893	.064	Rejected
Model 1	**F=** 11.228	**R^2=** .376	**p=**.000	
		Endogene variable: RO advantage		
RO (exogene variable)	.332	2.189	.033	***Accepted***
IQ (exogene variable)	.194	1.253	.216	Rejected
EQ (exogene variable)	.105	.691	.493	Rejected
Model 2	**F=** 6.354	**R^2=** .239	**p=** .001	
		Endogene variable: CI advantage		
RO (exogene variable)	.293	2.088	.042	***Accepted***
CI (exogene variable)	.163	1.253	.216	Rejected
EQ (exogene variable)	.320	2.428	.019	***Accepted***
Model 3	**F=** 10.472	**R^2=** .358	**p=** .000	
		Endogene variable: IQ advantage		
RO (exogene variable)	.276	1.893	.064	Rejected
CI (exogene variable)	.094	.691	.493	Rejected
IQ (exogene variable)	.342	2.428	.019	***Accepted***
Model 4	**F=** 8.820	**R^2=** .315	**p=** .000	
		Endogene variable: EQ advantage		

Table 5: Multiple regression results among the advantages

Table 5 shows that a regression analysis im Model 1 indicates that CI and IQ advantages (as exogene variables) have a positive effect on the RO *advantage* (as an endogene variable), because of a better communication, warning tools, higher employees involvement, improvement of the forecasting process and information reports. However, the RO advantage (as an exogene variable) in model 2 also has a positive effect on the CI *advantage* (as an endogene variable), because of the focus on what really matters, clear and more transparency structures of organizations, movement of 'loose control' to 'tight control' and monthly review meetings. The results in model 3 also show that both RO and EQ advantages (as exogene variables), have a positive effect on the IQ *advantage* (as an endogene variable), because of a more effective communication on organizational strategies, more accurate management information, higher quality in products and services and strengthened reputation of the organization as a quality firm. The findings in model 4 show next that the IQ advantage (as an exogene variable) has the highest influence on the EQ *advantage* (as an endogene variable), because of highly pro-activity, greater commitment of personnel, a better strategic process orientation and a better strategic alignment of organizational units. Further, the existence of a relationship between the EQ advantage (as a exogene variable) and the RO *advantage* (as an endogene variable) in model 1; between the IQ and EQ advantages (as exogene variables) and the CI *advantage* (as an endogene variable) in model 2; between the RO and CI advantages (as exogene variables) and IQ *advantage* (as endogene variable) in model 3; and between RO and CI advantages (as exogene variables) and the EQ advantage (endogene variable) in Model 4 are not supported by the results.

In summary, there results show that most of the hypotheses are rejected especially those between the reasons behind the implementation of SPM and the advantages. The regression analysis results show that many reasons behind the implementation of SPM have a negative effect on the advantages. This means that not each reason behind the implementation of SPM yields particular advantages. This in itself is not very surprising, because organizations are at the beginning of the implementation of the SPM process. Other possible reasons for this negative effect are that for firms at the beginning of the implementation of a SPM process, strategy is too abstract and not sufficient translated into operational objectives, the supported reports do not (yet) reach the employees on the operational level; the introduction of SPM is labour-intensive (expensive in terms of the well-educated employees) while a time scale of

approximately 1 à 2 years is too short. The implementation of SPM is time-consuming and organizations have to be patient to reap the fruits of the implementation of SPM. Furthermore, many correlations among the advantages are significant, but there are differences in the relationships among the four SPM advantages. The regressions analyses results show that there is a strong correlation between the advantages IQ and EQ, RO and Cl, and EQ and IQ, and these are inserted in Figure 3 with black arrows in the following way:

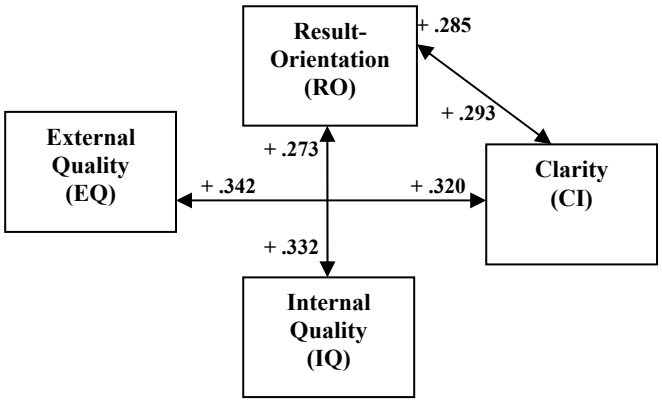


Figure 4: Results of the relationship among the advantages.

The results demonstrate that the outcome of each advantage does not always influence the outcome of other advantages. Figure 4 indicates that the outcome measures of particular advantages can sometimes be lagging outcome measures and at other times they can be leading indicators. This means that each advantage, as an independent variable, has a multiple positive effect. The advantage EQ may best be predicted through both advantages RO and EQ. Thus, knowing that organizations have a higher IQ would lead them to influence their EQ and RO. Furthermore, CI had, as predicted, a positive influence on the outcome measures of RO and also the other way round.

4 SPM in High-tech SMEs

The previous chapter reviewed previous empirical research that presented the experiences of big firms for gaining a competitive advantage from SPM. This prior study provides now the basis for crafting a conceptual framework, which can be used for further research on experiences of advantages, disadvantages and reasons behind the implementation of SPM in high-tech SMEs.

4.1 Methodology new research

The same quantitative and qualitative methodological approach ouline in Section 3 is undertaken for our study in order to address experienced advantages, disadvantages and reasons behind the implementation of SPM in high-tech (knowledge-based) SMEs operating in the electronics industry in the Netherlands that are familiar with the firm's SPM and performance. High-tech SMEs refers to highly innovative and technology and knowledge-based SMEs engaging in development, manufacture, distribution of high-tech products, technology transfer and consultation. High-tech SMEs usually cover specific industry sub-groups such as information, electronic equipment, medicine, materials, etc (Radauer, 2002). In this new study big firms were deliberately excluded from this study. The sample of 20 high-tech SMEs (11 high-tech SMEs with SPM implementation and experiences and 9 high-tech SMEs without SPM implementation) has been drawn from Syntens (an innovation network for entrepreneurs that stimulates and accompanies entrepreneurs in the SMEs via many innovation projects) with management personnel. The main research instrument was a

self-established survey questionnaire from the previous research and in-depth interviews. This research also will use the ‘common factor analysis’ (CFA) based on the 'Maximum Likelihood-method' to identify the underlying factors, to avoid a large amount of data and to measure the experienced advantages within high-tech SMEs. The research is primarily incomplete at this moment! The analysis for this study will be continued as follow:

4.2 Dimensions of SPM in high-tech SMEs

1. *Advantages Factors:* The analysis of the advantages results of SPM in high-tech SMEs.
2. *Disadvantages Factors:* The analysis of the disadvantages results of SPM in high-tech SMEs.
3. *Reasons Factors:* The analysis of the reseaons results of SPM in high-tech SMEs.
4. *Conceptual model*

4.3 Direct effect between the factors

5 Comparing big firms and high-tech SMEs

	SPM	SPM
High-tech SMEs	**X**	**O**
B.F. (Big Firms)	**X**	**O**

6 Conclusion

Primarily incomplete!
The analysis for this study will be continued.

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THE NATURE OF THE ENTREPRENEURIAL PROCESS: CAUSATION, EFFECTUATION, AND PRAGMATISM

Work in progress paper

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Abstract
This paper forms an appreciation of and a critical reflection on Sarasvathy's work on causation and effectuation models of entrepreneurship. While Sarasvathy has made significant contributions to the field, it is suggested that a more fruitful approach can follow if two modifications are made. First, it is argued that the six dimensions on which the two models differ are independent and therefore that it is more fruitful to focus on the dimensions rather than on the two models. Second, it is argued that a pragmatist view on entrepreneurship is most fruitful when it is not applied at the level of the entrepreneurial process but at the level of the underlying human actions.

Introduction

Entrepreneurship scholars have made significant efforts to explain how and why new firms originate, survive, and grow (Davidsson, 2004; Gartner, 1985; Schumpeter, 1934). These efforts have converged into a teleological model of entrepreneurship as a rationally planned, risk-taking and linear process of opportunity recognition and exploitation (e.g., Bhave, 1994; Bird, 1988; Jenkins & Johnson, 1997; Shane & Venkataraman, 2000). This model has now become the mainstream model of the entrepreneurship process. Recently, however, some scholars have started to question the validity of this model. As an alternative, these scholars have developed a model of entrepreneurship as a means-driven, risk-aversive, and circular process involving 'bricolage' and 'effectuation' (e.g., Baker & Nelson, 2005; Sarasvathy, 2001a; Sarasvathy & Dew, 2005). This alternative model could be described as the pragmatist model of entrepreneurship (cf. James, 1907; Peirce, 1931; Rescher, 2005).

The merit of the pragmatist model is that it provides a counterbalance against an overly rational view on entrepreneurship. As such, it addresses some of the limitations of the teleological model. At the same time however, it has appeared that also the pragmatist model does not provide a sufficient explanation of the entrepreneurship process and its relation to firm survival and growth. This has led scholars from both sides to believe that, to arrive at a better explanation, both models are needed or that the two models should be combined (Groen, Wakkee, & De Weerd-Nederhof, 2008; Sarasvathy, 2006b). Currently, entrepreneurship scholars are puzzled by the questions of what are the similarities and differences between the two models relate, how do they relate, and whether and how combinations can or should be made. Illustrative for the liveliness of the topic are the discussions held at the professional development workshop (PDW) on effectuation at the 2007 meeting of the Academy of Management (Sarasvathy et al., 2007c) and the initiation of a PDW on opportunity creation and discovery in 2008 (Alvarez et al., 2008).

The point that there are two opposing models of the entrepreneurial process has been most explicitly made by Sarasvathy. She even called her pragmatist model of effectuation the *inverse* of the teleological model, which she labeled the causation model (Sarasvathy, 2001b). Below we shall argue that Sarasvathy's point carries weight but that it needs to be refined and extended. We shall put forward that it is more useful to focus on the dimensions on which the two models different than on the models themselves because they are merely two extremes within a much broader spectrum of entrepreneurial behavior. Moreover, we shall argue that neither of the two models should be exclusively connected to pragmatism and that a more explicit distinction should be made between the entrepreneurial process and human action in general.

We shall proceed this paper by reviewing and building further on Sarasvathy's work on effectuation and causation. Our analysis will we based on Sarasvathy's published work in conference proceedings and journals and her recent book (Dew & Sarasvathy, 2002, 2003; Sarasvathy, 2001a, 2001b, 2003, 2008; Sarasvathy & Dew, 2005, 2007; Sarasvathy, Dew, Read, & Wiltbank, 2007b; Sarasvathy & Kotha, 2001; Venkataraman & Sarasvathy, 2001) as well as unpublished manuscripts made available on her website (Sarasvathy, 2006a, 2006c; Sarasvathy, Dew, Read, & Wiltbank, 2007a; www.effectuation.org).

Comparison of the Two Models

In several of her publications, Sarasvathy systematically compares the causation and the effectuation model. Six dimensions appear repeatedly in these comparisons, mostly in the form of dichotomies: means-driven vs. ends-driven, control vs. prediction, affordable loss vs. expected returns, new vs. existing products and markets, cooperation vs. competition, and cyclicality vs. linearity (see Table 1). Below we summarize Sarasvathy's arguments and assess them.

Table 1. Comparison of the causation and effectuation model

Dimension	Causation model (teleological)	Effectuation model (pragmatist)
Starting point	Ends are given	Means are given
Assumptions on future	Predictability means controllability	Controllability reduces need to predict
Predisposition towards risk	Expected return	Affordable loss
Appropriate for	Existing products and markets	New products and markets
Attitude toward outside firms	Competition	Cooperation
Type of model	Linear	Cyclical

Means-driven vs. ends-driven

The key distinction that Sarasvathy stresses in all her publications on effectuation is the different starting point of the two models. She argues that the causation model starts with goals as a given and that the basic decision for that model is the decision on what means *should* be accumulated to achieve these goals. Effectuation, on the other hand, starts with means and focuses on the decision on what effect *can* be created given these means. The idea that effectuation starts with means and takes them as a given does not imply that it is merely a variation of the resource based view (e.g., Barney, 1991). On the contrary, by its focus on subjectivity and imagination, effectuation explains a great deal of what are means and how they are created (Dew & Sarasvathy, 2002). Effectuation involves seeing means and resources where others do not see them or only see worthless things that cannot be used to create value. It starts by asking the questions of who I am, what I know and whom I know, rather than by a particular goal or opportunity (Sarasvathy & Dew, 2005).

Sarasvathy's focus on means-driven entrepreneurial processes is an elemental extension of entrepreneurial thinking that serves as a counterbalance against the dominant teleological model. It allows for opportunistic and creative explanations of entrepreneurship that fall beyond the scope of the teleological model. Hence, this first dimension is a strong point of her model. However, as we shall argue below, her effectuation model requires further attention where Sarasvathy starts to directly connect this dimension to other dimensions of the entrepreneurial process.

Control vs. prediction

A second dimension – or actually two dimensions – on which the effectuation and the causation model differ, concerns the assumed predictability and controllability of the future. The causation model focuses on the predictable aspects of an uncertain future and follows a

logic of "to the extent we can predict future, we can control it" (Sarasvathy, 2001a: 251). Effectuation, on the other hand, focuses on the controllable aspects of an unpredictable future and follows a logic of "to the extent we can control future, we do not need to predict it" (*ibid.*). Hence, while causation primarily focuses on those aspects of the future that are predictable, effectuation primarily focuses on the aspects that are controllable.

As the above quotes illustrate, Sarasvathy considers controllability and predictability to be related. In the causation model, a higher predictability implies a higher controllability and in the effectuation model a higher controllability implies a reduced need for predictability. At other places, however, Sarasvathy suggests that predictability and controllability are two different characteristics of a firm's environment. Sarasvathy explicitly recognizes this when she locates effectuation in a 2x2 matrix spanning up four ideal type entrepreneurial strategies (www.effectuation.org/faq.htm). From that matrix we can invoke that effectuation will be most effective in situations with high controllability and low predictability. We can also invoke that there are three other strategies and not one, implying that the exclusive focus on effectuation and causation models is probably too limited. The other three strategies are labeled adaptive strategies (low predictability, low controllability), risk-aversion strategies (high predictability, low controllability) and scientific strategies (high predictability, high controllability). It is not clear which of these three relates to the causation model. Hence, we must conclude that, on these dimensions, causation and effectuation are not two mutually exclusive models and that there are more entrepreneurial strategies than only these two.

Through her focus on the two models, Sarasvathy claims that a means-driven entrepreneurial process goes automatically together with a focus on controllability. However, while the means-driven vs. ends-driven dimension *can* be related to controllability and predictability, it is not necessarily so. Means-driven entrepreneurship can just as well go together with a focus on predictability. Suppose, for example, somebody is extremely good in motivating and instructing other people and starts thinking what to do with this capability. This is a means-driven approach. Yet, the person can still adopt a strategy in which he or she chooses to focus on predictability. An example would be to become a teacher or a business coach in a stable and relatively predictable industry. Hence, we must conclude that a combination of means-driven behavior and a focus on controllability is only one out of multiple possible combinations.

Affordable loss vs. expected returns

A third dimension that Sarasvathy puts forward to distinguish the effectuation model from the causation model concerns the assumed predisposition toward risk in both models. She argues that causation focuses on maximizing returns by selecting optimal strategies while effectuation begins with a determination of how much one is willing to lose. "The causal entrepreneur calculates up front how much money he needs to start the venture and invests time, effort and energy in raising that money. The effectuator, in contrast, tries to estimate the down side and examines what she is willing to lose in order to start the venture." (Sarasvathy, 2006a: 1).

Also here we must conclude that this dimension is not necessarily related to the previous dimensions. A focus on affordable loss *can* go together with a focus on means and controllability. However, it not necessarily has to go together with them. If I start my enterprise from the question of how to maximize returns from my own capabilities and resources, I follow a means-driven strategy focusing on expected returns. Or, if I have a clear goal in mind where to go with my business, irrespective of whether I currently have the means to realize that, I can still follow a risk-aversive strategy in which I try to minimize my risks and potential losses.

Unlike Sarasvathy suggests, risk-aversiveness is also not directly related to the perceived predictability and controllability of the environment. I can perceive my environment as very predictable but still follow a strategy that focuses on minimizing losses. Similarly, if I focus on the controllability of my environment, I can still strive to maximize my expected returns. Hence, we must conclude that the three dimensions of means vs. ends-driven, control vs. prediction, and affordable loss vs. expected returns are not related in the unequivocal way suggested by Sarasvathy.

New products and markets vs. existing products and markets

A fourth distinction between the two models centers around a firm's focus on new or existing products and markets. Sarasvathy argues that the causation model focuses on acquiring a market share in existent markets whereas effectuation focuses on the creation of new markets (Sarasvathy & Dew, 2005). In terms of product-market combinations, causation is assumed to concentrate in existing products and markets while effectuation concentrates on new products and markets, also called the 'suicide quadrant' (Sarasvathy, 2003). Two remarks can be made about this.

First, it is not clear why the effectuation model would only apply in, or be best suitable for, the creation of new markets. Firms working smarter and more efficient within an existing market can just as well benefit from effectual thinking and behavior. When applied in such situations, effectuation would focus on how the current business can be improved or optimized by using and exploiting the existing means and contacts without creating any new product or market. Hence, effectuation also works for existing products and existing markets.

Second, effectuation typically only works for evolutionary development, while for radical disruptive innovations the causation model is more appropriate. Since the effectuation model starts from what is already there and gradually develops this into something new, it hinders the development of revolutionary changes. For such changes, vision, long term goals, anticipation of customer needs, and thinking beyond what is currently possible are important (Walsh, 2004). Hence, both the effectuation and the causation models can be suitable for the development and creation of new products and markets.

Cooperation vs. competition

The fifth dimension on which Sarasvathy characterizes the two models is the attitude toward outside firms. She distinguishes between cooperation and competition. She argues that, for the effectuation model, the focus is on establishing cooperative partnerships in order to build a market together with customers, suppliers, and even prospective competitors. Docility – people's ability to persuade and be persuaded – plays an important role in this. (Dew & Sarasvathy, 2003). In the causation model, firms are supposed to focus on competition and to constrain task relationships with customers and suppliers to just what is necessary. Two comments can be made about this.

First, the associations of effectuation with cooperation and causation with competition are not necessary and oversimplify both cooperation and competition in business relationships. By arguing that the causation model is associated with a minimizing of cooperative relationships and referring to the work of Porter (1980), Sarasvathy seems to put away the broad literature on alliances, interorganizational relationships, joint ventures and networks. While that literature focuses on end-driven behavior, it makes clear that firms make use of cooperative partnerships all the time (e.g., Dyer & Singh, 1998; Ring & Van de Ven, 1994). Hence, we can conclude that partnerships are elemental for both the effectuation and the causation model.

Secondly, Sarasvathy hardly pays attention to the disadvantages of cooperation and the impact of time. She focuses on the creation of markets, for which cooperation is assumed

to be necessary. At the same time, however, cooperation also means that returns and profits will have to be shared with others. This can mean a lower market share than otherwise could be the case or lower profits. For an entrepreneur, it can be beneficial in the early stages of development to cooperate with a venture capitalist, for example. However, this same cooperation also limits the returns that flow to the entrepreneur at a later stage. Also, if intellectual property plays an important role a too early cooperation with other firms can be detrimental for the firm when it has not sufficiently protected its own intellectual contributions.

Cyclical vs. linear

A final distinction that Sarasvathy sees between the two models is that the causation model is primarily linear and the effectuation model inherently cyclical. As she argues, causation is applicable in static, linear, and independent environment whereas effectuation is better applicable in environments that are dynamic, nonlinear, and ecological. We see no need why this should be the case and believe this too is an oversimplification of the teleological model. The mere fact that teleological behavior is mainly driven by goals does not imply that it is so in a simple linear way. Goals are adjusted based on the situations that are faced and the means that have become available. If we consider the entrepreneurial process of opportunity recognition, development and exploitation, there is an implicit and sometimes even explicit assumption that the process is iterative rather than linear (Bhave, 1994; Van der Veen & Wakkee, 2004). Along the same line, the fact that behavior is means-driven does not imply that it is cyclical. Hence, cyclicality cannot be a characteristic exclusively attributed to the effectuation model.

Intermediate conclusion

From the above evaluation of Sarasvathy's elaborations on the two models we can conclude that Sarasvathy has made substantial simplifications in automatically connecting the six dimensions to one another. We hope to have demonstrated that the six dimensions are to a large extent independent and that the effectuation model and causation model as described by Sarasvathy are only two extreme models. They are ideal types composed of the six dimensions but in no way is the practice of entrepreneurship limited to these two models.

Beyond the Dichotomy: Causation, Effectuation, Teleology and Pragmatism

So far, we have focused on Sarasvathy's work on causation and effectuation without much reference to teleology and pragmatism. While the notion of pragmatism does only play a peripheral role in Sarasvathy's papers, she repeatedly mentions the classical works of James, Peirce, Dewey, and more recently Joas (1997) as interesting developments in the broader social sciences (Dew & Sarasvathy, 2002: 12; , 2003: 25; Sarasvathy & Dew, 2005: 553-554; Venkataraman & Sarasvathy, 2001: 11-13). Moreover, she suggests that the effectuation model is a pragmatist model that stands in stark contrast to the teleological causation model.

While Sarasvathy thus clearly favors ideas developed in the pragmatist tradition, her work stands in an equivocal relation to that tradition. She refers to it and suggests that her own thinking is very close to pragmatism, but she does not really incorporate work on pragmatism nor does she explicitly contribute to it. As we shall argue below, her treaty on effectuation and causation could have been more accurate and productive if she would have done so. In a more general sense, her work is largely based on psychological and economic theories whereas important developments on the nature of human action in the field of sociology have been largely ignored. The disregard of the sociological roots of entrepreneurship is a serious omission since teleological and pragmatist approaches are in the center of the sociological debate for decades (e.g., Alexander, 1983; Giddens, 1984; Joas,

1997; Luhmann, 1995; Parsons, 1951). By ignoring these developments, Sarasvathy and entrepreneurship scholars in general have overlooked an important opportunity to bring the field's understanding of the entrepreneurship process a significant step further – Dunham & Venkataraman (2002) being an exception. Below we shall elaborate on the distinctions between the teleological and pragmatist views on human action as they are put forward in sociology and argue about implications for a model of the entrepreneurial process.

On pragmatism

Since Talcott Parsons' attempt to develop a theory of action in the 1930s, many sociologists have engaged in the debate on the teleological and pragmatist character of human action (e.g., Alexander, 1983; Giddens, 1984; Joas, 1997; Luhmann, 1995; Parsons, 1951). To explicate the differences between the two, we will draw specifically from Parsons' functionalist theory of action (Parsons, 1937, 1951) and Joas' theory of creative action (Joas, 1997). These two theories, respectively, provide exemplar teleological and pragmatic models of human action. Moreover, Joas particularly positioned his theory against that of Parsons. As such, the two theories are a good starting point for understanding the differences and similarities between the two entrepreneurship models. As Joas argues, there are three defining characteristics of the pragmatist model that distinguish it from the teleological model: situatedness, corporeality, and sociality. These three characteristics are similar to what Nonaka & Takeuchi (1995) have referred to as the Japanese tradition of oneness of humanity and nature, body and mind, and self and other. For explaining these characteristics we unashamedly adopt Dunham & Venkataraman's (2002) efficient summary:

> "According to Joas, our perceptions and hence our actions, are shaped by three major influences – our particular situation, our "corporeality" or connection to our bodies, and our sociality. The first of these is the most straightforward -- our particular situation shapes our action. We must continually revise our actions to conform to the experience that uniquely arises in each situation. And thus, "it is not sufficient to consider human actions as being contingent on the situation, but that it should also be recognized that the situation is constitutive of action" (1996: 160). Our very particular circumstances thus shape our perceptions and understandings of the world, and the actions we take in response to the circumstances. Thus the situation becomes the replacement for the means-ends schemas that characterize rational action theories. Rather than viewing each situation through the lens of pre-established means-ends frameworks, it is the reverse that is true. It is the situation that continually generates and revises our learning, perceptions, goals, and actions.
>
> The notion of corporeality is more complex. According to Joas, our perceptions are rooted in our bodies – it is through our sensory, locomotive and communicative powers that we experience the world and control our actions in it. "Given that the fundamental forms of our capacity for action lie in the intentional movement of our body in connection with locomotion, object-manipulation and communication, our world is initially structured according to these dimensions" (1996: 158). Our bodies also play an important role in shaping our conscious plans of action, for within our bodies resides the pre-intentional feelings, emotions, inchoate aspirations that ultimately shape our intentions.
>
> Although our situations and our bodies' connection with those situations are unique, the meaning we ultimately draw from our perceptions is socially based, rooted in language and shared experiences. We are inherently social creatures, dependent upon one another to make sense of the world. Furthermore, even our individual identity, and ultimate ability to achieve personal autonomy, is rooted in the social relationships that enable one to develop an evaluative sense of oneself. Hence, our interactions with others and the values, beliefs, and norms which guide those interactions play a critical role in the emergence of creative action." (Dunham & Venkataraman, 2002: 16-17)

Joas' view on human action comprised by these three characteristics can be summarized as follows. First, humans always perceive the world in terms of the possible actions they can take. Hence, they perceive the world as a set of alternative opportunities that allow them to do certain things and constrain them in doing other things. Second, in perceiving these opportunities, humans are facilitated and constrained by their own body – their own

capabilities, skills, and existing knowledge. Humans have a perception of their own abilities and take this into consideration when judging the opportunities they face. Finally, being social creatures, humans are facilitated and constrained by others. Humans mutually influence and persuade one another to take particular actions and to refrain from taking other actions.

Creative human action and the entrepreneurial process

In theorizing about the implications of a pragmatist view for the entrepreneurial process, both Sarasvathy and Dunham & Venkataraman focus on developing an alternative model for the dominant teleological model. Both consider that pragmatist entrepreneurship is radically different from teleological entrepreneurship and that these are alternative modes applicable in different situations. While such view on the role of pragmatism in entrepreneurship has been useful to go beyond the teleological model, it fails to appreciate the most important point that Joas makes: that *all* creative human action is characterized by situatedness, corporeality, and sociality. This means that, irrespective of whether an entrepreneurial process is means-driven or ends-driven, is based on predictability or controllability, focuses on expected return or affordable loss, aims at existing or new products and markets, is based on competition or cooperation, or is linear or cyclical, the human action involved is always situated, corporeal, and social.

The issue here is that Sarasvathy and Dunham & Venkataraman have applied pragmatist logic at the level of the entire entrepreneurial process while it is better applied at the level of individual human actions. Dew & Sarasvathy show some awareness of this in their remark "…entrepreneurial effectuation is but a special case of a more general theory of effectuation that might potentially be developed" (Dew & Sarasvathy, 2002: 22). Rather than taking entrepreneurial effectuation as the basis for a more general theory of effectuation, however, we believe it to be far more fruitful to turn their argument around. Building upon a long tradition of sociological theorizing and research on the nature of human action, Joas' theory is more developed than the model of effectuation. Therefore, it seems more appropriate to take Joas' theorizing as a pragmatist basis for conceptualizing the entrepreneurial process. Combined with the above observation that it is more fruitful to focus on the six dimensions rather than on the two models of entrepreneurship, we come to the following characterizations of entrepreneurial behavior (see Figure 1).

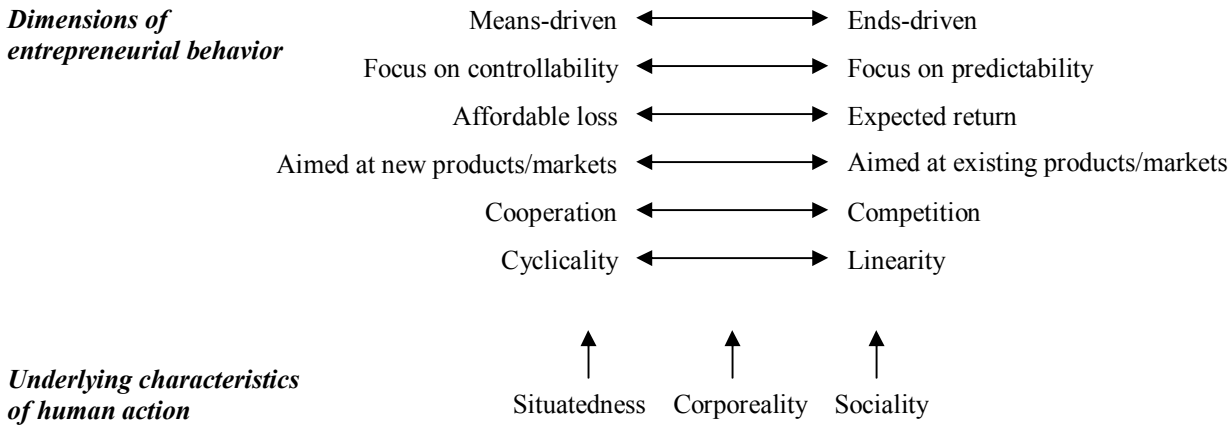

Figure 1. Human action and entrepreneurial behavior

Conclusion and discussion

In this paper we have taken stock of Sarasvathy's work on effectuation and have made two comments on it. First, we have argued that the six dimensions that Sarasvathy distinguishes are independent of one another and therefore, that the distinction between a causation model and an effectuation model is an oversimplication. Second, we have argued that pragmatism should better not be used to distinguish between two alternative models of entrepreneurship but to understand the nature of the underlying human action.

By making these two comments, the paper intends to make two contributions. First, we intend to contribute to the current discussion on entrepreneurship. Most particularly the paper suggests that we should move from a discussion on alternative models to a discussion on the dimensions that comprise these models. Second, the paper suggests that a more explicit distinction and connection between the nature of the entrepreneurship process and the nature of human action should be made.

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ENTERPRISE EDUCATION AND THE ADOPTION OF NEWER TECHNOLOGIES WITHIN SMALL FIRMS[i]

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Abstract

Enterprise education has been regularly cited as a tool which can be utilised to not only increase the level of entrepreneurship within an economy, but also the success of those enterprises started. This paper explores the extent to which participation in enterprise education is associated with the adoption of new technology within new businesses. As this is one way that businesses can remain competitive not only within their own countries but when competing against international competition. Using data from the Global Entrepreneurship Monitor survey from the UK, the study finds weak evidence that those undertaking enterprise education in the form of university based schemes or government sponsored training schemes are more likely to be using newer technology. However, this relationship is relatively weak and does bring into question whether many enterprise courses are effective value for money.

1. Introduction

Research has indicated that entrepreneurship plays a vital role in creating wealth, employment, diversity and innovation in an increasingly competitive global economy (Van Stel et al., 2005; Ács and Audretsch, 2003; Thurik, 2008). As such policymakers wishing to boost their economies may implement policies aimed at encouraging greater development of entrepreneurial behaviour. One mechanism through which this might be accomplished is through the provision of enterprise education, with courses at school providing many children in the UK with a first experience of enterprise. However, just generating interest in entrepreneurship is not necessarily enough, courses should also provide prospective entrepreneurs with the relevant skills and abilities required for starting a business and running it successfully (Kuratko, 2005; Gorman et al., 1997). This way the economic benefits of start-up activity can be maximised.

Using data drawn from the Global Entrepreneurship Monitor (GEM) UK surveys for the years 2005 to 2007 this study attempts to identify if participation in enterprise education shows any evidence of increasing the probability that entrepreneurs remain competitive through one particular mechanism, the adoption of newer technology within their businesses. The impact of enterprise education from four different sources (school based enterprise education, university based enterprise education, formal work placements, and government training schemes) are explored.

The remainder of the paper is structured as follows. Section 2 reviews the existing literature relating to technology adoption and education in particular that aimed specifically at developing the entrepreneurial skills within existing or future small business owners. Section 3 introduces the GEM data, and methodology adopted within this study. Section 4 presents the results and Section 5 concludes.

2. Entrepreneurship education and innovation

Whilst many public policies have attempted to simply boost the level of small business ownership in the UK in general, there is an acknowledgement that a large proportion of employment created by small business is from a small number of high growth businesses. Innovation and the use of new technology is strongly associated with higher levels of growth (Marsh, 1996), and also survival particularly in the smallest and youngest firms (Cefis and Marsili, 2006), and therefore should be encouraged. Publicly sponsored schemes to encourage greater innovation have suggested that one method of achieving this is through provision of education specifically designed for enterprise, to help unlock the ‘knowledge base’ held by institutions like universities, an approach which would seem likely to succeed

given that US evidence finds new firm formation higher in sectors more closely related to university research (Audretsch and Acs, 1994). However, the entrepreneurs themselves express doubts as to whether this 'knowledge base' is the primary source of innovation (Macdonald et al., 2007).

As Carter and Collinson (1999) point out, there has been considerable debate over the role of educational attainment in encouraging entrepreneurial activity. Whilst many early studies in the field of entrepreneurship indicated the educational attainment of entrepreneurs to be low, more recent work has begun to recognise that those with higher levels of education will have the abilities and skills required to recognise an opportunity and exploit it successfully (Robinson and Sexton, 1994). For example, research by Delmar and Davidsson (2000) and Arenius and Minniti (2005) found that nascent entrepreneurs tend to be highly educated, whilst Arenius and De Clercq (2005) also showed a positive correlation between education and opportunity recognition.

With increasing interest in entrepreneurship, its impact on the wider economy and growing evidence that education is an important factor in influencing entrepreneurial activity, it is not surprising that the number of entrepreneurship courses has been increasing globally (Kuratko, 2005; Katz, 2003; Vesper and Gartner, 1997). However, the proliferation of such 'interventions' has not been uniform across the school or higher education sectors and the materials and techniques used to 'teach' entrepreneurship are by no main means homogeneous. Indeed, the main critiques of enterprise education are that it tends to follows a traditional didactic format rather than being action-oriented (Sexton and Upton, 1987; Jones-Evans et al., 2000), adopts a corporatist approach to enterprise (Gibb, 1993), and fails to discuss theories that budding entrepreneurs can apply to improve their chances of success (Fiet, 2000). Studies also criticise enterprise education as not being designed for those participating, either relying on skills which are not in place, providing knowledge of factors not required by participants with more experience, and not tailoring education to provide skills required by local business (Laukkanen, 2000). As Rosa (2003) suggests, courses of this type might be expected to have an impact only on the number of individuals intending to start a firm rather than increasing the percentage of nascent entrepreneurs who are successful. Consequently, the 'ivory tower' stereotype of academics continues to exist in many industries, particularly amongst relatively less well-educated owner-managers, leading to a lack of trust in their practicality and their relevance to the real world (Jones-Evans et al., 1999). Courses provided through schools and as work placements with SMEs are less likely to have large influences directly on start-up activity given their low impact on the entrepreneurial skills and knowledge of participants. However, these courses may encourage further involvement in enterprise education at higher levels, and can also help develop an enterprise culture in young people through greater desirability (Peterman and Kennedy, 2003; Birdthistle et al., 2007).

One aspect of which entrepreneurial activity that policymakers may particularly wish to encourage is the adoption of new technology, as this may result in economic growth. It is important to note that one-off, radical introduction of new technology inventions (Schmupeter Mark I innovation) are often limited in geographical, sectoral, financial and temporal contexts (Lajanja and Fontes, 1998; Oakey and Mukhtar, 1999). The majority of innovative behaviours conducted by new technology-based firms are therefore likely to concern technology adoption rather than technology invention (Lajanja and Fontes, 1998). Studies examining the potential of education to enable individuals to successfully reallocate resources in disequilibria have a long history with in a multitude of situations and environments examined (Schultz, 1975). Although less complex than technology invention, in most cases technology adoption requires absorptive capability (Aharoni, 1991), which is likely to involve high levels of skills as well as accumulated human capital in order to search,

select, replicate and adopt technologies developed across the boundaries of firms, research institutions and countries (Lajanja and Fontes, 1998). More specifically Wozniak (1986) shows that human capital is positively associated with early adoption of new technology, and the associated collection of information on new technology prior to adoption (Wozniak, 1993), as human capital reduces the level of uncertainty faced in regard to the payoffs from technology adoption. It is also necessary for some degree of business science knowledge to maximise the benefit of even fairly low level technology adoption (Knol and Stroeken, 2001). Once technology has been adopted human capital is likely to be positively related to the degree that implementation of this new technology is successful (Meyers et al., 1999). It may be possible to provide these more technical entrepreneurship skills through higher education and government training schemes.

For entrepreneurs running growth businesses courses covering 'succeeding in a rapidly changing world' were found to be ranked highly by entrepreneurs themselves particularly high-tech entrepreneurs (Sexton et al., 1997). However, the applicability of many forms of education and training targeted at increasing innovation is questioned by entrepreneurs themselves (Macdonald et al., 2007). Whilst earlier studies of enterprise education highlighted the importance of identifying opportunities on the technological frontiers for developments in future entrepreneurship courses (Vesper and McMullan, 1988), it is unclear to what extent these calls were heeded. A mainly US survey of business schools found by the mid 1990s undergraduate entrepreneurship courses were mainly based around starting a new venture or small business management with very few found to concentrate on innovation evaluation and technology transfer, and although more graduate course of this ilk existed they were still swamped by more generic new firm courses (Vesper and Gartner, 1997). Even those courses specifically designed to cater for entrepreneurs starting ventures using high technology or in knowledge intensive sectors do not emphasise understanding the continuous process of technology adoption as an important learning objective, although this may be partially encompassed in more general elements designed to help participants deal with the uncertain environment they will face (Garavan and O'Cinneide, 1994).

It appears that whilst earlier work looking for the directions that enterprise education should head in indicated that one aspect that needed to be covered was the use of and influence of new technology, many courses do not appear to specifically cover this element of entrepreneurship. Whilst at the same time enterprise education and training is encouraged and in some cases funded with the express aim of increasing the level of innovation and use of technology in the small business sector. It would seem that the influence of enterprise education on technological adoption within UK SMEs will be uncertain.

It would seem likely that more technical courses such as those provided by higher education establishments and government sponsored organisations would be likely to have a greater impact on technology adoption, than those courses designed to encourage greater interest and participation in entrepreneurial activities at a younger age, such as school based enterprise education and work placements. However, there is still potential for these courses to increase the use of new technology, if as intended these courses not only direct young people towards further sources of small business and enterprise education, but also help a entrepreneurial mindset in those of a younger age.

3. Data and Methodology

The data utilised in the study is drawn from the Global Entrepreneurship Monitor (GEM) surveys for the UK undertaken in 2005, 2006 and 2007. The GEM project is an international study providing comparable data on entrepreneurial activity and attitudes in a number of countries across the world (42 participants in 2007). For an exhaustive description of the

GEM data collection and processing methodology see Reynolds et al. (2005). The survey in the UK takes the form of a stratified random sample collected from the population as a whole and conducted in the form of telephone interviews by a profession survey company IFF. Levie (2007) gives a more in-depth description of the data collection processes utilised within the UK. Whilst the sampling population consists of all adults in the UK, a number of questions are asked to determine whether individuals are actively involved in starting businesses they will own and manage, or currently running businesses as owner-managers. These individuals are asked further questions in relation to their businesses. Although not specifically isolating entrepreneurs for interview the sheer scale of the UK survey (117,395 individuals when combining the surveys of 2005, 2006 and 2007), means that a sub-sample of entrepreneurs can be isolated that is still of usable size.

Those individuals included in the sub-sample studied in this paper consists of those starting new businesses and those who currently are owner-managers of existing businesses. The first group are those undertaking activities to start businesses in which they will be part or whole owners of, and have a managerial role (nascent entrepreneurs). The second group within the sample are those currently managing a business which they are part or whole owners of. Given the expansion of enterprise education has only occurred relatively recently and a vast majority of participants will be younger we limit the sample to those aged between 18 and 45 years of age. The total sample size available when eliminating those not providing data required to control for other characteristics is 3,689.

Given that the paper aims to ascertain the impact of differing sources of enterprise education on the likelihood that business owners will adopt the latest technology within their businesses, we split the sample according to their response to whether the technology or procedures utilised in their ventures will have been available for longer than a certain time period. In order to check for robustness, two periods of time that technology/procedures have been available for are utilised. This allows the isolation of those using relatively new technology (introduced within the last 5 years), and the newest technology (introduced within the last 12 months). The sample includes 783 technology adopting entrepreneurs when using the wider definition and 231 early adopters when using the tighter definition. The binary characteristic of these definitions allow logit estimations to be utilised to determine the impact of enterprise education on technology adoption after controlling for other characteristics of the entrepreneur which may influence the decision.

Four different sources of enterprise education are examined for their impact on technology adoption, these being: school based business or enterprise education; university based business or enterprise education; formal work placements with SMEs' and government training schemes in business or enterprise skills. Additional controls are also included to account for the impact of: gender; human capital in the form of experience (age and age squared divided by 100), and as general educational attainment (dummies utilised to represent the highest level of qualification achieved); potential of financial constraints (household income bands); risk aversion and familiarity with current UK region (migration status split into three groups life-long residents, in-migrants from other UK regions, and immigrants born overseas). As the characteristics of firms themselves may have a direct influence upon the probability of utilising new technology further controls are also made for: the age of the firm (years since wages were first paid or profits first made); the size of the firm (number of employees); and industry sector of business at the 1-digit Standard Industrial Classification (SIC) level. Finally to control of geographical and temporal differences dummies are included to represent the UK government office regions of residence of the business owners, and year of survey. The proportion of entrepreneurs utilising newer technology by entrepreneurs' and firms' characteristics are reported in Tables 1 and 2, with

Table 3 reporting the proportion of entrepreneurs utilising newer technology by participation in enterprise education.

For each form of the dependant variable size models in total are utilised. The first excludes all of the dummies for enterprise education participation and acts as a base model with which to make comparisons (Model 0). Models 1 to 4 allow a single source of enterprise education to enter the equation, with school based, university based, formal work placements, and government training each entering in turn. Model 5 incorporates all four sources of enterprise education in order to allow for the participation in multiple sources of enterprise education by individuals.

4. Results

i) Broad Definition of Technology Adoption

Initially concentrating the broader measure of technology adoption that of using technology only made available in the last five years (Table 4), the base model (Model 0) is found to only explain a relatively small portion of the variance in technology adoption, with R^2 values indicating around 7 per cent of variance being explained. However, the likelihood ratio test of Model 0 compared to the alternative of a constant probability is significant at the 1 per cent level. The Hosmer-Lemeshow test of goodness of fit is not rejected, so whilst not performing spectacularly the models are suitable.

Concentrating in on the control characteristics of the owner-managers it is found that few of the personal characteristics of the owner-manager have a strong influence on the decision to utilise newer technology. Although only significant at the 10 per cent level it appears that male owner-managers are more likely to utilise newer technology perhaps reflecting a lower level of risk-aversion and greater growth orientation than their female counterparts (Marlow and Carter, 2006).

In terms of human capital, the coefficients on age and age^2/100 suggest that experience increases the probability of technology adoption but at a decreasing rate, but these coefficients are far from significant. The lack of a significant influence from age may reflect the relative youth of the sub-sample. General education appears to play no role on the probability of utilising newer technology within a business. Whilst this at first appears to run contrary to Wozniak's (1986) findings this may reflect the tendency for greater specialisation in UK education at a relatively early age, where individual's with quite different levels of education may possess similar levels of knowledge appropriate to a particular industry sector.

Interestingly financial constraint as measured by the household income of the owner-manager appears to play no role in the adoption of newer technology. However, similar to the gender effect, the potential for lower risk-aversion of those who are more mobile means that in-migrants are more likely to be utilising newer technology in their businesses than life-long residents of a region, although it should be noted that the coefficients are only significant at the 10 per cent level. Similar sized coefficients are found upon the immigrant dummy, but the smaller size of this group means that a lower level of significance is found.

Variables based on the characteristics of the firms themselves appear to explain the adoption of technology better. This is found to be the case particularly for the age of the business. Younger businesses are understandably more likely to be utilising newer technology, as the adoption of this technology involves lower fixed costs associated with the scrapping of existing technology. The use of newer-technology declines as firms age perhaps no longer requiring the same level of efficiency they required when firstly attempting to overcome barriers to entry, or substituting technologically derived efficiency for lower costs based on economies of scale.

The results provide little evidence that economies of scale are utilised in place of efficient newer technology as the coefficients imply that larger firms are more likely to utilise newer technology, although these effects are not significant. Although not reported here for brevity it comes as little surprise that the level of technology adoption varies considerably between industry sectors, with the agriculture sector least likely to be utilising new technology, whilst the business services, and finance, insurance and real estate sectors are more likely to be utilising newer technology.

Moving onto the impact of enterprise education the likelihood of any influence would seem relatively remote with little evidence that more general human capital greatly increases the probability of using newer technology. As discussed in the preceding section it would seem unlikely that enterprise education provided at school or in the form of formal work placements would involve providing the technical skills and knowledge to influence adoption of newer technology. This is born out by the results in Models 1, 3 and 5 where the coefficients are far from significant and in the case of school based education in Models 1 and 5, and formal work placements in Model 5 are actually negative.

It is little disappointing that those participating in these 'gateway' forms of enterprise education are not engendered with a more entrepreneurial spirit, so that perhaps not whilst having the skills to better judge the costs and benefits of technology adoption would be more inclined to taking innovative paths. However, the role played by these forms of enterprise education could take the form of developing an entrepreneurial spirit which encourages the uptake of enterprise education at a higher level at either university or through a government sponsored training scheme.

Both university based enterprise education and government training schemes are found to significantly increase the probability that participants will utilise newer technology in their businesses controlling for other influences. Both these significant influences remain present in Model 5 where all four sources of enterprise education are allowed to simultaneously enter the regression.

In terms of the performance of these models, the likelihood ratio tests imply that Model 0 is outperformed by Models: 2 (χ^2 = 5.61 d.f. [1] p-value = 0.018); 4 (χ^2 = 5.06 d.f. [1] p-value = 0.025); and 5 (χ^2 = 10.56 d.f. [4] p-value = 0.032) at the five per cent level. The Hosmer-Lemeshow test for these models appear to be better fits to the data as well with no danger of the null of a good fir being rejected.

It would seem therefore that university based enterprise education and government training schemes do have a positive influence on the level of technological adoption, even entrepreneurs themselves have often criticised university enterprise education in particular (Macdonald et al., 2007). In addition the models of adopting newer technology are also improved by including these variables in the regression.

ii) Narrow Definition of Technology Adoption

The results above of course use quite a broad definition of new technology, and therefore may not accurately represent the influence that enterprise education and other personal or firm characteristics have on the probability of utilising the latest technology, that which has only become available in the last twelve months. Table 5 below presents the result of logistic regressions when using this tighter definition of new technology adopters.

The percentage of the variance explained by the regressions is a little higher than the broad definition with R^2 values indicating around 12 per cent explained by the models. Again the likelihood ratio tests indicate the Models outperform the alternative of constant probability. The Hosmer-Lemeshow statistics imply that models fit the data relatively well.

As with the regressions utilising the broader definition personal characteristics of the entrepreneurs appear to have little influence on the adoption of new technology. There is no longer weak evidence that male owner-managers are more likely to adopt new technology, in fact a negative sign is found on the male dummy, although this is not even significant at the 10 per cent level.

New technology adoption rather than increasing with age is decreasing, which may imply the lower risk-aversion of the young encourages the use of newer riskier technology, however, again this is not significant. Similarly the impact of general formal education is reversed compared to Table 4, but coefficients are very small and far from being significantly different from zero. With the tighter definition of new technology only those entering their current region of habitation from outside the UK are more likely to be utilising new technology in their businesses and even here the coefficients are not significant.

As previously the age of the firm is negatively linked to the probability of being an early adopter of technology. Similar industry sectors are more likely to encourage and discourage early adoption of new technology with the tighter definition. Larger businesses are less likely to use the newest technology although this is not a significant effect.

Addition of the enterprise education variables finds that again school based enterprise education, and formal work placements have no impact on increasing the probability of early adoption, as was the case with the broader definition. However, university based enterprise education is also found to have no significant impact on increasing the probability of using the latest technology. The only source of enterprise education that participation in has a significant impact on the probability of using the newest technology available are government training schemes. The likelihood test implies that Model 4 outperforms Model 0 at the 5 per cent level (χ^2 = 5.75 d.f. [1] p-value = 0.017), but this is not the case when the other sources of enterprise education are also included in the equation (χ^2 = 6.14 d.f. [4] p-value = 0.189).

5. Conclusions

Moves over the last 20 years to develop a more entrepreneurial economies with higher levels of innovative firms capable of competing in the global marketplace have encouraged the expansion of a multitude of entrepreneurial courses at all levels of education. This study has examined the impact of a number of different types of enterprise education on one particular aspect of entrepreneurship, the adoption of new technology, by small business owners.

The results indicated that when examining a broader definition of new technology, participants in those sources of enterprise education more likely to include provision of more technical business skills and knowledge, such as those provided by universities and government training schemes, were more likely to be utilising newer technology. It appeared that ‘gateway’ sources of enterprise education had no significant impact on newer technology usage, and therefore currently only provide a role in encouraging further study in terms of developing innovative activities through this particular mechanism. However, when using a tighter definition of new technology only government training schemes were found to have a significant impact, on early adoption.

A study does have a number of limitations including the fact that the data source is entirely from the UK, enterprise education courses do differ between countries and therefore the findings may not be generalisable to other countries. Secondly the categories of enterprise education are relatively broad and do not differentiate for example between students taking courses based around business, and those from other faculties such as engineering or science students taking courses aimed at helping commercialise inventions and innovations developed through their major subjects. Thirdly experience can only be crudely measured

through age, whilst previous work experience may obviously have an important impact particularly where this is in the same industry as their current business.

It is worrying that given the large amount of money spent on enterprise initiatives to aid the development of aspiring entrepreneurs that sources such as university education appear to have little impact in developing technologically innovative business-owners. This implies that some of the worries set out in previous literature in relation to the form that enterprise education takes may be justified. It also brings into question whether public money is being wasted in initiatives which are aimed at boosting greater new technology use and innovation, but utilise courses where it is rare for these elements to be explicitly dealt with.

Although the limitations outlined above must be considered, it does seem that before more public money is spent for little reward, it may be necessary to reassess and identify what the aims of enterprise education are for society as a whole. If as is often stated, the enhancement of small business in the UK through greater innovation and use of technology remains the aim then this should mean concentrating funding on those schemes where technology and innovation play an important role. In areas or regions of the country where no such existing courses are present this should mean the development of new courses, which fit the criteria.

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[i] *Although data used in this work are collected by the GEM consortium, their analysis and interpretation are the sole responsibility of the authors.*

Binary logistic regression of utilisation of technology and processes introduced in last the five years

		Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Male		0.1575 (0.085)	0.1576 (0.085)	0.1591 (0.082)	0.1576 (0.085)	0.1676 (0.068)	0.1684 (0.067)
Age		0.0151 (0.816)	0.0141 (0.827)	0.0190 (0.768)	0.0149 (0.817)	0.0116 (0.857)	0.0122 (0.851)
$Age^2/100$		-0.0631 (0.515)	-0.0622 (0.522)	-0.0670 (0.490)	-0.0627 (0.519)	-0.0586 (0.546)	-0.0609 (0.532)
Educational Attainment (base category: secondary qualifications)	Some Secondary	0.0680 (0.730)	0.0661 (0.737)	0.0980 (0.619)	0.0687 (0.727)	0.0824 (0.676)	0.0985 (0.618)
	Post Secondary	-0.0401 (0.771)	-0.0394 (0.775)	-0.0644 (0.641)	-0.0405 (0.769)	-0.0432 (0.754)	-0.0623 (0.652)
	Graduate Experience	-0.0080 (0.936)	-0.0067 (0.947)	-0.0441 (0.664)	-0.0081 (0.935)	-0.0092 (0.927)	-0.0394 (0.699)
Household Income (base category: middle third)	Lower Third	-0.1381 (0.264)	-0.1387 (0.262)	-0.1340 (0.279)	-0.1383 (0.264)	-0.1419 (0.252)	-0.1394 (0.261)
	Upper Third	-0.1490 (0.130)	-0.1488 (0.130)	-0.1497 (0.128)	-0.1490 (0.130)	-0.1401 (0.155)	-0.1409 (0.153)
Migration Status (base category: life-long residents)	In-Migrants	0.1647 (0.082)	0.1650 (0.081)	0.1711 (0.071)	0.1647 (0.082)	0.1600 (0.091)	0.1685 (0.076)
	Immigrants	0.1393 (0.359)	0.1405 (0.355)	0.1235 (0.417)	0.1395 (0.358)	0.1256 (0.408)	0.1155 (0.449)
Age of Firm, years since wages paid (base category: not yet)	3 years or less	**-0.4669** (0.000)	**-0.4672** (0.000)	**-0.4547** (0.000)	**-0.4667** (0.000)	**-0.4503** (0.000)	**-0.4417** (0.000)
	4 to 12 years	**-0.8751** (0.000)	**-0.8762** (0.000)	**-0.8651** (0.000)	**-0.8751** (0.000)	**-0.8580** (0.000)	**-0.8547** (0.000)
	13 years or more	**-1.0269** (0.000)	**-1.0272** (0.000)	**-1.0258** (0.000)	**-1.0268** (0.000)	**-1.0158** (0.000)	**-1.0180** (0.000)
Size of Firm, number of employees (base category: no employees)	1 to 5 Employees	0.1525 (0.301)	0.1518 (0.303)	0.1441 (0.329)	0.1524 (0.301)	0.1535 (0.298)	0.1421 (0.336)
	6 to 19 Employees	0.2621 (0.243)	0.2620 (0.244)	0.2532 (0.260)	0.2620 (0.244)	0.2531 (0.260)	0.2448 (0.277)
	20 or more Employees	0.2050 (0.511)	0.2060 (0.509)	0.1796 (0.566)	0.2049 (0.512)	0.1883 (0.547)	0.1691 (0.589)
Enterprise Education	School based		-0.0265 (0.820)				-0.1246 (0.311)
	University based			**0.2222** (0.017)			**0.2277** (0.021)
	Work placement				0.0069 (0.937)		-0.0371 (0.683)
	Government training					**0.2228** (0.023)	**0.2027** (0.043)
N		3689	3689	3689	3689	3689	3689
LR d.f. p-value		272.41 [38] (0.000)	272.46 [39] (0.000)	278.02 [39] (0.000)	272.42 [39] (0.000)	277.47 [39] (0.000)	282.97 [42] (0.000)
R^2		0.0714	0.0714	0.0729	0.0714	0.0728	0.0742
Hosmer-Lemeshow		12.2 (0.143)	13.65 (0.091)	5.87 (0.662)	11.37 (0.181)	7.88 (0.446)	4.18 (0.841)

Binary logistic regression of utilisation of technology and processes introduced in the last year

		Model 0	Model 1	Model 2	Model 3	Model 4	Model 5
Male		-0.0597 (0.696)	-0.0598 (0.695)	-0.0584 (0.702)	-0.0596 (0.696)	-0.0363 (0.813)	-0.0357 (0.816)
Age		-0.0406 (0.691)	-0.0412 (0.686)	-0.0388 (0.704)	-0.0407 (0.690)	-0.0495 (0.628)	-0.0497 (0.628)
$Age^2/100$		0.0458 (0.768)	0.0461 (0.766)	0.0441 (0.776)	0.0462 (0.766)	0.0583 (0.708)	0.0563 (0.717)
Educational Attainment (base category: secondary qualifications)	Some Secondary	0.3323 (0.290)	0.3292 (0.295)	0.3479 (0.269)	0.3332 (0.289)	0.3737 (0.236)	0.3707 (0.241)
	Post Secondary	-0.0467 (0.837)	-0.0460 (0.840)	-0.0579 (0.799)	-0.0472 (0.836)	-0.0520 (0.819)	-0.0548 (0.810)
	Graduate Experience	-0.0603 (0.724)	-0.0590 (0.730)	-0.0765 (0.657)	-0.0604 (0.723)	-0.0559 (0.743)	-0.0625 (0.717)
Household Income (base category: middle third)	Lower Third	0.1921 (0.317)	0.1912 (0.320)	0.1923 (0.317)	0.1918 (0.318)	0.1816 (0.345)	0.1809 (0.347)
	Upper Third	0.1233 (0.466)	0.1242 (0.463)	0.1233 (0.466)	0.1232 (0.467)	0.1275 (0.452)	0.1299 (0.444)
Migration Status (base category: life-long residents)	In-Migrants	-0.0391 (0.809)	-0.0386 (0.812)	-0.0363 (0.823)	-0.0390 (0.810)	-0.0466 (0.774)	-0.0439 (0.787)
	Immigrants	0.3583 (0.119)	0.3589 (0.119)	0.3511 (0.127)	0.3585 (0.119)	0.3340 (0.147)	0.3301 (0.153)
Age of Firm, years since wages paid (base category: not yet)	3 years or less	**-0.7945** (0.000)	**-0.7952** (0.000)	**-0.7895** (0.000)	**-0.7942** (0.000)	**-0.7607** (0.000)	**-0.7605** (0.000)
	4 to 12 years	**-1.8782** (0.000)	**-1.8799** (0.000)	**-1.8740** (0.000)	**-1.8780** (0.000)	**-1.8513** (0.000)	**-1.8536** (0.000)
	13 years or more	**-2.0448** (0.000)	**-2.0453** (0.000)	**-2.0452** (0.000)	**-2.0448** (0.000)	**-2.0315** (0.000)	**-2.0335** (0.000)
Size of Firm, number of employees	1 to 5 Employees	-0.0487 (0.845)	-0.0503 (0.840)	-0.0518 (0.836)	-0.0488 (0.845)	-0.0524 (0.834)	-0.0589 (0.814)
	6 to 19 Employees	-0.6262 (0.197)	-0.6268 (0.197)	-0.6311 (0.194)	-0.6262 (0.197)	-0.6493 (0.181)	-0.6537 (0.178)
	20 or more Employees	-0.3916 (0.527)	-0.3913 (0.528)	-0.4002 (0.518)	-0.3917 (0.527)	-0.4196 (0.498)	-0.4227 (0.495)
Enterprise Education	School based		-0.0364 (0.850)				-0.1008 (0.620)
	University based			0.0994 (0.528)			0.0677 (0.687)
	Work placement				0.0067 (0.964)		-0.0348 (0.822)
	Government training					**0.3867** (0.015)	**0.3891** (0.016)
N		3689	3689	3689	3689	3689	3689
LR d.f. p-value		209.69 [38] (0.000)	209.73 [39] (0.000)	210.09 [39] (0.000)	209.69 [39] (0.000)	215.44 [39] (0.000)	215.83 [42] (0.000)
R^2		0.1214	0.1214	0.1216	0.1214	0.1247	0.125
Hosmer-Lemeshow		6.74 (0.565)	6.27 (0.617)	5.7 (0.681)	6.73 (0.566)	2.47 (0.963)	2.51 (0.961)

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Managing innovation for growth in high technology small firms

Abstract

This paper studies ways to support sustainable growth in high technology small firms by managing innovation. The paper examines technology based and knowledge intensive business service firms (KIBS) and their innovation management in Finland. The goal is to find at least one meaningful innovation process for a small KIBS firm that takes growth into consideration. In the paper incremental, radical, disruptive, open and systemic innovation are seen from small KIBS firm perspective a model that combines these types of innovation is presented. Two cases of small technology based small KIBS firms are also selected to closer examination.

Growth, knowledge creation and innovation in small KIBS firms

Growth can be seen in many ways in small firms. It can be seen as intention to grow or potential to grow. It may also be growth in competitiveness, effectiveness, turnover, profit, personnel, partners and networks, knowledge or innovativeness. In this paper growth through creation and commercialisation of new innovative services in KIBS is in focus. There are growth models for firms (like Greiner 1972, Churchill and Lewis1983) but they are not studied in this paper as such.

In knowledge based economy competitiveness of firms is strongly based on innovation (Tidd et al. 2005). According to innovation management theories a systemic approach in management of innovation is needed (Rothwell 1992). Development and learning should be strategy based because it accelerates them. Many KIBS act in turbulent environments so strategy must have rather simple rules so that decisions can be done fast. Content of services is most important but selection of technologies and market demand must support the content and business models and service concepts.

In global knowledge based economy there is a transition from products to services and competition is based more on business concepts and models than on technology, products and services. While large firms focus to their core competencies and processes they outsource others than core processes including research and development and even the whole innovation chain or parts of it. Outsourcing of r&d is expanding to open innovation where new ideas are searched outside the organisations and also ways to commercialise ideas are looked outside the organisation as well. Global economy requires local and global presence simultaneously, knowledge intensity is increasing and new technologies enable novel processes. Value chains are breaking so that research is done on favourable regions and production is mostly moving and done close to large markets. Change is happening with accelerated speed in operating environment of firms and therefore also innovativeness is seen as a central source for competitiveness in firms.

Value creation in KIBS is not only based on creation of knowledge but also on combining, applying and accumulating knowledge from several sources. New business opportunities are based on change or combination of discontinuities (Prahalad and Ramaswamy 2004, Hamel 2000, Tidd et al 2005, Bessant et al. 2005). Instead of innovating alone firms innovate in networks. Also innovation models have developed from linear models to iterative and interactive models (Rothwell 1994, Sundbo et al. 2006). Innovation process is a knowledge process (Tidd et al., 2005, Nonaka and Takeuchi 1995). Innovation is also based a combination of knowledge gathered from several sources instead of single knowledge (Henderson and Clarke 1990). Innovation should happen with right timing and cycles. For example during very fast growth the idea is to sell as much as possible because market share is then determined (Izosimov 2008).

Knowledge creation in collaboration requires physical and virtual interaction. Knowledge creation process is an interaction with tacit and explicit knowledge. One concrete form of organizing it is a hypertext organization (Nonaka and Takeuchi 1995) where the system consists of line organization, project teams and knowledge platform. With KIBS firms the hypertext organisation is built with customers. The value networks can be complex (Laine 2006). In Nonaka and Takeuchi model project managers and middle managers had a special role. In the model new product development process was considered to be the most important process in new knowledge creation. Focusing on knowledge creation can bring growth on mid term scale (Salojärvi). Also in small manufacturing firms active learning orientation (challenging the paradigm) is found to be related to growth (Sadler-Smith et al. 2001). Developing a new service or product is a problem solving process. The most usual way to solve problems is trial and error (von Hippel).

Networking should be managed according to firm's innovation goals (Tidd et al. 2005, Laine 2006). In networks there are more trust and communication in inner parts or core of the network. Outer areas of the network are based on different rules and there is not as much trust and therefore also knowledge flows are smaller between actors (Ruuskanen, 2004). One strategy a small firm for optimising networking could be to have connections to partners who have a lot of contacts. Networked firms are better in recognition of new opportunities for collaboration and they make better strategic decisions. On special fields of technology best partners are often international partners (Lemola and Honkanen, 2004). Networks can also be used for innovating by brokering where ideas collected from one network are commercialised to other networks (Hardagon 2003). It is not networks itself but how you build and use them (Huston and Sakkab 2006).

Most of innovations are incremental meaning small improvements to existing products, services and processes. Incremental innovations seldom create fast growth but they can create slower growth with lower risk compared to radical or disruptive innovations. Incremental innovation is also more manageable than disruptive or radical innovation. Changes needed are smaller and also customer needs are clear (Tidd et al. 2005). Incremental innovation can also be used when KIBS service is started as radical or disruptive innovation and there is a need to improve process or technology after the launch of the service. If a small KIBS firm likes to start with an incremental innovation in services it will face challenges. It has to compete against more experienced firms with smaller resources. In beginning of a firm and entering markets a niche strategy seems to be easier for a small firm. In case of small KIBS a regional niche is often enough to start with. Small firms may also not have enough knowledge about customer acceptance because of their small customer interface. Therefore their possibilities to create successful incremental innovations are smaller.

Disruptive innovation is an interesting way for a KIBS firm to start because according to the theory of disruptive innovation it gives room for new entrants. It is based on identification on emerging technologies where small firms are good at. It should also be connected to market knowledge to create a low-end disruption or market disruption (Christensen 2004) Small firm can recognise opportunities well but they may lack market insight. Therefore to make a disruptive innovation successful small KIBS need to develop their market insight.

Open innovation model (Chesbrough 2003) has been followed with open business models (Chesbrough 2006). Open innovation is based on finding ideas outside the organisation and also finding new ways to commercialise new ideas through external channels. Large firms are disappointed to their r&d effectiveness (Chesbrought, 2006). They look for ideas in public research centres, universities and small firms. It is good to keep in mind that open innovation is not outsourcing where usually the same things are done cheaper in somewhere else. Goals should be clear when entering to open innovation (Huston and Sakkab 2006). One benefit in open innovation is also that selling the same technology or knowledge to others forces the seller to be competitive by adding value by other means. So from this point of view open innovation is an innovation incentive itself.

Systemic innovations can make the innovation more acceptable. Systemic innovation means using different dimensions of innovation simultaneously like if new technology is introduced to a certain process also process is developed at the same time (Teece 1986). When systemic innovation requires changes in adopting organisation it is not easy way to go for a small firm. Scalable business model enable growth. Scalable business model means that there are possibilities to increase turnover significantly without increasing the amount of work done. Therefore also pricing in KIBS firms should be based on added value and not on work done. Successful firms are found to innovate with concepts (Orihata and Watanabe) and they use competitive advantage to recognise new opportunities and not to sustaining their position on the market (Brown and Eisenhardt 1998). Future oriented planning and forecasting should create at least one meaningful future scenario for organisation (Hamel and Prahalad 1996).

Radical innovations are rare and the risk related to them is bigger than with other types of innovations. Therefore creation of a radical innovation is a challenge. Successful radical innovation combines change in technology or society, customer needs and strengths of the firm (Linturi 2007). Possibilities for small firms to create radical innovations depend also how radical is defined. Radical can be defined at least as new to firm, new to customer, new to field of industry and new to world. Three—quarters of attempts to grow outside the core fail (Zoo and Allen 2003).

One way to foster innovation and growth in innovative firms is to use public sector as an innovative customer. This means that public private partnerships are created where public sector pays for innovative firms to innovate for public sector. Demand supporting actions on public sector can be public procurement, standardisation and tax incentives. Growing R&D expenditure is not anymore enough to grow innovativeness in Europe. There is also a need to add support for marketing and demand of innovations (Aho et al.). Public buyers can have high volumes. They can help in creation of critical mass and diffusion of new technologies. They can help in lowering risks and accelerating learning. Their action can also foster scale benefits. Public customers can have an important role in young sectors and on sectors where their role is significant. In innovation favourable markets demand creates innovations. Public customers can also make new technologies more acceptable. Public actors can also

help firms to create regional niches. This helps firms to grow and create critical mass on their field of expertise. This kind of niche management (Lemola) also accelerates learning**.** Existing regulation does not hinder sustainable partnerships. It is the capability of actors to apply these regulations. Clear rules for long lasting partnerships are needed as well as to make the applying of them easier. Public procurement in innovative cases could be one central vehicle to lead small innovative firms to growth. They are seen to be important on new industry sectors (Halme and Kotilainen, 2008). When public demand is concentrating on innovative solutions it has an affect on innovation dynamics on sectors where public sector can have an important role like energy, environment and healthcare sectors to name some of them.

Innovation process in services and small firms

According to literature there are general steps common to almost all innovation processes: search, selection and implementation which are all combined to learning. It is not so important how the process is described and named than to have a process that works, is integrated and managed (Tidd et al.). Appropriate innovation management tools depend on dynamics of the environment and r&d cycle lengths (Aplilo et al. 2007). Competitive and dynamic environments foster shorter time scale, less than year and tools are more likely to be experiments, platforms and networking. With over three year scale strategic planning and research can be used. Project portfolio management is used between these two with one and two year scales (Apilo et al. 2007).

Basically product innovation processes and service development processes are quite similar although services are intangible. Also same tools for managing innovation in services can be used than managing innovation in products (Hull 2005). Service development is perhaps more often starting from strategy and in service development it is common to connect customers to the development process from the very beginning. However, most innovative customers are not representing average mainstream customers. After first adaptors of the service there is a gap before mainstream users. A niche strategy with application is found to be essential in crossing this gap called " the chasm" (Moore 1991).

Small firms differ from large ones in innovation. With lesser resources they have to create positive cash flow faster. So they must be better in making decisions and faster in reacting in the case of failure. Small firm's future may be depending on a single project (Apilo et al. 2007). On the other hand small firms are considered to be better in innovativeness, flexibility and agility compared to large firms. And they may be interested in technologies and knowledge that is not seen as interesting by large established firms (Laine 2006).

Factors that hinder innovation in services in Finland are found to be uncertainty of market demand, lack of knowledge and lack of funding (Statistic Central Finland). It is quite obvious that firms do not innovate as much as they could (Lemola and Honkanen 2004). In industry firms seem to have too few ideas and too few ways to exploit the ideas (Apilo et al.).

In innovation process risk is always involved so there is a need for risk analysis. Analysis should be from several directions, considering all detected uncertainties (see for example Dunham 2002). In search for growth the risk evaluation should give bigger weight to return on investment, payback time, and value adding than other factors. However, in the cases

other than incremental innovation the economic calculations are very likely to be uncertain and indicative (Kettunen et al.).

Case studies

Two KIBS firm cases are selected to closer examination. The first called “Case A” is a firm that started eleven years ago and is producing simulation and optimisation services for industry. The second called “Case B” is a new firm started one year ago and produces software development services for industry based on open source, agile computing methods and their own development tools. Both firms have been started in the same incubator at Satakunta University of Applied Sciences in Finland and both of them value partnership with higher education and research institutions. Data presented here is based on several discussions, case studies, surveys and participating observation, value network analysis, and innovation management assessments, collaborative research and development projects. Some result of the case firm A have been published earlier (Laine 2004, 2006). The two case firms have used several means to improve their innovation performance. They are summed in Table 1 and also the benefits are described.

Idea screening and enrichment are more strongly based on strategy in case A. Both firms try to bundle public and private funding already in the beginning of their innovation process. They both say that they have a lot to learn on this field. Still most of the innovation process is funded by positive cash flow. This can be done by selling the idea generation phase and concept development phases to customers as well. Case A has been able to get funding also from foundations. For a small firm this can be remarkable help because reporting to foundations is usually lighter than reporting to many other external sources of funding.

Iterative development is used by both case firms. Case B uses an agile development method where iterative development is essential. Customers or lead customers are connected to their development processes. Interactive project management tools with customers are used intensively by case B. Both firms have created their own solution to share knowledge and documents with their customers. Those solutions include personal contacts and virtual environments. Experiments are used to test ideas and new technologies. Case A also heavily uses simulation. Case a sells risk analysis for its customers. Case B uses more intuitive style in risk analysis. Both are technology oriented. Both use demonstrations, prototypes and artefacts to convince customers and to make their ideas more tangible.

Both use platforms to create new service innovations. Platforms can be tested with universities or innovative customers. Case B makes cross sector benchmarking and adopts and further develops successful and promising models. This requires high absorption capacity and good knowledge of field of industry benchmarked. Case A uses project portfolio management. Case B uses customer portfolio management and looks for most profitable customers. However, most profitable customers are not necessarily the best ones to innovate with and therefore it also looks for innovative partners in other networks.

Case A is experienced and sophisticated in CRM with more experience on their field. They already have several tested ways to develop the relationships with their customers. Case a uses strongly visionary management. They have had the same vision since the beginning which actually it is more like a short statement (Kawasaki uses word “mantra” for this type of

statement), that describes what they are doing. Both have multinational large firms as their customers.

Tools and methods, processes	**Benefit**
Iterative development	Lower risk in innovation
Experiments	Low cost idea testing, developing insight
Customer involvement in service development	Lower risk in innovation, accelerating innovation
Internet based data storage for knowledge management and data exchange with customers	Accelerated learning, process improvement
Interactive project management tools with customers	Accelerated learning, fast feedback
Simulation software	Lowering risk, concept development
Risk analysis	Lowering risk
Demonstrations and prototypes, artefacts	Gaining credibility and mutual understanding, making intangible to tangible
Web 2.0 (social web) tools for interactive innovation process with partners	Cost effectiveness, increased interaction, mapped idea development process
Using open source software in service concept and their development	Cost effectiveness, transferring innovation to customers
Networking	Opportunity recognition
Partnering	Accelerated learning, opportunity recognition
Technology or software platforms	Fast development, credibility
Copying successful innovation	Benefiting from earlier success
Lead customers involved in new service development	Radical innovation
Project portfolio management	Allocating resources
Customer portfolio management	Customer focus
Customer relation management	Effective marketing of new ideas and concepts
Visionary management	Sustainable advantage, accelerated learning
Collaboration with large firms	Gaining credibility, accelerated learning, global business insight,
Collaboration with university	Credibility, opportunity recognition, idea enrichment, development of new services, knowledge and technology transfer, technology backup in decision making, incubator services and mentoring, additional resources
Mentoring	Business development, vision, sense making
Incubator	Successful start and survival, access to regional networks, first customer references
IPR management	Protection of own ideas, hindering competitors using same ideas, option to sell or license
Idea screening based on strategy and customer needs	Focus, critical mass
Public and private funding for development	Optimal mix of resources
Time horizons	Balancing visionary, strategic and operative decision making
Detecting changes to recognise opportunities	Possibility to disruptive innovation
Technology and market forecasting	Opportunity recognition and screening
Technology and service roadmaps	Timing, meaningful converging and diverging development paths, demand innovation
Scenario development	Finding meaningful path to future, developing strategic flexibility
Market research	Understanding real market demand
Innovation management audits	Finding strengths and weaknesses
Reference lists	Credibility
Scalable business models	More value added with same cost level
Niche management	Entering markets easier, crossing the chasm

Table 1. Innovation management tools and methods detected to be in use in case firms.

Case A uses strongly time horizons management. Both detect changes to recognise new opportunities. Case B has broader scanning in this. Case A uses technology and market forecasting, technology and service roadmaps and scenario development to make development future oriented and better timed. Market research used to detect real customer needs and potential. Both cases use open innovation with limited number of partners in idea generation and concept development. Case A is using also external channels to commercialise its innovations. Case A has a remarkable reference list.

Project based customer relations seem to create a challenge both for marketing and innovation. During a hectic project it is difficult to sell new projects or innovate more than necessary. Customer database with alarms may hep in marketing but mainly it is a resource question. Both firms want to develop the innovation processes beginning to be more systemic. Developing methods and processes in scanning the environment, idea generation, idea enrichment, screening of ideas and concept development. Case A wants to describe the processes and involve all to the innovation process. So innovation starts to be also a leadership challenge in case A.

Case A uses web 2.0 tools like blogs (weblog) and wikis (wikipedia type tools) with partners to create new service innovations. Both use open source software but Case B is almost totally based on open source tools and platforms. Case A has very strong networks. Social web tools help to map the innovation process. Discussions and comments are stored. This makes it is easy to follow how discussion and idea enrichment has developed in time. All ideas remain in blog or similar tools and platforms and wait for enrichment or combination with other ideas for concept creation. The tools are very cost effective. Many of them are available for free as open source software or in other ways.

Both firms have been able to exploit networks effectively. There are signals of brokering where ideas collected from one network are commercialised to other networks (see Hardagon 2003). There are also dynamics in network development. Part of the dynamic seems to be emerging like strategy development. It is difficult to evaluate the value creation and strength of ties in their networks (Laine 2006, 2007). It looks like both are good in trust creation. They both seem to have analytical, creative and operational skill on their field so they are able to adapt to different network configurations. Without trust creation it is difficult to use interactive tools. Experiments create insight into innovation. They tell if ideas work or not. It is not high risk tolerance that is needed but low cost experiments that tell if ideas are worth exploiting (Hamel 2000). The firms have complex and dynamic strategies which are both emerging and planned.

Firms started in the same incubator and have been actively collaborating with university since then. The collaboration has covered opportunity recognition, idea enrichment, development of new concepts and services, business incubation, mentoring, forecasting, technology and knowledge back up, using students as development resources, using web 2.0 tools in innovation, innovation process development and collaborative research. Collaboration between small KIBS and university seem to create benefits to both parties. The KIBS can develop to a level where they start to be interesting partners for multinational companies as well. Feedback from entrepreneurs challenges university to rethink its role and make improvements to processes and gives insights to KIBS firm's niche technology, knowledge and applications. Learning, idea generation and enrichment, concepts and knowledge are created for different reasons at university than in firms. Processes have been both goals

oriented and open ended looking for creation of meaning (see Lester and Piore 2004 for analytical and interpretive interaction). It seems that the firms do well also without the university after the survival phase. However, they seem to come back now and then when they want to renew themselves (Laine 2004a). The university has also acted as an innovative public customer in collaborative development projects.

Innovation in small KIBS firms is not pure success. Failing, giving up, selling the business and going bankrupted are also choices that are present. These two case firms are using a complex set of tools and processes and systemic approach except in idea generation phase. However, firms do not necessary recognise themselves that they are using a formal method. Both firms have done innovation management audits (see Tidd et al. 2005, pp. 564-569). Although they use sophisticated tools for knowledge management they both evaluated that they have most improvement potential in learning from innovation. Case B also evaluated itself to be relatively better in radical innovation than incremental innovation.

One of the key issues from the point of view of growth seems to be how to develop from customer based knowledge and business models to generic knowledge and from customer based business models to generic models. And still how to use scalable business models in development. Still there are open questions like does immaterial property management help in knowledge intensive services. In most cases only trademarks can be used. Open innovation is a challenge for small firms because of immaterial property rights. Case A has been able to protect some of their service products with trademarks. None of the two cases has a strong immaterial property rights management or knowledge on the field. The Case B firm works on a sector where changes are so fast that immaterial property protection looses its meaning and the position of small firms can be stronger. Case A was mentored by experienced expert with strong views on the field in the beginning. It had an influence also on their innovation performance.

Results

According to case studies and theories the study suggests that one possible innovation process for growth in a small KIBS firm may be as following:

1. Detecting disruptive technologies, markets and changes as opportunities,
2. idea generation and enrichment with partners and innovative customers,
3. screening and selection based on (emerging) strategy,
4. fast concept development with most innovative customers,
5. first launch of new service as “simple but working”,
6. improvements based on first customer experiments,
7. creation of generic niche application,
8. second launch for all potential niche customers,
9. incremental innovation with new customers and
10. return to step one.

Although this process is described as a linear one it is actually interactive and iterative. Interactions happen within the phases between actors involved. Iterations are both within the phases and between the phases. In phases 1, 2, 4, 6 and 9 social web tools are suitable. It is the step 7 that makes this process suitable for growth. In step 7 can also be new features be added to make the application more attractive like in the case of systemic innovation. The business model in this step should be scalable. From step 10 there is also an option for

returning to step 7 to create new niche applications. That could not be proved by the cases. The model uses open innovation only in idea generation. Although case A uses open innovation also in commercialisation it was no added to model because of lack of data. The studied innovation processes in the cases seemed to have common elements also found in literature (Van de Ven et al. 2008).

Trust creation is found to be essential from point of view of knowledge creation for innovation. Credibility and acceptance of new technology and processes are also important issues for marketing. Niche management is needed in entering the market and niche applications crossing from innovative customers to mainstream customers. Processes are often long so patience and also in many cases positive cash flow from other sources or external funding are needed.

Conclusions

The results indicate that small KIBS firms looking for growth can benefit several types of innovation and tools to achieve them. It is suggested to combine tools and processes from at least disruptive innovation, open innovation, systemic innovation, incremental innovation and even radical innovation as well. A systemic approach is needed not only in innovation process but also in combining the tools and methods. The model presented in this paper is only one possible solution and is based on two case firms. The subject deserves additional studies to find other models like using open innovation for commercialisation in small firms.

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An exploratory study on manufacturing strategy formulation in start-up companies

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Abstract

In the UK, as more traditional manufacturing is outsourced to lower-cost countries, the development of new high-tech manufacturing firms is increasingly perceived as important for sustaining a competitive UK manufacturing base. Early in their lifecycle, start-ups are vulnerable and prone to failure. Mistakes made in critical decisions regarding entry into manufacturing can significantly impact the survival of the firm. Developing the most appropriate strategy is probably more critical in start-up companies than in established organizations, yet little research has addressed this area. This paper reports research into the development of manufacturing strategy in start-up companies. The paper first reviews the literature and then presents findings from nine case studies of start-up companies, showing the nature and timing of the key strategic decisions that were taken, and examining the issues and problems encountered. Using the results from the cases, and the concepts of development tasks and strategic decision areas taken from the literature, a conceptual framework for strategy formulation in such companies is developed. The paper concludes by discussing the use of the framework, and suggesting how it might be operationalised to provide assistance to operational managers in start-up companies.

Keywords: Manufacturing Strategy, Start-up Companies

Introduction

The role of high-tech manufacturing start-ups as a major source of innovation and as an engine of economic growth is increasingly recognized by Western economies. In the UK, as more traditional manufacturing is outsourced to lower-cost countries, the development of new manufacturing firms based on science and engineering is increasingly perceived as important for sustaining a competitive UK manufacturing base.

Start-ups are new businesses with limited operational histories and few established practices. Early in their lifecycle, start-up companies are vulnerable and prone to failure. Usually small and with limited resources, they have yet to build up the strength and resources to sustain them through both internal and external challenges [1]. Operating in such an environment, mistakes made in critical decisions regarding entry into manufacturing can significantly impact the survival of the firm. Only a minority of start-ups survive ([1], [2] and [3]). Most fail to move beyond building a feasible prototype into creating significant market value.

Despite the increasingly important role high-tech start-ups play in the economy, research relating to the manufacturing strategy development process of start-ups is surprisingly scarce. Most literature on manufacturing strategy assumes the existence of established activities and industry structure (see, for example, [4], [5], [6], [7], [8] and [9]). In established manufacturing firms, target markets, products and manufacturing strategy have already been defined to a certain extent. It is unclear whether or not findings about manufacturing strategy development and implementation processes in established firms are relevant to start-up companies that have far fewer resources and face markets and products that are still evolving. Studies of new firms, on the other hand, have concentrated on

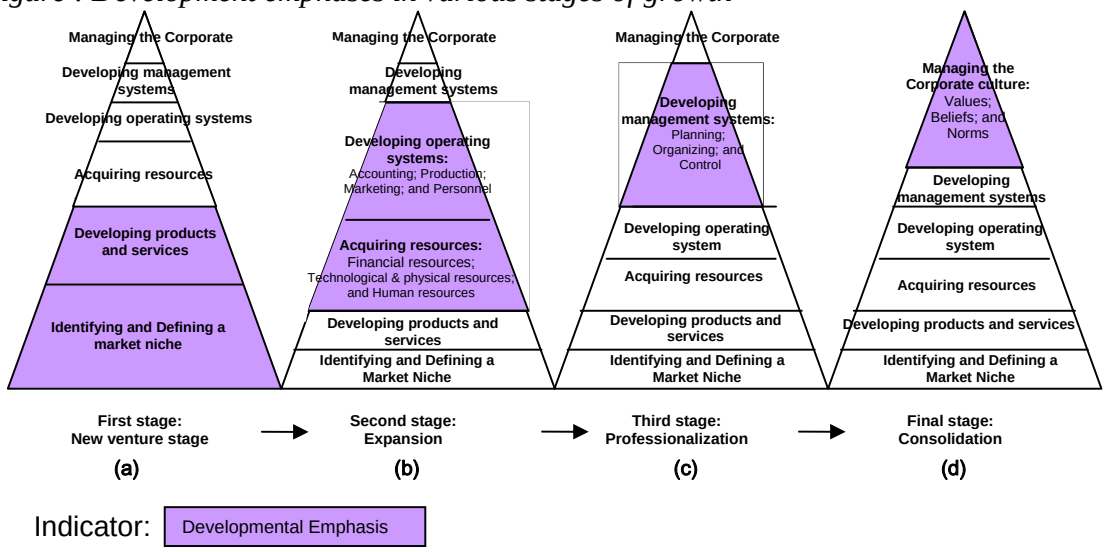
entrepreneurial personality and activities in the process of discovery and exploitation of business opportunities (see, for example, [10] and [11]). There is little collective knowledge about the practical methodologies and tools which can help start-ups design, formulate and manage their manufacturing strategies.

Understanding Start-ups

Start-ups are fundamentally different from established firms and require decisions and solutions to problems that are unique to them. A review of the literature about start-ups shows that they have different organization structure, management style and management focus from established firms ([12], [13] and [14]). The challenges facing start-ups are also unique to themselves [14]. In early stages of existence, the organizational structures in start-ups are informal [12] or even non-existent, as observed by Kazanjian and Drazin ([14] and [15). The main business objective is simply to exist and to survive ([14]). Usually technically or entrepreneurially oriented, the founder(s) play a central role in decision making and often supervise directly the overall operations of the firm [14]. Due to the skeleton structure, the management is often able to respond swiftly to customer and market feedback [13]. Business activities that take place during the early stages of operation include: a search for matching opportunities and resources, selection of entrepreneurial projects, securing resources and setting up production [10].

Flamholtz [16] observes that after a company is formed, it focuses on identifying and defining the markets, as well as on developing products and services (depicted in pyramid (a) in Figure 2). As the young firm grows, the development foci are shifted to another set of key development task: acquiring resources and developing operational systems (pyramid (b) in Figure 2). Flamholtz's observations are consistent with those of Churchill and Lewis [13] and Kazanjian and Drazin [14] who suggest that obtaining customers and developing products are the two management foci at these early stages. Greiner [12] affirms that as a young firm grows, the need for knowledge about the efficiency of manufacturing becomes apparent.

Figure : Development emphases in various stages of growth



Source: adopted from [17] and [18]

Area	Types of problem	Details of the problem
Product development and technology	• Technical problems	• unforeseen product design difficulties • manufacturing equipment does not work to specification
Marketing	• Market credibility • Lack of focus because of desperation for sale volume	• customers are uncertain about the new company • underestimate marketing costs • underestimate time to get established • overestimate sales revenues
Suppliers	• Managing suppliers	• untried and untested, so may be unreliable • suppliers unwilling to sign contracts • new company lack creditworthiness • delays
Production	• Difficulty in scaling up production from pilot operation • Delays	• delays due to difficulty in recruiting, suppliers, customers, approval authorities, and so on
Finance	• Cost overruns • Overtrading • Financial leverage too high • Accounting and control systems relegated to bottom of priority list	• poor estimations in original business plan • cost of moving along the learning curve not taken into account • grow faster than cash resources permit • delays in arrival of funding
Human resource	• Finding the right people • Retaining people • Lack of experience managing people	• do not know where to find staff • poor at judging them • cannot pay enough to recruit top-quality people • may have little or no experience in this area
Management team	• Entrepreneur's own attitudes • Lack of business skills and management experience • Informal entrepreneurship leadership • Time pressure on entrepreneur	• lack of real commitment to the business • lack of urgency when no cash flow problems exist • poor leadership ability when the inevitable crises arise • partnership problems or boardroom conflicts • everything takes longer than planned because entrepreneurs consistently underestimate the time necessary to implement even simple actions, speed of market acceptance, the cost of moving along the learning curve, etc. • too much to do, stress and its effect on health and family

Source: Adopted from [18]; [19 Table 3]; [20 Table 2.2, pp. 62] and [21]

Table 1: Typical problems encountered by start-ups

Table 1 presents a list of typical challenges facing start-ups. These challenges include: exhaustion of early resource endowments, the absence of a strong and experienced management team, informal entrepreneurial leadership (that cannot cope as the firm grows more complex) and communication problems ([18] and [19]). Other challenges are: product development and technology problems, cash flow problems, scaling up production from pilot lines, marketing, enlisting suppliers, managing supply chains and the lack of management experience ([20] and [21]). Slatter [20] emphasizes that these challenges often are interrelated with one another, causing cash flow problems. Specifically, Ford [21] finds that while they are highly skilled in a specific technical area, many founders of start-ups recognize that they lack the business skills to turn the venture into a profitable business. Founders also often face difficulties in recruiting and retaining sufficiently skilled individuals [21].

Manufacturing Strategy

This paper defines manufacturing strategy as '*a pattern of decisions, both structural and infrastructural, which determine the capability of a manufacturing system and specify how it will operate to meet a set of manufacturing objectives which are consistent with overall business objectives*' [22, pp. 7]. Despite the differences between start-ups and established firms, current research findings about manufacturing objectives, strategic decision areas and strategy process provide a useful basis for research into manufacturing strategy for start-ups. Manufacturing objectives address the issue of competitive priorities, which according to Skinner [4] include cost, quality, deliverability and flexibility. Table 2 summarizes these objectives and their scopes.

Objectives	Scopes of the objectives
Cost	refers to cost related factors in the production and delivery of products, i.e. internal costs (e.g. material, labour, facilities, technology, equipments and overhead costs)
Quality	refers to achieving the company defect rate targets, i.e. manufacturing of products with high quality and performance standards
Delivery dependability	refers to achieving delivery targets, i.e. meeting delivery schedules
Delivery speed	refers to achieving delivery targets, i.e. reacting quickly to customer orders to deliver fast
Flexibility	refers to the ability to cope with change or uncertainty and variety, i.e. reacting to changes in product, changes in product mix, modifications to design, fluctuations in materials, changes in sequence and volume
Others	refers to after-sale service, advertising, broad distributions and broad product line

Source: Adopted from [23, pp. 758] and [24, pp. 113 – 115]

Table 2: Manufacturing objectives and their scopes

Strategic decision areas, often categorized in two groups: structural and infrastructural, are the critical areas that make up a manufacturing strategy. Wheelwright [25] asserts that the collective pattern of decisions in these areas determines not just the structure but also the capabilities of a manufacturing company. Effective choices in the structural and infrastructural decisions often lead to manufacturing excellence [26]. Table 3 summarizes the strategic decision areas suggested in the literature.

Category	Decision Areas	Scope
Structural Decisions	Capacity	Total capacity, capacity flexibility, shift patterns, temporary subcontracting policies
	Facilities	Location, number and size of sites, focus of manufacturing resources, allocation of tasks to sites
	Process technology / Production equipment	Equipment, automation, connectedness, integration, technology choice, configuration of equipment into lines, cells, etc., maintenance policies and the potential for developing new processes in-house , implementation, subcontracted development
	Vertical Integration	Strategic make vs. buy decisions, supplier policies, supplier relationship, supplier development, extent of dependence on suppliers, network behaviour
Infra-structural Decisions	Human resources	recruitment, training and development, culture and management style
	Quality	quality assurance and control policies and practice, defect prevention, monitoring, intervention
	Production planning and materials control	computerization, centralization, decision rules, production and order, material control systems
	Organization	structure, reporting levels, support groups, accountability and responsibility
	Performance measurement	Financial and non-financial performance measurements and links to recognition and reward systems
	New product introduction	design for manufacturing guidelines, introduction stages, organizational aspects e.g. manufacturing role in concurrent engineering

Source: adopted from [8]; [27] and [28]

Table 3: Strategic Decision Areas comprising a Manufacturing Strategy

It is apparent from the above review that most literature on manufacturing strategy, be it the study of manufacturing strategy content or manufacturing strategy processes (such as the processes proposed by [4], [5], [6], [7], [8] and [9]), assumes the existence of established activities and industry structure. This review also demonstrates that a start-up company is distinctive from an established firm in various aspects, ranging from organization structure to business objectives and to management focus. It is unclear whether findings about manufacturing strategy development and implementation processes in established firms are relevant to start-up companies that have far fewer resources and face markets and products that are still evolving. These observations lead to the following questions:

- To what extent are the findings about the manufacturing strategies of established firms relevant to start-ups?

- Do strategic decision areas play an equally important role in a start-up's manufacturing strategy? Could there be some decision areas that are more prominent than others in the early stages of a firm's operation? Which particular decisions are made earlier than the others?
- How do start-ups formulate and implement their manufacturing strategies?

The review also reveals that although the challenges facing start-ups have been identified by the research community, there is little research into how these challenges are dealt with. An in-depth case study is likely to be effective in studying these issues.

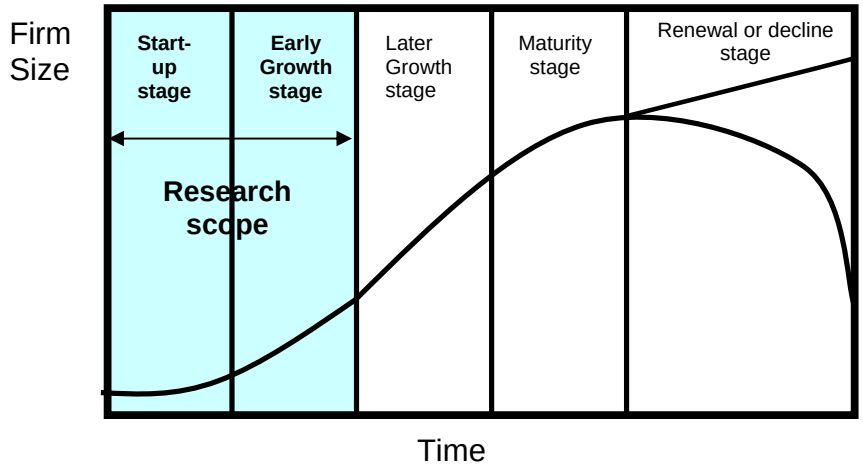
Exploratory Research

In order to address the issues highlighted above, we conducted an exploratory case study that asked the following questions:

1. *How does a start-up develop manufacturing strategy?*
2. *What manufacturing decisions does a start-up make?*
3. *What are the issues and problems a manufacturing start-up encounters and how are these issues dealt with?*

This research builds on the existing work on entrepreneurship, organization-growth models and manufacturing strategy. In particular, it focuses on start-ups that are set up to design, manufacture and market physical products that are assemblies of individual components. The context is set in the early stages of the start-ups' operations (as illustrated in Figure 2). The literature on organization-growth models shows divergent views about firms' growth patterns. Nevertheless, there are similar findings about firms' early phase development (see, for example, [13], [18] and [29]).

Figure 2: The growth stages studied in this research



Source: Adopted from [30], pp. 407

The study investigated strategy formulation in a total of nine UK manufacturing start-ups, all of them with less than ten years of manufacturing experience and which still have their founders managing the firms. The companies come from diverse industries ranging from bio-medical devices to renewable energy, to software developers, to security, to printing. Primary data was collected through semi-structured in-depth interviews with the company's

founding teams. A total of twenty interviews involving fifteen informants were conducted. The informants were interviewed either together or separately in a single session or over the course of multiple sessions. On average, each interview lasted approximately 90 minutes. Past decisions that lead to and/or were linked to the development of manufacturing strategy in these companies were probed. In order to better understand the contexts of the decisions, information regarding the events that took place alongside the decisions, as well as the sequence by which the decisions and events took place was collected using Strategy Charts (developed by Mill et. al, [31] and [32]). Triangulation techniques [33] were applied to eliminate recall or hindsight bias ([34] and [35]. Contemporaneous documentation and archival records were gathered as secondary data [33] and [36]. Both the primary and secondary data were then synthesized and analyzed to illuminate the strategy content and formulation process in these companies.

Findings and Discussion

Starting a business

All the companies went into business with a technology that the founders believed would create commercial value. In some cases, businesses were sparked by a technology or a solution that was not, or not initially, developed for commercial use. When one of the founders in Company C came across a three-dimensional X-ray technology developed by an academic in a UK university, he saw a business opportunity in the security market. Subsequently, he set up a business to commercialize it. However, as the technology was not initially developed for commercial use, it took Company C three years to develop the product concept before they could turn it into a product prototype. On the other hand, in company G, from an early stage the founder developed the technology (biological scaffolds that support tissue regeneration, the founder's PhD research) with an intention for later commercialization. Hence market requirements were taken into consideration early on. Nevertheless, not all the companies followed this technology driven route. Company I for example, was not prompted by a new technology, but rather by a market opportunity. Before starting the business, the founders conducted a thorough market analysis. Only after a business opportunity was identified did they start to develop a product that would exploit it.

Development tasks/value creating activities

Preliminary findings from the study suggested that there were seven major value creating tasks the start-ups undertook in their early stages of operations, viz. (1) acquiring financial resources; (2) developing products; (3) developing a market and acquiring customers; (4) acquiring human and production resources; (5) delivering products; (6) developing production systems and (7) developing other systems. This finding is consistent with that of Flamholtz [16], Churchill and Lewis [13], and Kazanjian and Drazin [14].

(1) acquiring financial resources

Acquiring financial resources involved activities such as identifying sources of funding, planning for rounds of funding, negotiating with investors and managing the funds received. Financial decisions dominated not just this task but also the other six tasks. Cash was the most critical resource for the survival of all the start-up companies. It had a strong impact on most strategic decisions the firms made. Founders of all the case companies found themselves constantly having to raise funds to sustain their company.

(2) developing products
Major activities involved in developing products were the proof of product concept and product technology through working prototypes, the proof of production viability through pilot lines, and managing issues associated with intellectual property and regulations. Key decisions made while this task was performed covered the areas of process technology, make vs. buy, new product introduction, capacity and facility.

(3) developing a market and acquiring customers
This task included activities such as understanding and identifying potential markets, creating a market/niche, developing a competitive strategy, acquiring the first customer and expanding from one key customer to a broader sales base. The majority of the companies acquired their first customers in tradeshows where they demonstrated their working prototypes. These companies were also quick to engage their new customers in the development of their prototypes into products. For Company A, this not only helped the young company understand the market but also raised its profile and expanded its customer base. Most decisions relevant to this task were marketing related. The dominant strategic decision areas were connected to the introduction of new products.

(4) acquiring human and production resources
Acquiring human and production resources involved activities associated with capital investment, production technology, scaling up of production, recruitment, new product development, and so on. Closely linked with this task was the development of production systems.

(5) delivering products
Delivering products included activities related to inventory management, product delivery, distribution channels and after-sales service. Most decisions were related to vertical integration.

(6) developing production systems
Developing production systems involved establishing systems for production planning and material control, quality, performance measurement, and so on. Key decisions were made in the areas of process technology, make vs. buy, supplier relations, vertical integration, human resources and facilities.

(7) developing other systems
Finally, developing other operational systems such as human resource systems, knowledge management systems and information systems meant decisions in the strategic areas of organisation and human resources were made.

Business and manufacturing objectives
Most of the case companies did not explicitly state business or manufacturing objectives, and none had formal processes for setting objectives and formulating plans for achieving them. Rather than setting production standards concerning quality and performance, they concentrated on activities related to survival. In order to survive, the start-ups strove to maximize their funding and minimize their running costs. In start-ups B and C for example, the founders reduced prototype development costs by making use of the production labs in the organizations they were associated with. The founder of Company B explained,

> "Construction and testing are obviously important parts of the prototyping process, but increasingly modern devices require very high capital cost equipment to construct and test…. The only solution is to partner early on with someone with the facilities to manufacture and possibly also test the design for you."

Approach to strategy

In the early stages when there was no clear division of responsibilities between the founders, most key decisions were made collectively by the members of the founding team rather than by just one person. The entrepreneurial mode of decision-making highlighted by Mintzberg [37] was not apparent in these case companies.

The study also found that most strategies in start-ups were emergent rather than deliberate. In other words, strategy emerged as strategic learning took place in the companies [38]. Most strategies emerged as a result of trial and error as unpredictable developments continually dominated the business landscape. Few strategies were deliberately planned in advance or developed consciously and purposefully. Additionally, most start-ups approached strategy development in an unstructured way. In most companies, no formal strategy processes were developed. It seems that a feasible way of understanding strategy formulation in start-ups is to identify at which point in the business cycle key decisions were made.

A majority of the founders, especially those without business or industrial experience were unsure of the events or challenges that were lying ahead of them. As a result, most of them failed to plan in advance and the management teams often had to make unplanned decisions. A decision roadmap that shows at which point key decisions are made is likely to be useful. A founder gave a clear description of this issue:

> "It's a reactive company rather than (a proactive one), we tend to react to situations. We have never had the luxury to sit back and plan... and that hits the personnel because it's high pressure for people, it hits our bottom line because reactive is always more expensive than planning for it, it can eliminate some of our customers because we can't respond the way they wanted us to…"

Resource constraints

A lack of financial resources was one of the biggest challenges facing start-up companies throughout their operations. Comments by a founder expressed this point clearly:

"Cash is king. Cash pays the wages, bills, suppliers, development, advertising, etc. This is particularly the case for start-up companies. Until neutral cash generation is achieved the start-up is regarded as a 'cash-burn' company. If you run out of cash at any point you fail. You raise more cash when you have cash not when you have run out of cash."

Financial constraints called for flexible solutions to all challenges, ranging from product development problems to production problems. Most companies attempted to delay investment in expensive equipment at the early stages. To test their prototypes, Companies B, C and G made use of equipment in the laboratories of universities where the founders worked. Company B recruited part-time technicians to work on its production line. To obtain the funding to scale up production and to extend their markets, some companies

floated on the stock market. In 1996, when Company D decided to change its business model from licensing its technologies to selling physical products, it went public to fund the implementation of the decision.

Pressure to bring product to market

A common feature found across the companies was pressure to reduce *time to market*. Time to market refers to the length of time a product takes from its conceptualization until its being available for sale. Owing to shortages in vital financial resources, especially in the early stages, a short *time to market* is crucial for a start-up's survival. This pressure had significant effects on the decisions the case companies made. For instance, as it was both time-consuming and uneconomical for the small start-ups to make the components of their products, almost all of them bought the components from suppliers. In addition, to shorten *time to market*, most firms outsourced standard and common manufacturing processes in order to achieve maximum parallelism in their product development. Company A achieved a short *time-to-market* through outsourcing almost the entire production process of its first product to a contract manufacturer. Only critical processes such as loading of software and product testing were kept in-house.

In some of the case companies, high pressure to bring the first product to market quickly resulted in the launching of premature products with compromised quality. Defects in product designs and manufacturing processes then became the triggers for setting manufacturing objectives (such as quality). For example, company A only realized that it had problems in its product design after receiving complaints from customers about bugs in their software and their products. This company responded by making quality its primary objective and introducing quality assurance processes into its production mechanism.

Lack of marketing, recruitment and management skills

Developing a market was a major task the companies undertook early on. For founders who lacked marketing experience, to understand and to identify potential markets, as well as to compete in them were challenging tasks. To tackle the problem, the founders of Company F engaged the services of an external marketing consultant who conducted a market assessment. This lead the team to identify four potential markets, viz. trade exhibitions, visitor attractions, advertising and mobile entertainment. Company F was then able to narrow down the scope to visitor attractions and advertising, and develop competitive strategies to enter these markets. Similarly, Company G employed external experts to help its founding team formulate a regulatory compliance roadmap that came with clear and explicit targets and milestones. Company B adopted another approach; instead of finding external help, the founders conducted a market survey themselves, followed by a product trial involving 100 participants to help them understand their potential customers.

Developing products, make vs. buy decisions and supplier relations

Whilst developing prototypes, a major challenge encountered by those founders without prior industrial experience was the sourcing of components. Off-the-shelf components found in catalogues were often used. As a result, the designs of their prototypes were dictated more by the available materials than by the most desirable designs. As catalogue suppliers usually hold a limited range of products ("typically the most common and most multi-purpose ones" as commented by a founder), start-ups had to alter their product designs to fit in. Off-the-shelf components were also often products of older technology

making the prototypes “inefficient” as commented by a founder of Company B. He explained,

> “If there is a new development in an area, it can take literally years for it to filter into the catalogues, because insufficiently large numbers of catalogue chip purchasers are leading edge developers, so you also end up only with old technology in the catalogues. That means your design is inherently inefficient because you are unnecessarily compromising your design simply because of what you can get hold of.”

Additionally, as a start-up lacks a track record and creditworthiness, initiating business with suppliers and contract manufacturers was not easy, especially for inexperienced founders. This is consistent with the findings of Slatter [21] concerning challenges facing small high-tech firms. For instance, most companies found that payments for components had to be made up front, increasing the financial pressure on the already cash-tight company. Equally challenging was managing effective relationships with the suppliers and contract manufacturers.

Challenges related to scaling up

When the need to produce more products arose, two major problems were experienced: limitations in resource availability (often due to cash constraints), and uncertainty in sales. As a result, most companies only expanded their production capacity gradually. Shortages in vital resources called for flexible solutions to production problems. For example, companies rented third parties’ facilities or collaborated with suppliers or contract manufacturers, as discussed in the earlier sections. Uncertainty in sales also made forecasting a challenge. Mistakes made in forecasting when scaling up production, such as over or under ordering components and recruiting, could be very costly for a young company. Recruiting professional production personnel early on was seen by many founders to be the solution to many production related challenges. With hindsight, most companies commented that they would have recruited their professional production personnel sooner than they did. A founder’s comment explains this issue clearly:

> “Getting someone thoroughly professional in manufacturing early on is the key, the earlier you can get it the better. What would have solved a lot of problems for us would have been to get this guy (an Operations Manager) in 1997 (when the company started to manufacture its first product from prototypes).”

A Conceptual Framework for Understanding Manufacturing Strategy Development in Start-ups

The findings and key learning points lead to the construction of a conceptual framework that illustrates the development of manufacturing decisions in start-ups. The framework, as illustrated in Figure 3, may provide a manufacturing decision roadmap for operations managers in start-ups.

The conceptual framework incorporates four elements: business/manufacturing objectives, value creating/development tasks undertaken by start-ups, decisions made in strategic decision areas of a manufacturing strategy, and the dimension of time.

The first component of the framework is the setting of business/manufacturing objectives. Findings from the research demonstrated that in the early stages of operations, the main aim of start-ups is to survive. In order to do so, they strive to secure maximum funding, to minimize their production and operational costs, and to bring the first product to the market quickly. Manufacturing objectives are only developed as start-up companies begin to build manufacturing capacities and deliver products to customers.

The second part of the conceptual framework shows the major development tasks start-ups undertake: (1) acquiring financial resources; (2) developing products; (3) developing markets and acquiring customers; (4) acquiring human and production resources; (5) delivering products and (6) developing production systems and (7) Developing other systems. In the conceptual framework, these tasks are plotted against a timeline to show the sequence in which they occur. Some tasks are presented in columns which are overlap with one another to show that they take place together.

The third element of the conceptual framework illustrates the financial, structural and infrastructural decisions start-ups make in order to accomplish their development tasks as well as to achieve their business objectives. These decisions, in the form of a list of questions, are also plotted along a timeline to show the sequence in which they are made. The framework also illustrates the links between the decision areas and the development tasks, as well as showing the interrelations with value creation activities. Showing the interrelations between these decisions and value creation activities illustrates the dynamics among them. In addition, the study also identified the sequence in which these development tasks were performed and strategic decisions were made.

Conclusion

This paper has identified from both the literature and from industry a knowledge gap in the study of manufacturing strategy of start-up companies. An exploratory case study inquiry involving nine manufacturing companies was conducted to help identify the key manufacturing strategy development decisions and issues in a start-up. Findings from both the literature and the exploratory case studies gave rise to a conceptual framework of manufacturing strategy development in start-ups. The framework captures key manufacturing decisions start-ups make as they develop their manufacturing strategies and elucidates how strategies are formulated. Further development of the framework in the forms of testing and refining it will be undertaken by means of multiple in-depth historical case studies, and longitudinal cases of companies that are currently in the start-up phase.

Figure 3: Conceptual Framework of Strategy Formulation in Start-up Companies

Business/ Manufacturing Objectives	***Survival / Cost / Speed-to-Market / Quality***
Development Tasks	**Financial, Structural and Infrastructural Decisions:**
(1) Acquiring financial resources	**Financial**: How much money should we raise? From where can we raise the money? How do we raise the money? How do we manage the money when we get it? When should we raise funding again? Should we sell the business and exit? Should we go public?
(2) Developing products	**New Product Introduction:** What are the product standards or regulations associated with the product/technology? Should we patent our technologies/products? **Process Technology:** Could we produce the prototypes by ourselves? Where can we get the necessary equipment to produce the prototypes/products? What is the ownership of the equipment? Who will manage the equipments? How do we test the prototypes/products? Should we enter into manufacturing our products? **Make vs. Buy/Supplier Relations:** What components of the prototypes should we be making in-house? Why? Which production processes should we keep in house and which should we outsource? Why? **Vertical Integration:** Where can we find suppliers of components and contract manufacturers for assembly? How do we choose among the suppliers/contract manufacturers? **Facilities:** Where should the production site be located? **Capacity:** What equipment do we need to produce the prototypes? Can we rent the equipment? Should we invest in the equipment?
(3) Developing a market and acquiring customers	**New Product Introduction:** How can we speed up time-to-market? What are the order winning criteria in the chosen markets? Are the prototypes/products meeting customers' needs? How flexible are the product designs to changes? Are there any relevant product/technology competitions we can take part in to raise the profile of the product/technology? **Capacity:** Do we have the production resources to meet market/customers' requirements/needs? **Vertical Integration:** What are the channels to acquire customers?
(4) Acquiring production resources	**Human Resources:** What set of skills does the company require in order to grow? Should we recruit professional staff or technical ones? Should we contract professional services? Where could we find staff? How do we attract the right people to join us? How do we keep them? Are people in the team compatible? **Facilities:** Should we build a pilot line? Should we expand the size of our site? Where should the site be located? **Process Technology:** What production equipment should we get? **Financial:** How do we finance the building of the pilot line/scale up production? Can we afford to recruit new staff and to invest in production equipments? How do we finance the decisions? **Make vs. Buy/Supplier Relations:** What have we learned about suppliers while building prototypes to scale up production? Should we stay with the same suppliers? Why and why not? How do we ensure the quality of components we buy? **Vertical Integration:** Which production processes should we keep in house and which should we outsource? **New Product Introduction:** What is our new product development strategy? When developing new products/evolving existing ones – can we afford to support the new product and the old one? Should we develop new products on common platforms? How to reduce time-to-market?
(5) Delivering products	**Vertical Integration:** How do we best deliver the products to customers? How do we build a distribution network? What after-sales services should the company provide?
(6) Developing a production system	**Process Technology:** What are the process technology policies on maintenance, automation, connectedness, technology choices, configuration of equipment into line, and so on? **Production Planning and Material Control:** What systems (i.e. computerisation, decision rules, production and order, material control) should the company adopt? **Facilities:** Should we focus all production on a single site? **Financial:** How can the company finance our expansion? **Human Resources:** What set of skills does the company require in order to develop our production systems? **Vertical Integration:** How do we evaluate the performance of our suppliers and contract manufacturers?
(7) Developing other systems	**Organization:** What organization structure should we adopt? **Human Resources:** How do we develop a HR system? How can the company prevent knowledge drain when staff leave?

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Ambition driven entrepreneurship in higher education

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Saxion Knowledge centre Innovation and Entrepreneurship (SKIO)
Saxion Knowledge centre Innovation and Entrepreneurship (Saxion Kenniscentrum Innovatie & Ondernemerschap) has the aspiration to stimulate and facilitate entrepreneurship within Saxion Hogescholen. The target is to increase the number of starting enterprises as well as its quality in the Eastern region of Holland.
The centre wants to give an impulse to the embedding and anchoring of competencies on the domain of entrepreneurship in the curricula of the courses given at the Saxion University. Additionally, a knowledge circulation with the business world is taking place, in which research is conducted and consultancy is offered.

Abstract

In this paper the results of a broad survey under all students (response 69%, n=12,481) and management of all faculties of Saxion University will be presented. Saxion is a university of applied sciences located in the East of the Netherlands with 18.000 students divided over 13 faculties and 64 studies. The survey was held in the summer of 2007 and will be repeated for several years. It is shown that the interest of students to start their own company is large (over 55% in the general population) and varies over the several faculties (range 13% - 81%). A total number of 287 student companies is identified for further in depth study. Some of these cases of student companies are included in the paper. The total number of student companies at Saxion University can be estimated at 415.

Based on the results of the survey a funnel type of approach is suggested to boost the number and quality of the Saxion University spin off firms to reach a total number to a turnover of 250 companies a year, to double the recent output since this doubling is the ambition of the management of Saxion University. A rather traditional approach of stimulating measures is the backbone of this funnel but the philosophy behind it is going much deeper.

The authors suggest to use a model for the development of a spin off company based on three independent sub processes :

- development of formula
- development of organization
- development of ambition

The most important sub process here is the development of ambition. One of the basic rules of supporting instruments should be the nurturing of the real and deep ambition of the young entrepreneur. This may seem in contrast with the more traditional supporting instruments like providing shovel money and helping to make a business plan. New instruments should be developed to nurture and stimulate ambition. But first of all :

When a university wants to attract ambitious young entrepreneurial students it starts with the ambition of the university itself.

Introduction

Entrepreneurship is seen as an important phenomenon to strengthen the growth of regional economy (van der Meer, 2007; van der Veen & Wakkee 2002-2003). Next to the growth motive, some authors, like Groen and Van der Sijde (2004) report also the powerful contribution of the transfer of knowledge and the improvement of educational systems. In the Netherlands most of the Universities like Saxion University see the importance of entrepreneurship and spin-off companies and have an explicit policy to stimulate entrepreneurship. To find out the effects and efficiency of the present policy instruments and to develop new policy, Saxion University made an investigation intro entrepreneurship in summer 2007 (Van den Berg, Bijleveld, Van der Meer, De Weerd & Wierstra, 2008).
In this paper we will show some of the results of this study and we will propose a framework for further research.

Method

Six different forms of approaches are used in this research:

- Survey of students (n=12.481)
- Interviews with the board of directors of every faculty (n=13)
- Workshop management of faculties (n=28)
- Casestudies (n=14)
- Survey of Saxion Young Business Professionals (YBP) entrepreneurs (n=37)
- Literature search.

All current students, which are subscribed to Saxion Universities for academic year 2007-2008, have received a postal survey together with their subscription form, resulting in the excellent response of 69%. Eventually 12.481 surveys are processed. The non-response investigation shows that the sample is representative for the total target group of 18.500 students, which is subscribed. The size of the response enables us to make detailed analyses. The results of the survey can be related by student numbers to already known student data (place of residence, age and preliminary education), so deeper analysis is possible.

The next source involves a series of interviews among the board of directors of every faculty. The result of these interviews is supplemented with observations during workshops and information from conversation with the management of several academies. Considering the journalistic approach of these interviews and conversations, the results should be seen as opinions.

During this research, a start is made with the development of a database with Saxion enterprises. A Saxion enterprise is understood to mean:

A company that is (partly) established, or (partly) acquired, by a student or an employee from Saxion Hogescholen, during school time or hours of duty, and within 5 years after leaving the institute.

The sources for the names of the Saxion Enterprises are various. By way of the YBP (the student entrepreneurs association of Saxion University) 37 enterprises were traced out.

12 Came out of interviews with the board of directors, and the remaining enterprises came out of sources like employees and the press.
In spring 2007 the database contained a modest 68 companies of which 14 are extensively interviewed. This case material is used particularly for the purpose of illustration. Meanwhile the database has grown to 420 companies and web-based surveys of additional research questions are prepared to be executed in spring 2008.

Results

Saxion is a university of applied sciences located in the East of the Netherlands with 18.000 students divided over 13 faculties and 64 studies, as shown in figure 1.

Figure 1:
The 13 faculties of Saxion University

Abbreviation	Name faculty	Number of students
ABO	Faculty Business Administration & Entrepreneurship	1229
MIM	Faculty Marketing & Internationaal Management	1993
HBS	Hospitality Business School	1643
FEM	Faculty Finance, Economics & Management	963
ROB	Faculty Environmental Planning & Construction	1146
TKT	Faculty Applied Art & Technique	995
ABR	Faculty Government & Law	1409
CII	Faculty Communication, Information technology & Information management	1008
LED	Faculty Life Science, Engineering & Design	1719
AMA	Faculty People & Work	1469
AGZ	Faculty Health Care	1773
AMM	Faculty People & Society	2114
APO	Faculty Pedagogics & Education	693

Results on *interest* in enterpreneurship
The importance of entrepreneurship is valued high within Saxion University. As much as 47% of all students is interested in the subject of entrepreneurship (figure 2), and an even larger percentage of 55% is intending to (maybe) start an own enterprise (figure 3). Apparently, students from Saxion University are more inclined to actually start an enterprise than being interested in the phenomenon Entrepreneurship in general!

Figure 2:
Interest in Entrepreneurship (n =12.481)

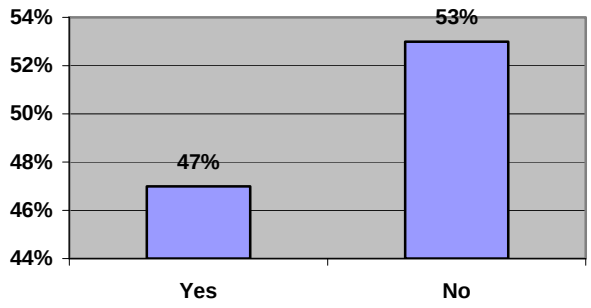
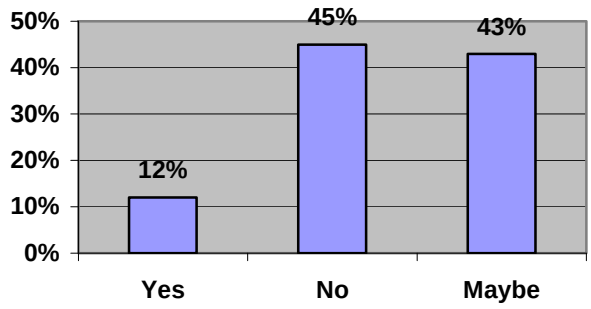
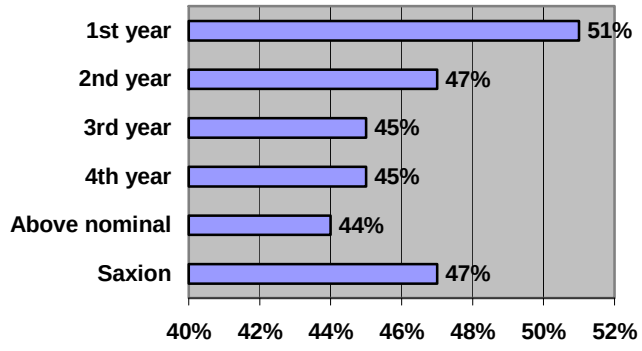


Figure 3:
Percentage of students that are intending to start an enterprise (n =12.481).



In the first measurement among all students, we notice a small decrease in interest, as a student is subscribed for a longer time (figure 4). Here the question arises whether this decrease can be attributed to the progress in study, or to the interest of young students in general. The subject of entrepreneurship is getting a lot of publicity last years, compared with the years before that. Therefore, probably the first year students are influenced by this publicity.

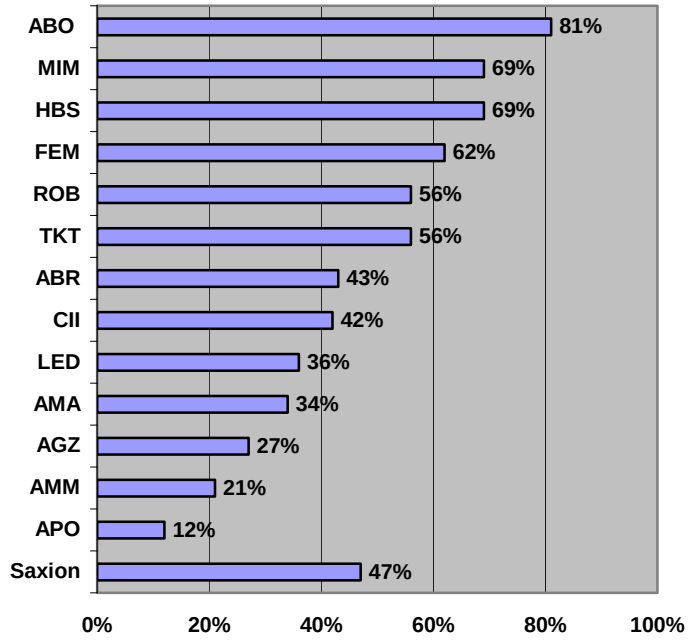
Figure 4:
Interest in entrepreneurship spread over academic year (n =12.481)



The image of students attaching great importance to entrepreneurship is confirmed by the image the board of directors and management of the faculties have. Here as well, importance of entrepreneurship is affirmed.

Obviously, the interest in entrepreneurships varies a lot between the faculties, as is shown in figure 5. For faculties like the faculty ABO and HBS, entrepreneurship is traditionally of great importance. When we look at the more technically oriented faculties like TKT, ROB and CII, interest is average. An other finding was that at faculties where directors and the management see a large turbulence in their fields of expertise with a resulting required attention to entrepreneurship (like in education and health care), students of the belonging faculty do not yet see this attention as important.

Figure 5:
Interest in entrepreneurship by faculty (n=12.481)

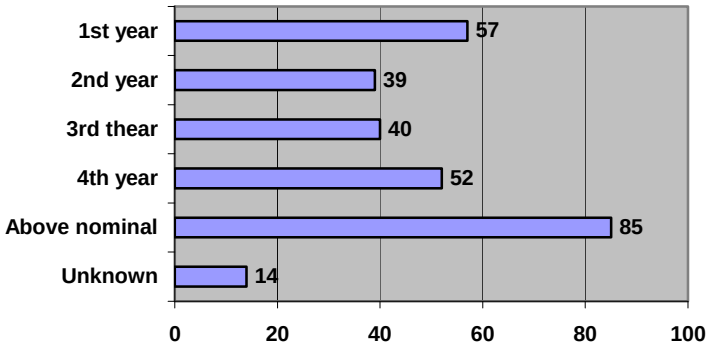


These interviews with students, Saxion entrepreneurs, management and employees of all faculties provide the image that entrepreneurship is of great importance at Saxion University now, and this importance will only grow the upcoming years. The previously mentioned attention for entrepreneurship in society, a cause of national competition force, is an important aspect here, just as the turbulence in several fields of expertise.

Results on Saxion entrepreneurs
A modest start is made with research concerning the Saxion enterprises.

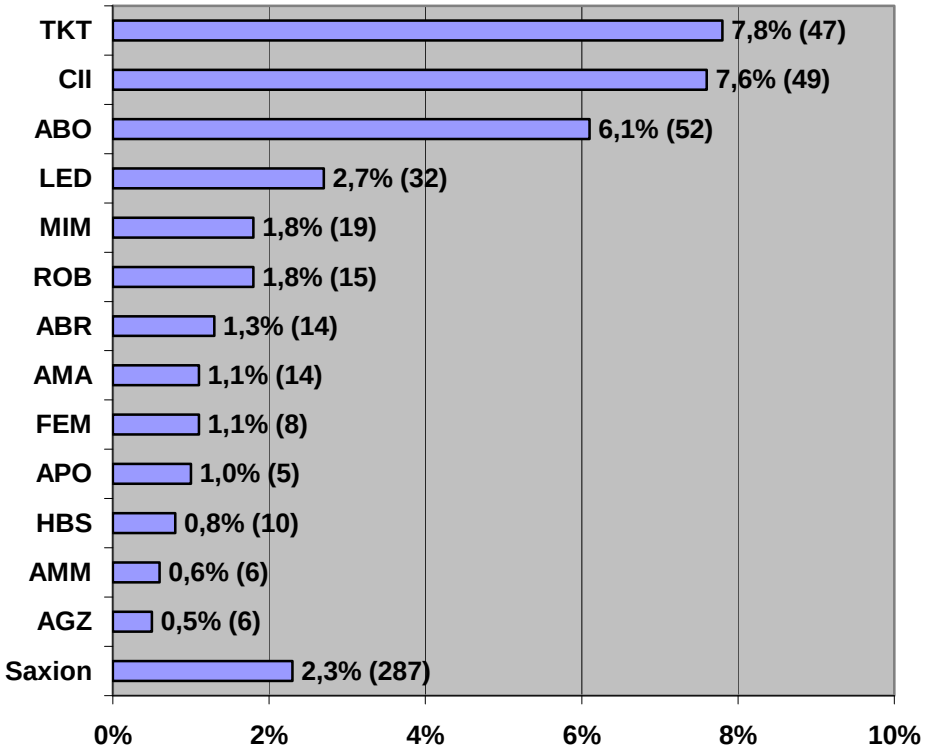
By now 287 Saxion student enterprises are traced, based on the survey among all students (see figure 6). The number of enterprises belonging to first year students is 57, which is quite high. The other academic years show a pattern, which can be expected: the more progress is made, the more enterprises are raised. A reasonable explanation for this is the increasing attention for the perspective after ending studies. Starting an own enterprise is one of the alternatives then.

Figure 6
Number of student entrepreneur by academic year (n =12.481)



Extrapolation of the 287 Saxion enterprises in the responses to our survey produces an estimation of 415 students owning an enterprise in the complete Saxion student population. Those are not distributes evenly over the faculties, as is shown in figure 7. The faculty ABO and HBS were expected to bring about most enterprises. However, the results do not show this. Apparently it is difficult to start a company in the hospitality business, while still studying. To earn extra money as an employee seems to be a more obvious way. Among students of the faculty CII, TKT and LED a reverse result is found: most enterprises are found there, while interest is average.

Figure 7
Percentage student entrepreneurs by faculty (+ absolute numbers) (n = 12.481)



It is nice to see that also faculties, which traditionally have less to do with entrepreneurship, like AGZ, AMM, APO, still have a few student enterprises. The curious reader will wonder what activity is carried out in these enterprises. In this research, however, only a modest start

is made with the description of all Saxion enterprises, about nature of the activities, dimensions, development and effect on the regional economy. We started to build a research database with Saxion enterprises, both student and alumni enterprises (since 1986). Until now we found the data of 418 Saxion enterprises (300 student and 45 alumni, the rest is unknown). At the next page a few cases of some typical Saxion enterprises can be read.

Based on the first estimate, we expect that, fitting the definition mentioned before (page 4), since the middle 80's approximately 1000 to 2000 enterprises are raised by students and recent alumni of Saxion Universities, which still exist nowadays. These companies will probably offer work to 10.000 to 20.000 employees, most of them employed in the eastern region. Many of these companies (estimated 80%) are small and probably have a nature like GEP (next page). A limited percentage of these companies will grow to a medium-sized company like Gladior, and only a few will become large. The largest Saxion company that is found in this research is EW, having over 3000 employees, spread in the Netherlands but also international.

EW

EW is a general and technical support service on the domain of guest-concepts for business, health care and hotels. The company is raised in 1991 by Eric Wentink, a former student of Saxion's Hospitality Business School at Saxion University.
EW can call itself the largest general and technical support company, having over 3000 employees and a turnover of more than € 60 million.
This market leadership is owed to EW's unique vision, in which the guest's perception occupies the central stage in offering service. EW is active in Holland, Belgium, Germany and Switzerland.

GEP Benelux

After finishing Business Administration Studies, Prins and Van Langeveld started a consultancy company called Prins van Langeveld, with help from the TOP-arrangement (a financial fund from the University of Twente).
Having the trend of durable entrepreneurship in the back of their mind, they decided to focus on rainwater-systems.
The products were imported from the German company GEP. In the year 2000 Prins van Langeveld was taken over and subsidiary company GEP Benelux was raised. GEP is at the moment the only business in this sector in Holland, nevertheless the biggest market is in Belgium, where such systems are obligated for companies. In the year 2007 the company has a complete, broad and high-quality assortment, which can offer any project a suitable water system, for companies as well as individual persons. In this way, utilizing rainwater can be accessible for everyone.

Deltanovum

Deltanovum is a young company, a mechanical engineering student consultancy, raised in 2007 by four students Mechanical Engineering of Saxion University.
The foundation of this company was the interest in entrepreneurship.
The company is now consisting of three students, and offers engineer-services across the total design-process. This varies from carrying out a total project, to problem definition and solution, but also focuses on parts of the process.

Deltanovum has its customers particularly in the region Twente and the Achterhoek. It derives its power from the knowledge and fresh view of the matter, in combination with knowing where to find the right experience. There are close contacts with a machine factory and a well-established engineering office.
Moreover, suitable prices are used, so there is always enough work to do.

Gladior

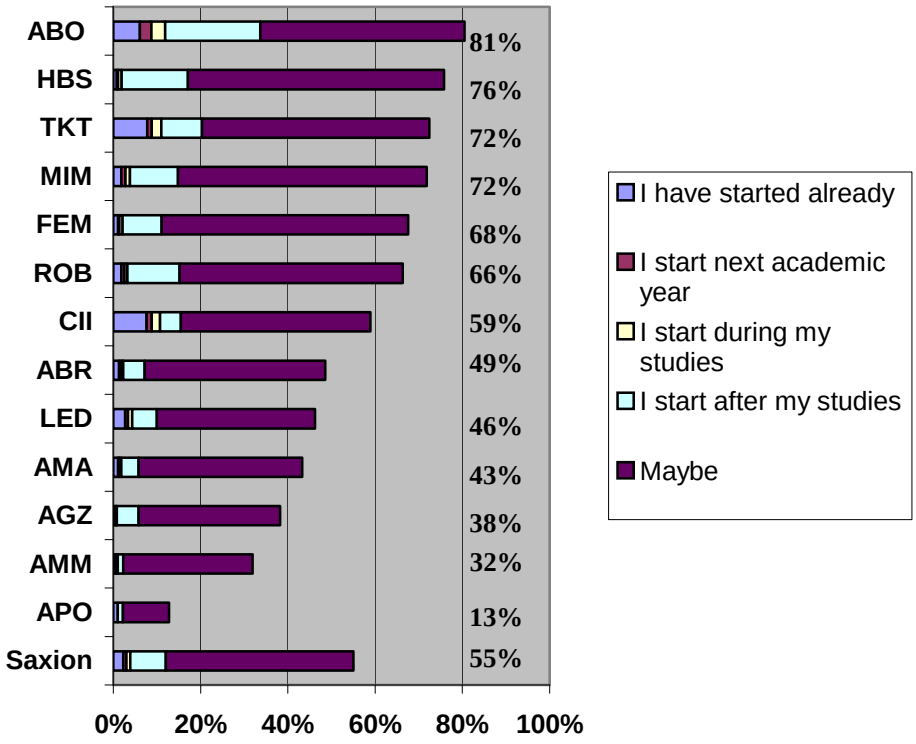
Gladior is a search engine marketing office that makes sure a website gets and keeps higher positions in search engines.
The company was established in 2000 by Peter Schinkel, former student technical business administration at Saxion University. Nowadays it has 70 employees.
Last years hundreds of companies and cooperating partners have taken advantage of Gladior's unique service.
Gladior has a lot of experience with various search engines and offers its service for several European countries and the international market.
To satisfy customers' wishes, Gladiator is split up in January 2008, forming two new organisitions with their own specialty: Gladior BV en Indenty BV. Gladior is taking care of the direct customers and Indenty of the company's partners. Peter Schinkel is chief of Indenty, for Gladiotor an external leader is attracted.

Results on entrepreneurship: high ambitions

Entrepreneurship is very important within Saxion Hogescholen and is getting even more important next years. The management has the aspiration to double the number of Saxion enterprises the upcoming years. The enormous interest of students in starting an own enterprise shows this aspiration is feasible. As much as 55% of all students indicate they are considering starting an own enterprise. We have to nuance this percentage: it surely indicates that the potential is high, but the respondents giving this answer exists out of different groups varying from 'yet started' to 'maybe'. Especially this last group has a lot of students who ultimately decide not to start an own enterprise.

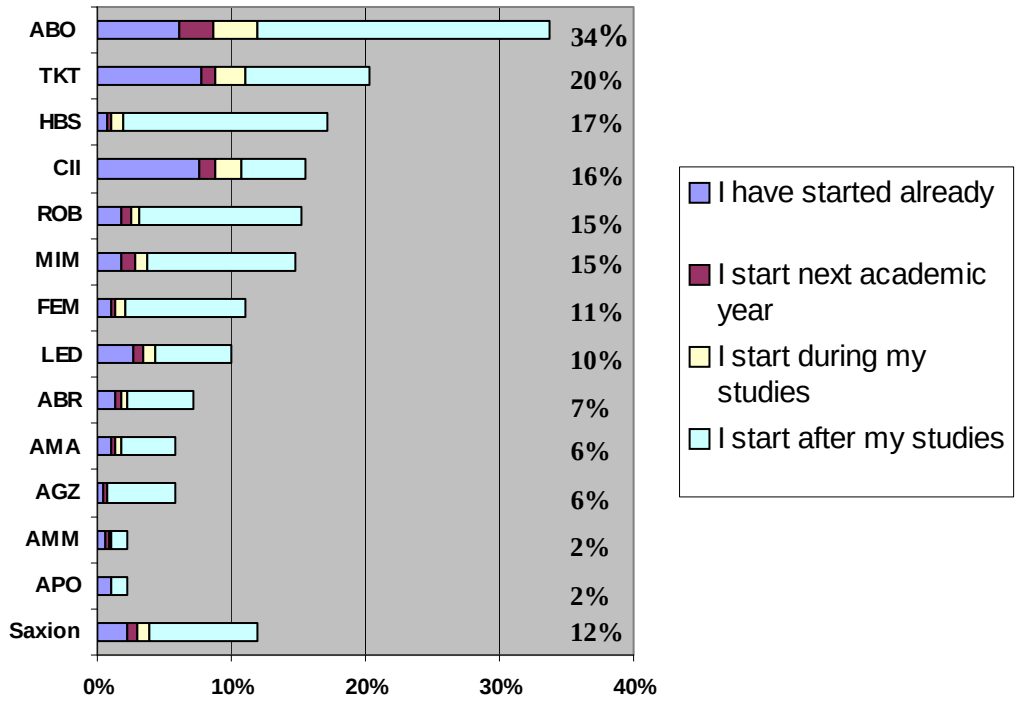
This percentage of 55% varies over the academies. This is shown in figure 8. Anyhow, even the faculty APO, which is hardly aiming on entrepreneurship, has a percentage of 13% of the students, which are intending to (maybe) start an own enterprise.

Figuur 8:
Percentage of students by faculty, which are (maybe) intending to start an enterprise (n = 12.481).



Also the move from having the vague feeling of 'maybe doing something like starting an own enterprise" to making concrete plans is made by as much as 12% of the students, as is shown in figure 9 and 10.

Figuur 9:
Percentage of students by faculty, who have plans to start an enterprise



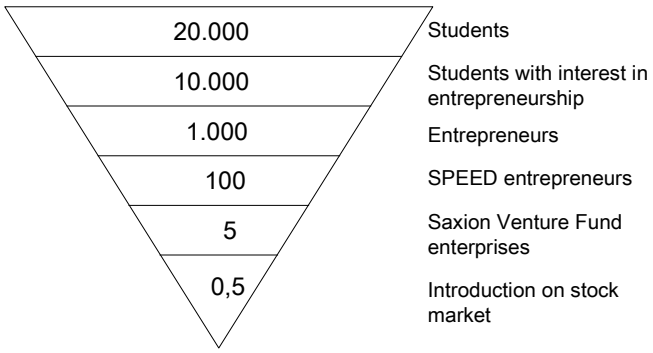
Another research about entrepreneurship and people's intention is carried out by TNS Nipo (2008), by order of ABN AMRO. This recent research, among 1002 (505 men and 497 woman) respondents, showed that one out of three persons between the age of 18 and 55 years old, is dreaming about starting an own enterprise. There is dreamed of more by men (38%) than by woman (32%). The results show that people mainly keep dreaming or thinking. Only 13% of all respondents were actually working out plans in order to realize the entrepreneur dream. The lack of financial resources and the uncertainty that goes together with entrepreneurship, are the most important reasons not to start an own enterprise.

If we compare these figures with the Saxion results, we can see that interest in entrepreneurship at Saxion University is relatively high. This may be due to the fact that Saxion students are young people. The ABN AMRO research showed that, compared to other age groups, especially 18-25 year and 26-35 old people are not to be withheld from their dream to start an own enterprise. While young people (18-25 years old) are willing to take a chance, 26 to 55-years-old are prevented by fear and uncertainty (26 to 35-years-old 23%, 36 to 45-years-old 31%, 46 to 55-years-old 27% respectively). Only 6% of the young people are experiencing this fear.

Results on stimulating entrepreneurship

The following years a well-developed Saxion approach for stimulating entrepreneurship can arise, when proper stimulation takes place. This approach is funnel-shaped, showing the following characteristics (figure 10).

Figure 10:
The Saxionfunnel for stimulating entrepreneurship in the year 2012



Approximately 20.000 students are studying at Saxion University. Our data show that half of these students is interested in entrepreneurship and is intending to start an own enterprise. However, interest is not enough. The ABN AMRO research (TNS NIPO, 2008) showed that fear, uncertainty, risk and a lack of guts form a barrier for starting an own enterprise for 24% of all people dreaming of an own enterprise.

Saxion has the aspiration to enlarge the interest (ambition development) and to inform students with knowledge involving the consequences of entrepreneurship (organisation development). The management of Saxion University proposes a set of activities, like a small topic in the introduction program of first-year students, a booklet with inspiring examples of successful examples of Saxion enterprises, guest lectures, and offering a couple of minors with entrepreneurship and innovation as a subject. The top ten of stimulating activities are shown in table 1.

This investigation has shown that there are important differences between all faculties. Therefore, a specific stimulating approach has to be used in every faculty.

Table 1
Order of ranking stimulating standard items according to board of directors (n=13) (1=high, 10 = low)

Average ranking	Range
1. (Small) topic in introduction program of first-year students	1 - 9
2. Minor entrepreneurship	1 - 6
3. Guest lectures by entrepreneurs	1 - 7
4. Optional subject about entrepreneurship	2 - 10
5. Student entrepreneur association YBP	2 - 7
6. Entrepreneur café	2 - 7
7. Saxion price for entrepreneur of the year	2 - 10
8. Seed capital (till 10.000 euro)	1 - 8
9. Venture capital	3 - 10
10.Support introduction on stock market (10 million euro and more)	7 - 10

Partly due to these activities, a couple of students will actually start an own enterprise. Research has shown that specific stimulating will cause a increase in the number Saxion enterprises to approximately 1000, or 250 in every academic year. However, as the ABN-AMRO research showed (TNS NIPO, 2008) not everyone is making his or her dream true. A lack of money and resources stops 30% of the dreamers to actualise their entrepreneur dream.

We estimate that 10% of these starters will be in need of externally acquired seed capital. At the moment Saxion University has its own seed capital fund, named SPEED (Saxion Program for Excellent Entrepreneurship Development), which can support these starters.

Most support programs, however, stop at this point of the funnel, which is a missed chance. The support program does on the one hand reflect the ambition of Saxion University, since it gives inspiration to the students. On the other hand, if we stop giving support at the point of offering €10.000- seed capital, mentoring, accommodation and helping to make a business plan, we might not expect to bring in large, growing companies like Gladior and EW. This is the general complaint about stimulating starters in the Eastern Region in Holland (see Enter, 2006).

Additionally it is an tremendous chance for Saxion university to receive the financial benefits of the stimulating policy. Crucell's stock market flotation in 2006 has returned 21 million to the participating University of Leiden. A similar flotation by a second company is worked on. If Saxion University wants to attract ambitious students, we can better start to be ambitious ourselves. Of course this will take long. It was not until fifteen years that the starter policy offered by the University of Twente had a substantial impact on the employment in Twente region, and even among the starters of this university, no stock quotation has been made. Here we can see a possibility for ambition for Saxion University. But how to realize this potential and ambition?

Ambition driven entrepreneurship

To conclude this article the authors suggest to use a model for the development of a spin off company based on three independent sub processes:

1. Development of formula
2. Development of organization
3. Development of ambition

Like During (1976) most authors on models for innovation and entrepreneurship suggest sub processes are strongly interlinked and interdependent. Our research showed several cases (like EW) of students with ambition to found and build a large million-euro multinational company without the faintest knowledge of the content of the formula. Imagine what type of reaction these young entrepreneurs provoked from their professors!
We also found good established Saxion enterprises solely based on the talents of their founder to organize things in an excellent way. No thrilling formula or skyrocketing ambition was found in this companies but simple businesses making stable money. So, contrary to what During proposed, based on our observations we suggest independent or loosely coupled processes. The three sub processes are described here, complemented with the way Saxion University wants to stimulate each sub process.

Sub process 1: Development of formula
For the development of formula a wide variety of literature on strategy is available. But this literature and the models in it hardly help to find a good formula. Most of the spin offs found in the survey have rather shallow formulas. Since the development of the formula is the core of the existence of a company we argue supporting instruments should not intervene too heavily in this sub process but leave content where content must be found: by the entrepreneur.

Sub process 2: Development of organization
Looking at most authors writing on entrepreneurship we see several functions and stages in the development of the new organization. For instant Groen and Van der Sijde (2004) describe entrepreneurship in terms of the entrepreneurial process. They divide the process in three main stages:

1. Recognition of the opportunity
2. Preparing for exploiting the opportunity
3. Exploiting the opportunity

Following this type of reasoning we see a broad variety of skills, competences and traits needed to develop the organization of a Saxion company. Part of the personal traits of the entrepreneur needed in stages 1 (more innovative) and stage 3 (more adaptive) cannot easily be found in one person (Kirton, 1989). The need for development of a team and an organization seems obvious.

When we look at the necessary competences and knowledge domains to develop the organization of a spin off company we found at least the following:

- Knowledge domain of the content of the company
- Marketing and sales

- Economics and law
- Human resources

In Saxion University we cannot find al these competencies together in one faculty so we prepare a design to cross-link the various competencies available in each faculty. Interesting support instruments are cross faculty minors on entrepreneurship and an easily accessible network of experts/professors to help entrepreneurs in their need for specific knowledge. The student entrepreneurs association of Saxion University YBP (over 500 members, www.ybp.nu) with an excellent program of specific lectures and meetings is also part of this cross-linking approach.

Sub process 3 development of ambition
The most important sub process however is the development of ambition.

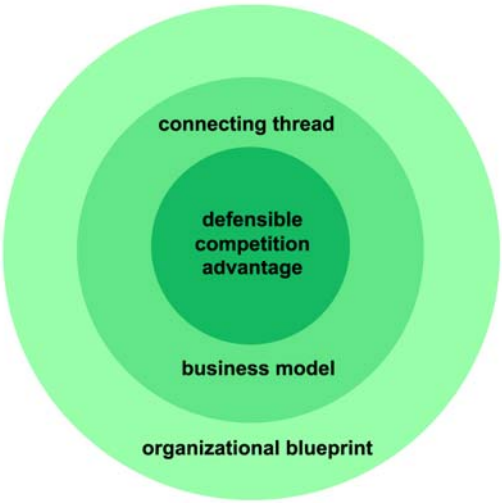
Research by Kirton (1989) showed that the individual human being develops a stable pattern of behaviour between the fourteenth and eighteenth year of life. This pattern, also called personality, is different for every individual, but changes hardly in the course of life of an individual. In other words, our personality develops until the eighteenth year of our life, but is surprisingly stable and unchangeable after that age.

What applies for the individual also seems to apply to companies. The personality, or the soul of a company, is formed in the head of the founder. Not much is found about this creation of an image of a company, as it's happening in the founder. There is more information available about the stability of this image throughout the year. In this image, also called mental model, we can distinguish three layers:

- The first layer is the defensible competition advantage, the formula which distinguish a company from its competitors, and which is used to win favour from the customers. Part of this formula is the way in which a company is forming the differences between costs and expenses in order to create profit.
- The second layer is called "a connecting thread" by Gerards (1980) and "the golden formula" by Peter Drucker (1954). More recent authors refer to this layer as being "a set of core competences" (Prahalad & Hamel, 1994) and a "business model" (Chesbrough, 2003). It is the way in which a company makes and maintains knowledge to give shape to the competition advantage. This knowledge is elaborated in all processes.
- The last, third layer is the total design of all functions within a company, called "organizational blueprint" by Baron and Hannan (2002).

These three layers are to be considered as the soul of a company.

Figure 11:
Three layers in the soul of a company



Rockey (1992) showed that founders of companies have a clear image of all three layers in an early stage. In his research towards fife hundred starters of Pepperdine University, Rocky describes the very detailed visions these founders have even before the actual start. Lots of them can even draw their future enterprise down to the smallest detail, including the colour of the interior.

On the contrary, Baron and Hannan (2002), researching two hundred starters of Stanford University, conclude that the last layer of the model, the Organizational Blueprint, is stable and not evolving, and only slightly related to the first two layers. The research by Baron and Hannan showed that roughly 90% of all starters still have the same blueprint after ten years compared to the start.

Other researchers report the same stability at the second layer, the business model. Gerards (1978) report the natural tendency to stay attached to the current business model. Nowadays Chesbrough (2003) finds that companies are not capable of using new business models. In his book Christiansen (1997) shows his amazement about the usual incompetent reaction of settled companies when innovative newcomers are entering their field. The settled companies underestimate the threat of new business models and new technologies badly and are not capable of changing. Also Collins and Porras (1994) detect in their book “Build to Last” that only few companies are capable of changing their mental model during their existence, in order to reach the status of “lasting”.

To put it shortly: settled models about the being of a company are difficult to change, but they do have a large impact on the eventual growth and prosperity of spin-offs. The moment this mental model is created, is in all probability the adolescence period young persons go through. Exactly the period in which adolescents are under the influence of institutes like Saxion University.

So one of the basic rules of supporting instruments should be the nurturing of the real and deep ambition of the young entrepreneur. This may seem in contrast with the more traditional supporting instruments like providing shovel money and helping to make a business plan. Our initial data show that university staff still is in favour of modest so-called “solid and feasible”

type of spin off companies like GEP and the support instruments reflect this vision. To break this paradigm we suggest to leave the more traditional ways of stimulating spin offs and come with more daring designs like breaking traditional role models, creating heroes and myths of Saxion entrepreneurship: an university internal stock market of Saxion companies with a giant display in the entrance hall of the Universities' main building and support instruments up to entering the public stock markets.
It goes without saying: ***When a university wants to attract ambitious young entrepreneurial students it starts with the ambition of the university itself***.

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This study examines the relationship between the competencies of the small business owner and their interest in international activities. Based on a review of the literature and a quantitative empirical survey among 803 newly founded Austrian companies, the paper identifies the central explanatory variables of internationalization, thus contributing to a theoretically based conceptualization of this phenomenon. Previous conceptualizations of small firm internationalization are extended and specified. This reveals the necessity for a wider inclusion of utilized resources throughout the internationalization process. Moreover, the impact of the structure of social capital of a business owner on the decision to start international activities is examined. The findings elucidate differences between performance drivers with regard to the network, marketing and technology competence of the small business manager. The study repudiates the Uppsala Model in favour of the „born global hypothesis".

social capital, networking capabilities, exporters, born global, international performance

Being involved in cross-border activities has been increasingly typical for small and medium-sized companies since end of the last century (Fan & Phan, 2007). Internationalization is assumed to be one of the most important sources of economic value creation and development in Europe. Major incentives and means have been implemented to foster, secure and accelerate the creation and the early growth of international new ventures – whatever their origin. However, despite years of experience, the problem of predicting potential growth and profits of future businesses remains highly uncertain (E. Autio, Sapienza, & Almeida, 2000). Actually, internationalization of born global companies seems to entail both high potential future profits and high uncertainty. A major question concerns the possibility to prove, at least partly, the future value of an opportunity before its realization. Recent research showed that international new ventures, those companies that enter foreign markets at inception, often suffer the two liabilities of newness and foreignness, which may increase the odds of their failure (Mudambi & Zahra, 2007).

This calls for a better understanding of the concept of internationalization competencies. This paper proposes to learn from successful international new ventures about the way they represent their opportunity early before its concretization so that both procedural and declarative basic knowledge may be identified.

A significant problem of small firm internationalization seems not to be so much a problem of lacking ideas or products but one of deficits in the resources and assets since international activity requires resources that newly founded firms may find it difficult to acquire. During the last two decades, International Entrepreneurship research has analysed the drivers for SMEs (in particular knowledge-intensive new firms) for international activities and how international new ventures can overcome hindrances such as the liabilities of newness and smallness. New business creation and growth are not autonomous, isolated processes but collective processes that involve the establishment and sustaining of a network of relationships between the new organization and other parties in its environment. A firm needs to interact with customers for and distributors of its outputs, and with the suppliers of inputs the firm requires, such as funds, labour, material resources and knowledge. A young firms`s

relationships provide access to external resources which compensate for internal resource constraints.

The phenomenon of companies that commence international activities increasingly early in their existence has elucidated a clear shift in theory building in the field of International Management research. Recent empirical evidence suggests that the symbiosis of internationalization and social capital has the unique ability to impart growth and survival to companies (Arenius, 2002). Autio stated that the role of social capital in an international context could be discussed in terms of an entrepreneurial network that becomes a base for international growth of new ventures (Erkko Autio, 2006), suggesting a strong reciprocal relationship between this type of entrepreneurship and social capital.

Until now, researchers (Oviatt & McDougall, 2005) have found that the pattern of internationalization in technology-based industries differs from that of traditional companies concerning choice of markets and entry modes, which tend to become international in a slow and incremental manner. Although some empirical evidence for the internationalization of the wine business industry exists (Graves & Thomas, 2006), the question of the impact of social capital on the pattern of internationalization has not yet been analysed. Therefore, the primary purpose of this paper is to provide a detailed account of how internationalization was inspired, adopted and managed in companies in the Wine Business Industry, in an attempt to locate the domain and distinctiveness of social capital. The significance of focusing on social capital is due to its unique role as the single common factor in all the three areas of wine business, international new ventures and high-technology companies.

This article differs from other empirical work on international new ventures in three ways. Whereas previous studies in the business field focused on only particular aspects of internationalization (e.g. export, family business etc.), the author examines the internationalization process in its complex form. Besides, the author places internationalization in the context of the SMEs strategic management processes to locate the support and structure of the social capital. Third, the author extends the internationalization theory building by including the concept of competencies in an attempt to define the domain and distinctiveness of the concept of international new ventures.

By so doing, the author addresses several hitherto unexplored questions: Can social capital embedded in international relationships be leveraged for relationship benefits in a similar manner as in domestic contexts? In this context, the paper attempts to answer the following hitherto unexplored questions: Can competencies and capabilities of the entrepreneur embedded in international relationships be leveraged for relationship benefits in a similar manner as in domestic contexts? Under which conditions is management and network competence advantageous in an international context?

Accordingly to these research questions the author has structured the paper as follows: A literature review is first carried out, in which different views on internationalization are discussed. Thereafter follows a presentation of the conceptual framework, the research model and the sample and choice of variables. The section two the methodology and research design, section three the results and section four will provide concluding remarks.

Firms' internationalization is a well-researched area. Earlier research is discussed here and categorized under different headings.

[redacted]

Internationalization is a complex process over time (Jones & Coviello, 2005). According to Oviatt & McDougall (2005), the phenomenon of early internationalization appeared towards the end of the last century (Oviatt & McDougall, 2005). International Entrepreneurship research occurs at many level of analysis (Barrutia & Echebarria, 2007) and therefore can be described as necessarily interdisciplinary and multi-level (Boojihawon, 2007).

The first level of analysis was the definition of the term international new ventures in order to distinguish exactly from firms with no international activities (Fan & Phan, 2007). Startup companies were the target group of the empirical survey – which requires a clear definition of the measurement concept for international new ventures (Knight, Madsen, & Servais, 2004).

A review of a decade of 'born global' firm internationalization observes that the literature remains fragmented with a comprehensive theoretical explanation (Knight et al., 1996; Oviatt & McDougall, 1997; Servais & Rasmussen, 2000) for SME internationalization (Rialp, Rialp, & Knight, 2005). The examination of the existing studies points to the need for a synthesis. Numerous theories have been presented to explain why start-up companies engage in international operations.

Four conceptual perspectives in the literature can be found which are of influence to the theory building in the research field of International Entrepreneurship.

[redacted]

As far as networks are discussed in the theory building process, two basic underlying theoretical perspectives on internationalization are seen as fundamental concepts for this article: on the one hand we find the Uppsala Internationalization Model and on the other hand the International-New-Venture Approach. The main premise behind the Uppsala internationalization model (J. V. Johanson, J.-E., 1990) is that the process of internationalization is gradual and evolutionary. Incremental learning at the firm level is the main factor explaining the firm's internationalization. A firm increases its commitment to a market incrementally as it learns about the market. Thus, the Uppsala model describes the managerial goals of internationalization in terms of reducing risk and avoiding uncertainty. Nevertheless, the Uppsala internationalization model has been criticized for being too deterministic and unable to explain the "leapfrogging" activities of born-global firms identified in the international-new-venture literature (MacDougall & Oviatt, 1994). The Uppsala model was extended by the network theory of internationalization which emphasises the impact of business relationships upon the development and internationalization process of firms (J. V. Johanson, J.-E., 1990; J. V. Johanson, J., 1992).

There is empirical evidence to suggest that networks are important for born global firms (Coviello & Jones, 2004) because of their resource constraints (Coviello & Martin, 1999). Networks have been argued to contribute to the success of born global firms by helping to identify new market opportunities and contribute to building market knowledge ((Majocchi & Zucchella, 2003). However, only little attention has been drawn to the capability of small

business owners to exploit resources from social capital. Sapienza et al. held a similar view and stated that internationalization theories for new ventures including only two or three variables have limited predictive ability for growth or survival of the company (Sapienza, Autio, George, & Zahra, 2006) Research therefore suggests a broader conceptualization of internationalization which was adopted in this study and which confirms that internationalization is multi-dimensional and complex phenomenon. Extension of network has been discussed by Loane & Bell (2006), suggesting that international new ventures on the one hand rely on the existing network but on the other hand try to expand the network (Loane & Bell, 2006). Moreover, networking capability plays an important role because it enables identification and exploitation of market opportunities, facilitates the development of knowledge-intensive products and firm international market performance in the born global firm is discussed (Mort & Weerawardena, 2006).

The type of networks with impact on the internationalization process were analysed and the central role of home-based social networks were identified (Zhou, Wu, & Luo, 2007). This leads to the first proposition:

Proposition 1. International involvement is encouraged by the presence of home-based social networks.

■

As far as internationalization is concerned it is the entrepreneur who has the freedom to choose between different strategic orientations under the same environmental contingencies, which determine firm performance. It is also the entrepreneur who has to decide how to integrate resources from social capital during the internationalization process. In this context, the role of networks can be analysed from a strategic adaption perspective. Social capital is defined by its function. It is not a single entity, but a variety of different entities, with two elements in common: they all consist of some aspects of social structures, and they facilitate certain actions of actors – whether persons or corporate actors – within the structure. (Bruno, McQuarrie, & Torgrimson, 1992; Coviello, 2006). While network relationships have long been recognized to be indispensable for SMEs to achieve international growth (J. M. Johanson, L.-G. , 1988) (Lu & Beamish, 2001), a particular focus on social networks has been limited to date (Ellis & Pecotich, 2001). There is evidence to suggest that networks are important for born global firms because of their resource constraints (Freeman, Edwards, & Schroder, 2006). However, the role of the decision maker and the firm's characteristics in taking up opportunities for international penetration, extension, integration and operations remain unclear (Jones & Coviello, 2005). Networks have been argued to contribute to the success of born global firms by helping to identify new market opportunities and contribute to building market knowledge (Coviello, 2006; Mort & Weerawardena, 2006). Other themes have also been explored (Eriksson, Johanson, Majkgard, & Sharma, 1997). Studies by Ritter et al. (2003) and Chetty et al. (2003) investigated the development of knowledge intensive products through networks. Others (Bell, Crick, & Young, 2004) examined the role of entrepreneur in the developing network relationship. The tentative conceptual model guiding the research leads to four research questions. It is a well-known fact that many small businesses are highly innovative as start-ups but eventually fail to maintain the competitive advantage as they grow, indicating a need to identify how firms can create competitive advantage from the extension of marketing activities to an international level. It has been demonstrated that home-based networks of the entrepreneur can play a mediating role in the relationship between inward and outward internationalization and firm performance. The

mediating mechanism is attributed to three information benefits of social networks: (1) knowledge of foreign market opportunities; (2) advice and experiential learning; and (3) referral trust and solidarity. (Zhou et al., 2007). Zahra et al. (2007) suggest SMEs' ownership and governance systems significantly influence the development of knowledge-based resources necessary for internationalization. They found a positive relationship between both the equity held by top management team members and venture capitalists and the development of these important resources (Zahra, Neubaum, & Naldi, 2007). The strategic role of networks in the internationalization process was confirmed. (Mort & Weerawardena, 2006).

Developing a unified framework goes beyond the limits of this study. In this article, the author concentrates on the role of social capital in the internationalization process. In this context a multi-disciplinary approach that includes entrepreneurship and strategic management is applied. From the perspective of the resource-based view the entrepreneur can achieve competitive advantage and niche positioning from social capital. Recently, researchers have reported a strong correspondence between a firm's strategic decision-making process and internationalization, necessitating that internationalization from SMEs, cannot be examined in isolation. Rather, internationalization should be seen within the context of the firm's management and its strategic choices. This perspective also considers the primary role of entrepreneurs which implies of the creation of social capital, through innovation and risk-taking, proactiveness and network expansion. The interconnectedness between social capital and the decision for international activities is now obvious. This necessitates that internationalization studies must place social capital in the context of the firm's strategic management processes.

This leads to the second and to the third proposition:

Proposition 2. International involvement is encouraged by the presence of resources from strategic partners.
Proposition 3. International involvement is encouraged by the presence of resources from social networks (e.g. family, spouse, friends).

Although technology competence and management competence are well introduced concepts in the literature (Brinkmann, 2006) the network competence dimension as the ability of the small business owner to utilize and extend resources drawn from strategic networks has been neglected so far. This final issue is therefore is linked directly to the personal competencies of the small business owner and highlights a gap in the International Entrepreneurship literature. It has been shown that human capital characteristics of the entrepreneur or of the members of the founding team provide personal abilities that can facilitate small firm growth and performance (Sapienza et al., 2006). While network relationships have long been recognized to be indispensable for SMEs to achieve international growth (Johanson and Mattsson, 1988; Coviello and Munro, 1997; Lu and Beamish, 2001), a particular focus on social networks has been limited to date (Harris & Wheeler, 2005). It has been critizised that the role of the decision maker and the firm's characteristics in taking up opportunities for international penetration, extension, integration and operations remains unclear although networks have been argued to contribute to the success of born global firms by helping to identify new market opportunities and contribute to building market knowledge (Chetty et al., 2000).

Therefore the following propositions can be stated:
Proposition 4. International involvement is encouraged by the network competence of the small business owner.
Proposition 5. International involvement is encouraged by the technology competence of the small business owner.
Proposition 6. International involvement is encouraged by the management competence of the small business owner.

Three theoretical imperatives were identified which were discussed in the literature as factors influencing growth of the firm. The core of the theories is summarized in the following table.

Theoretical Framework	***Network Theory***	***Resource based Theory***	***Competence Based Approach***
Variable	Structure of network	Internal firm resources	Marketing Competence Network Competence Technology competence
Literature Level of Analysis	Firm	Firm/Entrepreneur	Entrepreneur
Dependent Variable	Performance	Performance	Performance

Table 1 Causal logic in explaining performance of three theoretical perspectives

A model is by definition a simplification of a complex reality and there is always a trade-off between including certain factors and relationships in the model and disregarding them. Simplicity and complexity need to be balanced. In order to simplify the model, reciprocal effects of the environment were omitted. The author argues that growth of the international new venture is dependent upon: (1) the structure of the network in the pre-seed phase, (2) the ability of the owner/manager to achieve resources from the existing networks, (3) the utilization of resources through the network, dependent upon the marketing, network and technology competencies of the individual entrepreneur.

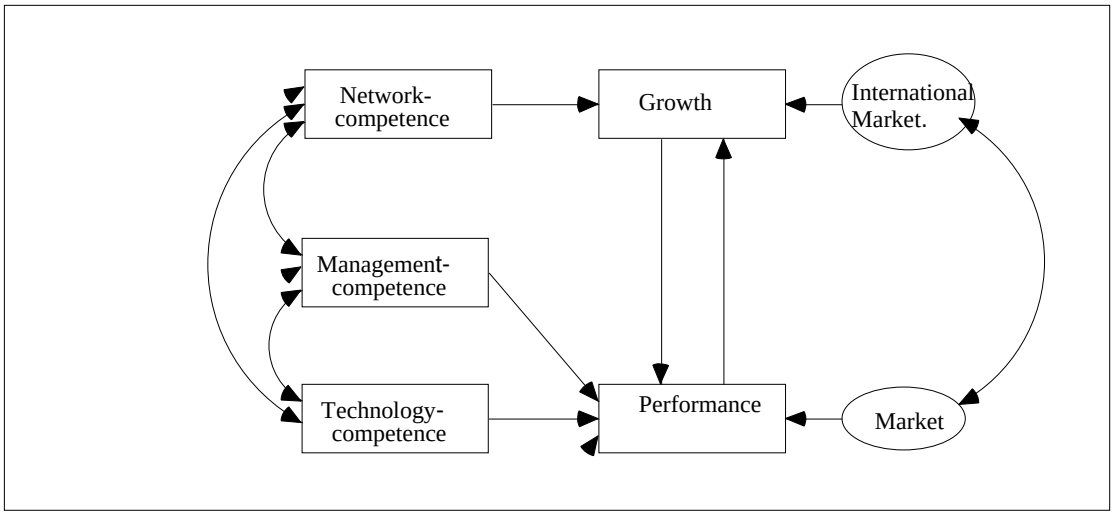

Figure 1 A framework for explaining international new venture performance

[illegible]

[illegible]

Individual SMEs are the unit of analysis in this study. To identify an SME, this study adopted the general definition of SME used by the European Union (2005) and focused on the definition of employee numbers. Accordingly to this definition, a business with less than 10 employees is a Micro business, and a business with 10 to 250 employees is a Small and Medium-sized business. In accordance with the support in the literature for quantitative methods, and in order to address the multi-dimensional nature of internationalization as was discussed earlier, a structure questionnaire was used to collect the data for this study. The respondents were informed by email about the survey and asked to fill out the questionnaire within a limited period of time. The author tested the hypotheses using survey data from startup companies in Upper Austria. This study used the Upper Austrian Chamber of Commerce database, which was accessed during February 2007. Usage of the filters, "foundation year (2002, 2003, 2004, 2005, 2006)" and "active member status" as well as exclusion of "business succession", yielded 3200 firms which was taken as the population frame. During the allocated time-period of 2 weeks for data sourcing, firms were contacted by email of which 803 agreed, translating into a response rate of 25%. Of the 803 returned questionnaires, 294 were excluded because of incomplete answers, leaving 509 usable responses, which relates to a net response rate of 15,9%. This response rate compares favourably with similar mail surveys of entrepreneurial firms: e.g., (McDougall, 1989; McDougall & Oviatt, 1996) had an 11 percent response rate in a study of new technology-based firms. All of the multiple-item constructs achieved Cronbach alphas of 0.71 or higher, indicating strong internal consistency.

[illegible]

In this section, the author presents the findings of the survey. Firm-level data were derived by counting the scores for internationalization for all respondents from each company. The profile of respondents demonstrated that 33,3% had no international activities at all (Group I),

14,4% of the companies plan international activities (Group II) and 52,3% already had experience in international activities (Group III). The analysing methods for gathered data in this research were divided in two parts. First is Confirmatory Factor Analysis which was implemented to validate the model and respectively compatibility and relativeness of the question to the model, and the second method was discriminant analysis which was implemented to discover the meaningful difference(s) between the theoretical constructs. The individual measurement items for the study's dependent, independent, and control variables are listed in Table 1; the construction of the measures is explained in the following. All statement-style items were measured on a scale from 1 = do not agree to 4 = completely agree. The SPSS program was used for the data analysis.

Referring to the social capital structure the resource analysis was measured with seven statements regarding the extent to which the firm's social capital is a source of international competitive advantage for the firm. While previous research has often focused on a single dimension of social capital and measured it indirectly as the number of relationships or network position (Kundu & Katz, 2003). The author found three dimensions of social capital; results indicate that these dimensions are distinct and have differential effects on internationalization for Wine Businesses. These components are personal relations which the owner has, strategic relations with Investors or Strategic partners and intercompany relations (with Industry colleagues, Friends). Staff showed loadings for both components Nr. 1 and Nr. 2. This finding is important because it provides empirical support for propositions in recent research that different social assets may have different effects on relationship outcomes. The standardized factor loadings are all above the recommended minimum in the social sciences of 0.40. Summarizing the findings indicate that propositions 1, 2 and 3 can not be rejected.

	Component		
	1	2	3
Industry colleagues	,783		
Friends	,651		
Staff	,549	,473	
Investors		,812	
Strategic Partner		,743	
Spouse			,872
Family			,768

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 5 iterations.

Table 2: PCA Resource Analysis

The major purpose of discriminant analysis was to predict membership in two or more mutually exclusive groups from a set of predictors, when there is no natural ordering on the groups. The dependent variable was the Intensity of International Activities (Range: 1…no international activities, 2….planning of international activities, 3…international activities). In this study three categories of independent variables could be found: Technology Competence,

Network Competence and Management Competence. These three categories distinguish the three groups of companies with different levels of international activities.

Entered	Wilks' Lambda							
Statistic	df2	df3	Exact F				Statistic	df1
Statistic	df2	Sig.	Statistic	df1	df2	Sig.	Statistic	df1
Management Competence	,844	1	2	114,000	10,558	2	114,000	,000
Technology competence	,772	2	2	114,000	7,798	4	226,000	,000
Network Competence	,705	3	2	114,000	7,145	6	224,000	,000

At each step, the variable that minimizes the overall Wilks' Lambda is entered.

Table 3: Discriminant Analysis for Entrepreneurial Competencies

Summarizing the findings indicate that propositions 4, 5 and 6 can not be rejected.

N

This article has identified and analysed three distinct streams of research on internationalization: research on (1) the personal networks of the entrepreneur, (2) the use of alliances and external resources by entrepreneurial firms, (3) the relationship between entrepreneurs and investors, (4) regional networks of entrepreneurial firms. The purpose of this paper was to highlight competence dimensions associated with performance variations of international active and non-active companies. Understanding what leads to superior performance is viewed as an important task, which has theoretical as well as practical implications. Rather than trying to maintain separation in theory building, future research should aim at finding ways to consolidate and combine elements from various approaches to form a more comprehensive understand of entrepreneurial exchange relationships. To explore the development and content of exchange, research could focus on questions such as the following.

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CONFIGURATIONS OF EXTERNAL SME CHARACTERISTICS TO EXPLAIN DIFFERENCES IN INNOVATION PERFORMANCE

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ABSTRACT
As SMEs need to focus on core competences for efficiency matters, they need to cooperate with external partners to compensate for other competences and resources. This is especially the case in the field of new product development, where SMEs face specific problems compared to large firms. Recognizing the increasing importance of collaboration, the question remains how to organize these external networks.
The research is based in the social systems perspective and systematically builds a research framework for the description and analysis of the organization of new product development in networks from the point of view of the SME. Furthermore the research framework not only elaborates on the individual external SME characteristics as past research did, but it identifies combinations of external firm characteristics that are hypothesized to improve the overall innovation performance.
The paper results in the central research question of "how to organize the interaction between actors (organizations) in order to successfully shift from the exploration stage (development) to the exploitation stage (commercialization) to achieve high innovation performance". In addition several testable hypotheses are constructed from theory.

INTRODUCTION
New product development is of high importance for both large and small- and medium sized organizations. Compared to large firms, small- and medium sized organizations (SMEs) have a number of typical problems with regard to their innovation process, especially in the shift from the development stages to the commercialization stages (Hanna and Walsh 2002). They are more confronted with financial constraints, they have more manpower bottlenecks in terms of too few or unqualified personnel and they often don't have the possibility to substitute for the lack of sales and profits through other products (cash cows**)** (Kaufmann and Tödtling 2002) which makes it necessary for these companies to cooperate with other organizations. On the other hand, SMEs also have some advantages with regard to new product development which makes them very suitable as network partner. SMEs are usually less bureaucratic, and generally have greater incentives to be successful than large firms (Michael and Palandjian 2004). As the SME needs the network to achieve high innovation performance at the firm level, the question arises of how to organize new product development (NPD) in networks.

The objective of this paper is to present a testable research question and hypotheses for the description and analyses of actor-interaction related to high innovation performance from the point of view of the SME, in order to successfully shift from exploration to exploitation.
This paper will continue first with a literature review of the business strategies that were used over time for new product development. As these insights indeed underline the importance of external cooperation, but remain vague about how to organize external cooperation, the second section describes network theories that do consider operational issues. In this second section the research question for actor-interaction related to innovation performance will be presented. The third section contains the theoretical framework, which results in a number of testable hypotheses to answer the research question of section 2. The fourth section presents the research model and describes the methodology. The last two sections (sections five and six) describe the relevance of the research, followed by conclusions.

1. FROM COMPETITION TO COOPERATION

To organize new product development the strategy that a company chooses to follow is of major importance. As Cooper (2000) stated "Undertaking product innovation without a strategy is like running a war without a military strategy" (Cooper 2000). Cooper (2000) is not considering strategy as type of strategy (prospector, analyzer, defender, reactor (Miles et al. 1978)) but rather as a course of action, a vision, needed in each business model. Mintzberg (1994) calls this strategic thinking: a process interwoven with all that it takes to manage an organization (Mintzberg 1994). Over the past century business perspectives have evolved from a closed innovation paradigm (Chesbrough 2003) towards a more open innovation paradigm (Chesbrough 2003) of new product development in which the boundaries of the firm become less clearly defined (see figure 1). Alongside the shift in paradigm also the strategic vision and operations, and the organizational form that was used changed (see figure 2). This section describes the transition from closed to open innovation, including the changes in strategic vision and operations, and organizational form.

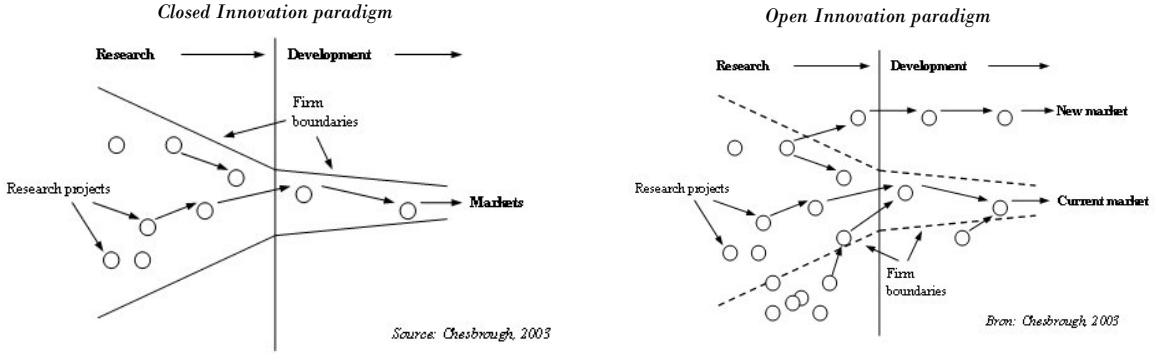

Figure 1 The closed innovation and open innovation paradigm (Chesbrough 2003)

Clear firm boundaries

Traditionally new product development was organized through the paradigm of closed innovation (see figure 1). The closed innovation paradigm says that successful innovation requires control (Chesbrough 2003). New product development is internally focused and the firm boundary is very strict. Ideas that originated within the company are internally developed, and ideas that originated outside the company do not enter the company (Chesbrough 2003). In the closed innovation paradigm especially the problems in new product development that were introduced in the introduction occur. In this paradigm the SME either has all the key operational functions and considers itself to be and remain small, or it needs a large company to provide some key operational functions.

At the beginning of the 20th century - when organizations were thought of as consisting of key operational functions - organizations used a U-form to execute their business model. In the U-form responsibilities for key operational functions remained at the top (Mayer and Whittington 2004). For a more efficient use of existing resources organizations started to pursue the strategy of diversification in the 1920s (Hoskisson et al. 1993; Mayer and Whittington 2004). This diversification led to several problems for organizations. (Chandler 1962; Hoskisson et al. 1993). As a response, organizations re-organized (see figure 2). Instead of using the traditional U-form, companies re-organized into the multidivisional form (M-form) (Chandler 1962). This M-form is characterized by the decentralization of operational responsibilities to divisions (Mayer and

Whittington 2004). Operational and overall strategic decision making responsibilities were separated. After the rise of the M-form in the 1920s, the most rapid period of dissemination of the M-form was the postwar era. In this period (from the mid-1960's) managers started to plan their company strategy. They thought that strategic planning would enhance the competitiveness of each business unit (Mintzberg 1994).

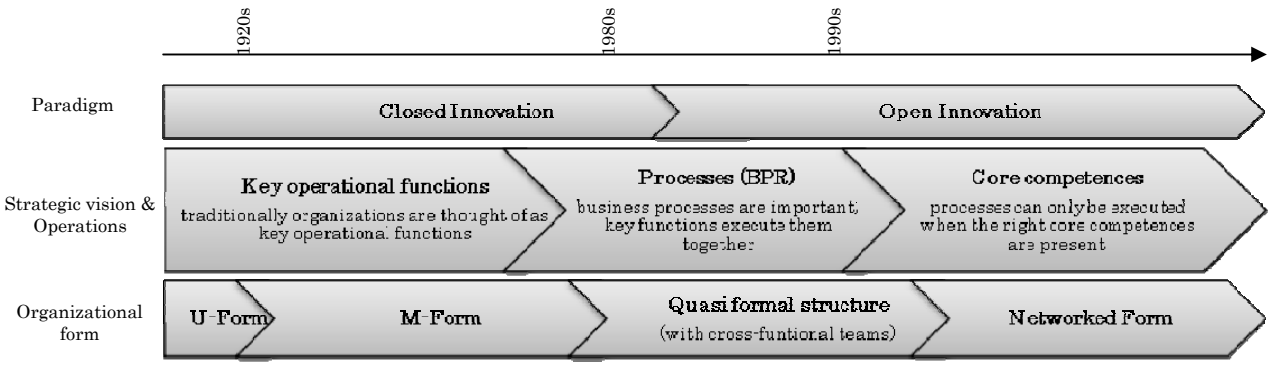

Figure 2 From closed towards open innovation

Towards open innovation

In the 1980s the spread and the popularity of the M-form declined as it became clear that the adoption of the M-form facilitated inefficient diversification, which caused the profitability of companies not to increase. For high performance not only the adoption of the M-form was a necessary condition, but equally important were the goals stressed by the management (Hoskisson et al. 1993). The perspective of thinking in key operational functions and departments shifted towards thinking in processes. This inevitably led also to a shift in organizational form (See figure 2). The traditional functional organizational form was modified into a form in which cross-functional teams were given 'ownership' of the process (Teng et al. 1996). Cross-functional teams are project teams consisting of different capabilities and disciplines (Clark and Wheelwright 1992).

The quasi-formal structure as organizational form becomes apparent. The quasi-formal structure as developed by Schoonhoven and Jelinek (1990) is an intermediary structure between a formal structure defined as subunits, positions, and reporting relationships and an informal structure consisting of unsanctioned patterns of interaction devised around social and task requirements (Jelinek and Schoonhoven 1990). The quasi-formal structure is closely related to the semi-structure which is introduced by Brown and Eisenhardt (1997), and in which managers rely on only a few key structure points that are never violated (Brown and Eisenhardt 1997). The use of cross-functional teams is especially successful in the quasi-formal structure as clear project goals and empowerment (stage-setting elements), cooperation and commitment (team behaviors), and team leadership and senior management support (enablers) are the most critical success factors for cross-functional teams (McDonough III 2000).

The importance of this strategic thinking in processes increased due to a changing business environment. An interwoven strategy process was needed because (1) customers became more diverse, segmented and expectant of consultation, (2) competition intensified to meet the needs of customers, and (3) change became faster and a pre-requisite in most markets (Hammer and Champy 1993). A new approach for the management of processes arose which would lead to

radical improvements in performance (O'Neill and Sohal 1999). This new approach was called Business Process Reengineering (BPR) (Hammer 1990) and is a strategy driven process change (Kettinger and Teng 1998). The aim of BPR is to make radical, major improvements. This inherently means organization change, the extent of which depends on the scope of the process reengineered (O'Neill and Sohal 1999).

Cooperation across firm boundaries

During the 1980s in which BPR was the dominating philosophy, managers were judged on their ability to restructure and delayer their organization. This changed in the 1990s when managers were judged on the ability to identify, cultivate, and exploit core competencies (Prahalad and Hamel 1990). Also (a) a growing mobility of highly experienced and skilled people, (b) a growing presence of private venture capital, (c) the shortening shelf-life of technologies, and (d) high degrees of frequency and mutual dependency led to a shift in mindset towards the paradigm of open innovation (Chesbrough 2003; Holmstrom and Roberts 1998).

In the open innovation paradigm (see figure 1) the company utilizes both internal and external ideas to create value, while defining internal mechanisms to claim some portion of that value. The boundary of the firm is porous, which reflects the interface between what is done inside the firm and what is accessed from outside the firm (Chesbrough 2003). This shift in mindset again led to a change in organizational form - from the use of cross-functional teams, towards the networked or matrix form of organizing (Teng et al. 1996) - and to a change in strategic vision to the core competence perspective (See figure 2).

The concept of core competencies starts in the resource based view of competition, which explains the success of an organization based on its competencies (Ritter and Gemünden 2004). Penrose (1959) argues that an organization doesn't achieve competitive advantage because of its resources, but because of the firm's distinctive competence of making better use of these resources (Penrose 1959). A core competence can be regarded as the collective learning in the organization, especially how to coordinate diverse production skills and integrate multiple streams of technologies (Prahalad and Hamel 1990).

Now, while on the one hand the focus on core competences and core products leads to sustained competitive advantage, on the other hand this focus causes firms to not be able to do everything themselves. Penrose (1959) describes this as follows: "growth necessitates specialization, but specialization necessitates growth and diversification…" (Penrose 1959). Jacobs and Man (1996) find that each company has to strike a balance between the development of its own core competencies and activities it contracts out to other firms. A firm should pursue a clear strategy of differentiation, in order to be attractive as a partner for other firms (Jacobs and Man 1996). It is widely acknowledged that organizations are embedded in networks of cooperative and competitive relations with other organizations (Ritter and Gemünden 2003). Branzei and Thronhill (2006) conclude that diverse networks increase the positive payoffs of internal innovation capabilities (Branzei and Thornhill 2006). Furthermore, Teece (1989) states that the successful commercialization of technology often requires collaboration among horizontal competitors that have different capabilities (Teece 1989). More recently there is a shift from vertical integration (which decreases) to more informal arrangements that keep industrial networks together (Gadde and Håkansson 1994). Especially in the field of new product development networking activity from the paradigm of open innovation becomes more and more popular as cooperation with other organizations increases the success of innovation and the

innovation performance of organizations (Chang 2003; Hanna and Walsh 2002; Ritter and Gemünden 2004; Ritter and Gemünden 2003; Rothwell 1991; Salman and Saives 2005).

Both the open innovation paradigm and the core competences perspective underline the importance of external networks for new product development. However, the academic debate about the open innovation paradigm does not address how to organize these external networks (Gassmann 2006). This is an important question, as numerous external alliances fail in practice (Duysters et al. 1999; Spekman et al. 1996). As a company to be able to organize your external network a certain amount of strategic choice should be present (Child 1972). The next section describes two streams of literature that do consider the organization of external networks.

2. ORGANIZING EXTERNAL NETWORKS

To achieve the objective of this paper – "to present a testable research question and hypotheses for the description and analyses of actor-interaction related to high innovation performance from the point of view of the SME" - a fit between theory on the organization of external networks and the open innovation paradigm is a prerequisite. Therefore this section not only describes theories that look at the organization of networks, but also links them to the open innovation paradigm. Theories that – among other things - look at the organization of networks can roughly be divided in two models: the natural selection model (determinism) and the resource dependence model (voluntarism) (Aldrich and Pfeffer 1976).

Determinism (of which structural contingency theory is derived) means that organizations are moving toward a better fit with their environment. The focus is on survival, in contrast to adaptation. The environment selects the most fit, or optimal organizations. Only those organizations that fit the environments will survive (Aldrich and Pfeffer 1976; Bourgeois III 1984). The internal actor is fully dependent on the external environment. The external environment determines the internal organization which leads to low social embeddedness[1] in terms of Granovetter (1985). This internal focus aligns strongly with the paradigm of closed innovation in that there is hardly any interaction with the external environment.

Moreover, the predictive value of contingency theory which searches for the best fit is often undermined by the possibility of a multitude of equally effective organizational design (Galunic and Eisenhardt 1994). An argument to explain the absence or nonfindings of contingency theory is equifinality (Drazin and Van de Ven 1985; Gresov and Drazin 1997). Equifinality occurs when a system can reach the same final state, from different initial conditions and by a variety of different paths (Katz and Kahn 1978). It means that multiple organizational forms are equally effective (Doty et al. 1993). The equifinality argument implies that there is strategic choice (Child 1972; Hrebiniak and Joyce 1985).

Besides the fit with the closed instead of open innovation paradigm, the main criticism towards determinism is the absence of strategic choice (Child 1972). Bourgeois III (1984) states that "any such assumption would eliminate the very need for management because it implies that the strategy of and organization follows more or less automatically from a technical appreciation of its environmental situation (Bourgeois III 1984). Furthermore Child (1972) argues that organizations have strategic choice because (1) decision makers have more autonomy than might be inferred from the perspective or environmental determinism, (2) organizations are not always passive recipients of environmental influence but also have the power to reshape the environment, and (3) the theory of determinism has blurred the distinction between

characteristics of the environment and the perception and evaluation of these characteristics by persons within the organization (Child 1972).

The resource dependence model (voluntarism) posits that while environmental influences are important, environmental constraints do not reduce the feasible set of social structures to a set consisting of only one form, there is strategic choice (Aldrich and Pfeffer 1976). The social systems perspective (Parsons 1937) is based in the voluntarism and widely acknowledges the presence of strategic choice. Furthermore, in contrast to determinism, voluntarism has higher social embeddedness (Granovetter 1985), because in the theory of voluntarism the interaction between actors in an external environment is value adding. The focus on the interaction with the external environment and the assumption that external cooperation adds value is also one of the most basic and important foundations of the open innovation paradigm.

As described before, SMEs need external partners for the development of new products, especially in the shift from the development stages to the commercialization stages. This interaction between actors is what adds value in terms of innovation performance which is consistent with the open innovation paradigm and voluntarism.
Based on the previous, we formulated the following research question:

"How to organize the interaction between actors (organizations,) in order to successfully shift from the exploration stage (development) to the exploitation stage (commercialization), to achieve high innovation performance?"

This main research question can be visualized in the research model which is presented in the next section. Also a number of control variables are presented.

3. THEORETICAL FRAMEWORK

As sections 1 and 2 made clear, in order to successfully develop and commercialize new products (and achieve high innovation performance) SMEs need to collaborate in external networks. Besides a clear definition of the concepts "innovation" and "innovation performance", the external characteristics of the SME are extremely important to organize the interaction with external partners. This section, starts by explaining the concepts of "innovation" and "innovation performance". The remainder of this section describes the external SME characteristics that influence external collaboration and innovation performance. The results of this theoretical framework are a number of testable hypotheses.

Innovation & Innovation Performance

There are a number of different definitions of innovation. It can refer to "product innovation, process, innovation, position innovation, and paradigm innovation" (Francis and Bessant 2005), or to "the technical design, manufacturing, management, and commercial activities involved in the marketing of a new (or improved) product or the first commercial use of a new (or improved) process or equipment" (Freeman 1982). In this research the definition of innovation proposed by Afuah (1998) is used, which states that in the field of high technology innovation is invention + commercialization (Afuah 1998). Garcia and Calantone (2002) explain this definition of the innovation more deeply as they state that innovation is ''an iterative process initiated by the perception of a new market and/or new service opportunity for a technology-based invention

which leads to development, production, and marketing tasks striving for the commercial success of the invention'' (Garcia and Calantone 2002).
Wheelwright and Clark (1992) state, that distinguishing between innovation types is very important, because different types of innovation require different levels and mixes of resources and organizational characteristics. They use three categories of commercial development projects: derivative (incremental), breakthrough (radical), and platform projects (Wheelwright and Clark 1992). In line with the findings of Wheelwright and Clark (1992) we distinguish between innovation types throughout the research and hypotheses.
The performance that is achieved as a result of new product development is the innovation performance. It can be defined as the sum of the individual innovations' successes (Salomo et al. 2007). (Miller and Friesen 1982) measure innovation performance using three factors: the existence of a strong emphasis on R&D, the introduction of many new products/ services over time, and significant changes in products/ services. Cooper and Kleinschmidt (1995) presented a number of measures for innovation performance at the firm level. They find that out of ten performance measurements the "percent sales" most clearly indicates whether a company is successful in new product development at the firm level (solid performers and high-impact technical winners) or not (dogs and low-impact performers) (Cooper and Kleinschmidt 1995).

External SME characteristics
The importance of external collaboration is stressed in the social systems perspective, which is based on the assumption of the importance of relationships among interacting units (Wasserman and Faust 1994). From a social systems perspective, the social capital (external SME characteristics) consists of three dimensions: positional, structural, and relational (Wasserman and Faust 1994). Each is described below.

Positional dimension
The "positional" dimension considers questions like, "What position in networks of knowledge, economy, or power are actors in?" (Groen et al. 2002). The position of an actor in a network is defined by Burt (1976) as the existence of an actor as a set of asymmetric relations to and from every actor in a network of relations. Wasserman and Faust (1994) refer to a position in a network as a collection of individuals who are similarly embedded in networks of relations. In other words, every actor in the network has a position, but every position in the network can be occupied by more than one actor. The social distance is the distance between two actors from the perspective of the two actors as elements of the overall network. This is the extent to which two actors jointly occupy the same network position (Burt 1976). All actors in a network have a certain role. In an ego-network, the level of analysis of these roles is the individual level (Wasserman and Faust 1994). The role is associated with the actor strictly on the basis of patterns and regularities in his or her "personal" network (Mandel 1983).
The most important or the most prominent actors in the network are usually located in strategic locations within the network. An actor is considered prominent if the ties of the actor make the actor particularly visible to the other actors in the network by looking not only at direct or adjacent ties, but also at indirect paths involving intermediaries (Wasserman and Faust 1994). This is similar to the stakeholder approach of Mitchell (1997). Mitchell et al (1997) present a framework of stakeholder salience on the basis of their power, legitimacy, and urgency[2].

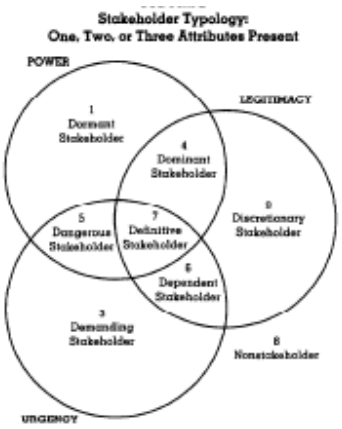

Figure 3 Stakeholder Model (Mitchell et al. 1997)

Mitchell et al (1997) found seven types of stakeholders which differ in the number of attributes (power, legitimacy, urgency) that are present (see figure 3). As the "definitive" stakeholder type has power, legitimacy and urgency, he is the most important stakeholder in influencing decision making, and is assumed to be the most important in achieving high firm innovation performance.

Whether a position has these dimensions or not depends (in the case of new product development) on whether the organization fills a gap (a structural hole) between different nodes, so as to become intermediaries (Pittaway et al. 2004) (see next section) and on the resources which are exchanged. Håkansson and Laage-Hellman (1984) term this resource exchange the exchange of bonds between companies. Six types of bonds can be distinguished (Johanson and Mattsson 1991): technical (product and process adjustments), planning or temporal (logistical coordination), knowledge (knowledge about the counterpart), socio-economic (personal confidence and liking), legal (special credit agreements, long term contracts). For technical development, the technical and knowledge-based bonds are the most important (Håkansson and Laage-Hellman 1984). We assume that for incremental innovation projects technical bonds for product and process adjustments are highly important, just as legal bonds as incremental innovation is a continuous flow of improvement to an already existing product. For platform innovation we assume that technical based bonds and planning bonds are most important. As in platform innovation projects multiple adjustments of the product take place, planning is highly important. We assume that for radical innovation projects not only the exchange of technical bonds is important, but even more important are knowledge bonds and socio-economic bonds. It is crucial to find a counterpart that you trust with the brand new ideas of your company and with whom you share the same vision for the further development of the radical innovation projects.

Structural dimension

The structural dimension focuses on questions such as, "Who is equivalent? How redundant/ unique are relations?" (Groen et al. 2002). Social capital exists where people (or SMEs, depending on the unit of analysis) have an advantage because of their location in a social structure (Burt 2004). Holding a certain position in the structure of a network can be an asset in its own right (Burt 2001). Actors are structurally equivalent if they have the same position (Burt 1976).

The “structural hole argument” is that social capital is created by a network in which SMEs can broker connections between otherwise disconnected segments. Structural holes are an opportunity to broker the flow of information between SMEs, and control the projects that bring together SMEs from opposite sides of the structural hole (Burt 2001). Burt (1992) argues and demonstrates that firms occupying the favored network position of bridging structural holes are likely to perform better because of the their superior access to information, regardless of innovation type (Zaheer and Bell 2005). Actors in a network rich in structural holes will be able to access novel information from remote parts of the network, and exploit that information to their advantage (Burt 2001; Burt 1992). In line with the research of Burt (1992), Zaheer and Bell (2005) found that firms perform better when they occupy a superior network position, in the form of a structural hole position (Zaheer and Bell 2005). After studying several hundred managers occupying structural hole positions in large companies, Burt (2004) finds that being in a structural holes position gives a vision advantage. Being in a brokerage position was also found to be associated with good ideas, as the “broker” was able to discuss the ideas with colleagues and superiors (Burt 2004).

Relational dimension

The relational dimension considers subjects such as, “Who is interacting with whom, how frequently, duration, intensity, strength of ties” (Groen et al. 2002). The ties between actors in a network differ in the strength of those ties. The strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie. Granovetter (1973) concludes that not only are direct, strong external ties important for the SME, but also weak external ties as these weak ties are the channels through which ideas, influences, or information socially distant from ego may reach him. Companies should aim to achieve a balance between strong and weak ties (Duysters et al. 1999). Weak ties are more likely to link members of different small groups than are strong ones, which tend to be concentrated within particular groups (Granovetter 1973). Therefore we assume that for radical innovation projects more weak ties in contrast to strong ties are important, because we expect that for radical innovation input and knowledge from a multitude of groups is needed to generate ideas that are fully different from current practices. In contrast we expect that for both incremental and platform innovation projects more strong, then weak ties can be found, because it only considers minor adjustments that ask for fast (straight forward) product development, without distraction of other tasks.

Duysters et al (1999) examined the reasons for failure of collaboration. It was found that once a partner is able to absorb the other partner’s skills or knowledge, the coalition is likely to fail. A win-win situation is of vital importance for the success of collaboration. It was concluded that effective technology partnering selection should involve an evaluation of the potential partner on the basis of that partner’s competitive and technological position and access to business networks but also on its track record of successful partnerships and the transferability of desired resources (licenses, patents etc.) (Duysters et al. 1999). Emden et al (2006) developed a framework for effective partner selection on the basis of its competitive and technological position. Three different phases in the partner selection process can be distinguished: technological alignment, strategic alignment, and relational alignment (Emden et al. 2006). Mohr and Spekman (1994) also research important partner and partnership characteristics for successful external collaboration. They find that trust, commitment, communication quality, joint planning, and joint

problem resolution all serve to better align partners' expectations, goals, and objectives. A company's internal strengths should be leveraged with a partner's core competencies. This contributes to collaboration success (Mohr and Spekman 1994). So in order to gain most from the external network and achieve high innovation performance, it is assumed that (regardless of innovation type) SMEs select their partners in a mutually effective way. The above described literature on the external SME characteristics in relation to the innovation performance leads to the first hypothesis.

Hypothesis 1:
For SMEs that focus on incremental innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly strong ties, (4) the use of technical and legal resource exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

Hypothesis 2:
For SMEs that focus on platform innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly strong ties, (4) the use of technical and planning resource exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

Hypothesis 3:
For SMEs that focus on radical innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly weak ties, (4) the use of technical, knowledge, and socio-economic resource exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

Table 1 gives an overview of the hypotheses.

	Hypothesis 1 (incremental innovation in networks)	Hypothesis 2 (platform innovation in networks)	Hypothesis 3 (radical innovation in networks)
Stakeholder position	"Definitive"	"Definitive"	"Definitive"
Structural holes position	present	present	present
Strength of ties	Mostly strong	Mostly strong	Mostly weak
Resource exchange bonds	Technical, legal	Technical, planning	Technical, knowledge, socio-economic
Effective partner selection	present	present	Present

Table 1 Hypotheses overview

4. METHODOLOGY

This section describes the methodology that will be used to conduct the research. After a description of the sample, the method of data gathering and the operationalization of the variables will be described.

Research model

To answer the main research question and test the hypotheses the research model below will be used.

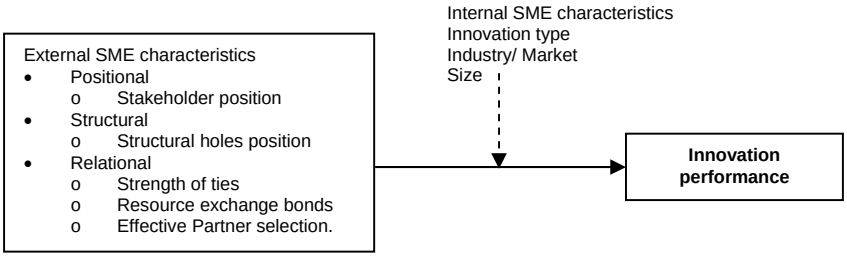

Figure 4 Research Model

The research model (see figure 4) shows both the dependent and independent variables of the research question, as well as the control variable. The external characteristics of (the central) SME in horizontally interacting with other SMEs determine whether the innovation performance of the central SME is high, due to a successful shift from development to commercialization.

We control for possible additional effects on the external SME characteristics - innovation performance relation by controlling for

a) Internal SME characteristics
b) Innovation type: derivative, platform, breakthrough. All three innovation types require a different organization of new product development (Wheelwright and Clark 1992).
c) Sector: In this research all companies are active in the same sector, which evaporates the industry influence on the relationships between the variables in the research model

Sample and data

The data that will be used to test the hypotheses of this research will be gathered in the medical devices sector. More specific in companies that produce high-tech and complex (Class II and Class III) medical devices. The medical devices sector is the focus of this research for a number of reasons. First, differences in innovation performance of the companies depend on management issues, and not on environmental or product concept issues. The environment of companies in the medical devices sector is characterized by very strict regulations. Both the quality and safety of products are very important and guaranteed by very strict regulations. These regulations are the cause of the time and cost consuming product development process (Atun et al. 2002). Second, innovative capability is in this sector of vital importance. The sector is characterized by short product life cycles, long development times, huge investments, and highly innovative products in which various technologies are brought together. The ability to develop and commercialize new products fast gives the company her right for existence (Atun et al. 2002). Third, cooperation with external partners for new product development means becomes increasingly important due to the complexity of the products and the fragmentation of the market. In the sector there are numerous SMEs that need and cooperate with external partners to share resources for the development of new products.

Hence, the sample of companies will be selected in this sector. Companies will be selected by first using the database of the Dutch Trade Office (Kamer van Koophandel) to indicate which companies are active in the medical devices sector. In addition, companies will be selected by

using patent databases to see which of these companies have NPD activity, and collaborate with external partners for new product development.

Data gathering
This research is a quantitative survey research. The survey will include questions on external SME characteristics and innovation performance. The reliability of the survey will be tested in a pilot study for which SMEs that are present in the already existing, and accessible company database of the international Patterns in New Product Development database will be used. After the pilot study the survey will be adapted when necessary and sent to the NPD managers of SMEs in the medical devices sector, that are selected as described in the previous paragraph.

Operationalization
The dependent variable "innovation performance" and the independent variable "external SME characteristics" are operationalized as follows.
Innovation performance is measured using the "percent sales" performance measurement of Cooper and Kleinschmidt (1995). They find that out of ten performance measurements this measurement most clearly indicates whether a company is successful in new product development at the firm level or not (Cooper and Kleinschmidt 1995).
External SME characteristics will be measured using the three dimensions of social capital from the social network perspective. For the *positional dimension* the stakeholder positions of Mitchell (1997) are used. In addition the six types of resource exchange (bonds) will be measured. These are technical, knowledge-based, temporal, social, economic, and legal (Håkansson and Laage-Hellman 1984). The structural holes theory is used to measure the *structural dimension*. Respondents will be asked to indicate on a 7-point Likert scale if they can access novel information from remote parts of their network, if they depend on network partners for access to information outside their network, and if partners depend on them for information from other parts of the network (Burt 2001; Burt 1992). The *relational dimension* will be measured through the strength of the ties. The higher the contact frequency, the stronger the tie. The measurements for contact frequencies of Granovetter (1973) will be used. Another measure in the relational dimension is the partner selection procedure. To measure this variable, the framework for effective partner selection of Emden et al (2006) and Mohr and Spekman (1994) will be used.

5. RESEARCH RELEVANCE

With the results of this research, SMEs that are operating in the medical devices sector gain more knowledge about the external characteristics they should possess to successfully shift from the exploration phase to the exploitation phase, and achieve high innovation performance. This research has scientific relevance as it not only elaborates on the individual SME characteristics that influence the exploration/ exploitation shift as past research did, but it identifies combinations of external firm characteristics that improve this shift from the exploration to the exploitation phase. Furthermore, the perspective of the research is the SME, whereas most research on external networks uses the perspective of the network as a whole. Finally the research will be conducted in the medical devices sector. This sector is highly undervalued in present research, as the focus is mostly on biotechnology or pharmaceuticals, even though the medical devices sector is a very dynamic and fast emerging sector. In addition, it influences the health care system as much as the other two sectors do. As the sector is both highly regulated and

fragmented the research findings might also be applied in other sectors with similar characteristics.

6. CONCLUSIONS

This article builds on the argument that as SMEs need to focus on core competences for efficiency matters, they need to cooperate with external partners to compensate for other competences and resources. This is especially the case in the field of new product development, where SMEs face specific resource problems. Although cooperation is increasingly important the question remains how to organize these external networks.

The goal of this paper was to present a research framework for the exploration and analysis of the organization of NPD in networks from the point of view of the SME, in order to successfully shift from exploration to exploitation. This paper explicitly dealt with the question "with which testable research question and hypotheses can the interaction between actors – that lead to high innovation performance – be explored?" As (1) the interaction between actors is the main subject and as (2) this interaction between actors is what adds value in terms of innovation performance, and (3) is the basic assumption of the social systems perspective, the research framework is based upon the social systems perspective. Then, from this perspective the central research question is

"How to organize the interaction between actors (organizations), in order to successfully shift from the exploration stage (development) to the exploitation stage (commercialization), to achieve high innovation performance?"

As the research is based in the social systems perspective the theoretical framework consists of several theories that are derived from this perspective. The results of the theoretical framework were the following hypotheses.

Hypothesis 1
For SMEs that focus on incremental innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly strong ties, (4) the use of technical and legal resource exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

Hypothesis 2
For SMEs that focus on platform innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly strong ties, (4) the use of technical and planning resource exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

Hypothesis 3
For SMEs that focus on radical innovation projects, the innovation performance will be higher when they combine (1) a "definitive" stakeholder and (2) structural holes position, with (3) the possession of mostly weak ties, (4) the use of technical, knowledge, and socio-economic resource

exchange bonds, and (5) the use of effective partner selection based on technological, strategic, and relational alignment.

These hypotheses will be tested in the medical devices sector, because (1) differences in innovation performance of the companies depend on management issues, and not on environmental or product concept issues, (2) innovative capability is in this sector of vital importance, and (3) cooperation with external partners for new product development means becomes increasingly important due to the complexity of the products and the fragmentation of the market (Atun et al. 2002). The quantitative data gathering will be done by using a survey questionnaire. The results of the data analysis and hypotheses testing contribute to both theory and practice. From a scientific point of view the research not only elaborates on the individual external SME characteristics that influence the exploration/ exploitation shift as past research did, but it identifies combinations of external firm characteristics that improve this shift from the exploration to the exploitation phase. Furthermore – in practice - it enables SMEs that are operating in the medical devices sector to gain more knowledge about the external characteristics they should possess to successfully shift from the exploration phase to the exploitation phase, and achieve high innovation performance.

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[1] The argument of social embeddedness is that "the behavior and institutions to be analyzed are so constrained by ongoing social relations that to construe them as independent is a grievous misunderstanding" (Granovetter 1985). The concept of social embeddedness as introduced by Granovetter (1985) avoids the extremes over undersocialized (there is no impact of social structure and social relations on human action) and oversocialized views (actors are overwhelmingly sensitive to opinions of others and hence obedient to the dictates of consensually developed systems) of human action.

[2] Definitions of power, legitimacy, and urgency from Mitchell, R.K., B.R. Agle, and D.J. Wood (1997), "Toward a theory of stakeholder identification and salience: defining the principle of who and what really counts," Academy of management review, 22 (4), 853-86.
Power: A relationship among social actors in which one social actor, A, can get another social actor, B, to do something that B would not have otherwise done
Legitimacy: A generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, definitions
Urgency: The degree to which stakeholder claims call for immediate attention

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The Use of Patents in Dutch Biopharmaceutical SME: a Typology for Assessing Strategic Patent Management Maturity.

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Abstract

In this paper a typology is presented that ideal typically describes strategic patent management practices in four developmental categories. The underlying framework integrates patent functions with strategic planning attitudes. Policy makers can apply it to survey the actual use of patents in order to identify potential for improvement in SME owned patent exploitation. Managers of these organisations can use it to evaluate the current patent management practice for making a next step towards a more active use of patents. Operationalisation of the framework into a questionnaire is grounded in a pilot study of three biotechnology firms, differing in size and age. The result has consequently been applied in a case study consisting of sixteen small-sized biopharmaceutical companies in the Netherlands. After presenting results from this sample of patent management practices, we present our findings and discuss the validity and use of the typology for abovementioned purposes.

Author Keywords: Intellectual property; strategic patent management; typology; operationalisation; pharmaceutical biotechnology, SME.

1. Introduction

Ideal typically, all activities concerning intellectual property (IP) are organised in a purposeful and coordinated manner as to serve the long term interests of the owner. Not in all high-technology, but certainly in the life sciences, patent portfolio decision-making is pivotal to corporate as well as business level management. To quote a business unit manager from a large pharmaceutical company:

"*Patents are the lifeblood of our business, a conditio-sine-qua-non for investing in new leads for product development.*" [1]

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However, success and failure in life science business development indicate that this may be a commonly shared view of the proprietary conditions to R&D, but it is certainly not standard managerial practice in small and medium-sized enterprises (SMEs). In general, the understanding of and the attitude towards the use of patents are in many SMEs blurred and are certainly falling behind that of their counterparts from large companies. Knowing that the Dutch academic biotech starter typically comes from a public environment, where there is little patent awareness,[2] that is understandable. Moreover, small companies are lacking the resources for managerial capacity to focus on such cost-producing activities. However, in commercialising proprietary technologies, they need to co-operate with and accept dependence on large companies. In such situations, strategically well-developed patent management practices contribute to a fair, equal and therefore more successful technology partnering playing field. Strategic patent management then is a critical success factor for SMEs in patent-intensive businesses. This line of argument implies that managers need to have a model of what a pro-active patent management practice looks like. Mature practices in large companies are in our view a valuable source of knowledge for SMEs in exploiting their patent portfolios. The typology presented in this paper is based on such knowledge.

In sections 2 and 3, a framework is presented and operationalised into an assessment tool for qualifying patent management practices. The framework consists of two dimensions: the first is based on Ackoff's well-known categories of strategic planning attitudes (section 2) and the second builds on knowledge of the functions that patents have in technology analysis, planning and research management activities of large companies in the pharmaceutical sector. These functions are described in section 3. In sections 4 and 5, we discuss the application of the resulting typology in the domain of pharmaceutical biotechnology SME, firstly in a pilot study of 3 firms and secondly in a case study consisting of a small-scale survey involving 16 firms. We describe outcomes from this case study, arguing for the validity of the typology to be used by SME and PRO managers as well as governmental policy makers. In the final sections 6 and 7, we summarise and present conclusions and issues for discussion as well as implications for further research.

2. Attitudes towards strategic planning and patents

In our view of building a corporate future, the science-based company's IP posture results from its cumulative technology and marketing efforts as well as from the attitudes of managers and researchers towards IP in general. Longitudinal consistency is critical for appropriation effectiveness and needs to be taken into account when planning and organising for a patent portfolio that is to secure future market positions that meet the company's scope and technological abilities, as built up in the past.[3] Whether the scientific founder(s), managers and researchers are sufficiently aware of the ins and outs of patents will hardly depend on their experience in operational patent activities, such as searching patent databases, writing and filing patents, or even defending them with the help of patent attorneys. More relevant from a strategic perspective are a profound vision of and knowledge about business, future applications of existing technologies, relevant market developments and connections to international technology and business networks. Such managerial competencies are preconditions to planning that make the difference between creating and successfully exploiting patent positions.[4,5,6]

As a consequence of this perspective, organising for planning preconditions is as crucial as managerial attention for patent filing processes in order to be effective in appropriating the knowledge. And it is not an activity that prescribes the strategy of a company and its products; it essentially develops managerial capabilities following from it.[7] It is especially essential in dealing with the dynamics in technological as well as market developments. Originating from 'the design thinking era', in which corporate planning developed as a general management discipline, it combines the internal state (the organisation) with the external state (the environment) of the firm into a temporal framework for action. What scholars and managers have learned from the rise and fall of planning is that it needs to be valued as a learning process, more than for its prescriptive output, i.e. the plan itself. For that very reason the phenomenon of corporate planning seems to be in reviving. Despite such scholarly reflection, the actual use of planning as well as patenting brings about quite some controversy if not opposition.[8] Though planning inhibitions may be legitimate to managers from the science world, in business there are no grounds for planning inactiveness, even when the business is research.[9] Therefore, corporate strategic planning purposes and a corresponding attitude are considered an indispensable tool

for survival in a business environment, especially for newly entering SMEs in patent-intensive business.

Based on Ackoff,[10] we distinguish four prototypical planning attitudes for patent management, representing an increasing level of activeness:

1. Inactive

Management does not take any initiative in identifying the relevant innovation environment by gathering information about scientific and technological developments in it. There is interaction with third parties, on a (co)incidental basis if that is perceived to be helpful in commercialising proprietary inventions. Young companies with this planning mode aim for in-house development, whereas older ones are also focussing on third party involvement. There is no systematic use of external proprietary information in developing the company's technology and business. No IPR policies have been erected in the sense that the internal organisation of the company is equipped with incentives and guidelines for the appropriation, protection, and dissemination of research results.

2. Reactive

Management is pre-occupied with maintaining the 'steady state' and, in doing so, adapts its activities if necessary for the survival of the company as it is, most preferably by neutralising its effects. Patent positions are built solely on the basis of in-house technological capabilities and exploitation of them is dependent on competitors' patenting and in-licensing activities. Technology is considered the primary source of change and circumvention the strategy for bypassing rivalling proprietary positions. The emphasis in IPR policies will be on the protection of patents, much more than on the dissemination of patent information. Cross-licensing deals result from third party initiatives that initially will be regarded as threats, more than as opportunities.

3. Active

Management does not only react to, but is also involved in scanning the relevant innovation environment for the necessary information about external in(ter)ventions and opportunities that can be related to exploitation of the existing portfolio. Technology and the market are equally believed to be sources of changes to be

adapted into the in- and external organisation of the company. Proprietary information is used to identify potential partners in exploiting the company's existing as well as co-operating in related technology areas. The company's patents are actively enforced, but based on the perception of technological rivals as providing opportunities, compensating for weaknesses. So, licensing activity means not only focussing on out-, but also cross- and in-licensing opportunities.

4. Proactive

Management is not only actively engaged in matching the external with the internal state, but also in developing options arising from existing and future knowledge in the networks the company is involved in. Management has an internally as well as externally communicated vision of where the company is technologically heading for. This means that intellectual property is very much a collective responsibility in the company and not only management, but also researchers are involved in decision-making. Science, technology and (potential) buyers' needs are believed to be the principal sources of change. Not only the inherent functions of patents are used to the full, but also attributed functions concerning patents as a portfolio component, performance indicator, and as an asset in the company's financial policies.

The latter two planning attitudes, i.e. active and proactive, are basic to what Chesbrough[11] calls the logic of Open Innovation, a mode of innovation involving alignment of internal as well as external innovation activities as to strengthen a firm's innovation capacity. In contrast, an inactive and particularly a reactive planning attitude towards patent strategy show very similar characteristics with the logic of Closed Innovation. This view largely concentrates on the control of internal resources, exploits internally established proprietary results from research, and regards the external environment as hostile.

3. Patent functions from a managerial perspective

Our starting point is the view of patents as "intermediate products of innovation representing a sanctioned behavioural relation among men that arises from the existence of goods and pertains to their use".[12]

In regarding what patents effect in the behavioural relations within and between companies, we adopt a managerial perspective. The use of patents for early stage bio-business development is often connected to typical corporate concerns of finance and marketing, as much as to the proprietary technology base. Securing finance for working capital, technological positioning, building exclusiveness for competitive advantage as well as reputation for partnering purposes are all served by patents in corporate strategy. So, these are typically functions that management attributes to patents for corporate purposes as a basis for planning activities in order to materialise them. The attributed functions are to be considered as interpretations of the purposes patents have in establishing and maintaining relations in business, other than the inherent functions as they are intended by the designers of patent systems (the legal environment to managers).[13] Both function categories are related to the managerial purposes of patents in the figure below.

<INSERT TABLE 1 HERE>

This logical construct follows from the pilot study in which we learned that the eight functions were perceived as being of a different order. The utility purposes as defined in the table are central to the managerial perspective of building a corporate future, i.e. planning, to which patents are only instrumental. Since we focus on the role of patents in planning for a corporate future, we consider the inherent functions as mainly relevant to proprietary knowledge creation and the attributed functions as mainly relevant to its exploitation. We operationalise them as following:

1. Incentive

This function represents the patent as an input motivator to R&D efforts. The quote in the first section illustrates the importance of this function to R&D investment decision-making. When patents are an imperative in the business, also small research-based companies can on the basis of these assets take part in the large scale drug commercialisation programmes controlled by ‘big pharma’. By introducing incentive schemes, management can raise awareness of the importance of patents as a basis for business and stimulate researchers to make their knowledge proprietary as soon as they can. Such awareness can also be materialised by a more structural reward system which would be based not only on the patent when it is granted, but also when it is

exploited relating, for instance, an incentive to corporate royalty incomes. Entrepreneurial researchers as inventors to patents that are not considered strategic to the company could also be more or less stimulated to start-up their own business, whether or not maintaining a financial relation with the former employer, particularly in the public domain (i.e. PROs).

2. Appropriation

This function represents the patent as a mechanism providing functional exclusiveness to an invention. The purpose is to retain returns from commercialising the idea. There may be no legal barriers involved, since an alternative to patenting is secrecy, which is hardly maintainable concerning product inventions. Process inventions however can more easily be maintained secret. Making in-house knowledge proprietary helps positioning the company technologically, which is crucial for the exploitation of biotechnological inventions. In the pharmaceutical industry, misappropriation of product inventions can be a reason to terminate a drug development project. So, patent management practices will vary in their level of appropriation activeness as expressed in the following questions:

- Are there guidelines for secrecy, authorisation for publication, etc.?
- Who takes the initiative for patent filing procedures?
- To what extent is it a subject in:
    - Regular meetings within the company
    - Labour or outsourcing contracts, and
    - Research proposals?

3. Protection

This function represents the patent as the legal ability to exclude others from gaining returns on investments the proprietor made to create the invention. This is the most commonly known, but not necessarily the most important function of patents. That depends on the efforts made by management to enforce them. Excluding others implies identifying actors by scanning proprietary information outside as well as inside the company. Externally focused technology intelligence is to serve patent enforcement and, eventually, litigation purposes. Internally focused intelligence is in a much earlier stage to prevent or screen for potentially appropriable knowledge to be

presented in other forms of publication than as a patent, such as scientific papers and in oral conference presentations. This internal function serves to prevent losing the option of protecting appropriable knowledge as a result of which commercialisation is in many cases blocked (misappropriation). In operationalising this function we are interested in the activities companies engage in focusing on 'proprietary friction':

- Prevention (detecting and informing about potential infringement);
- Negotiation (investigating and settling disputes outside court); and
- Litigation (initiating and pursuing legal proceedings in a court of law).

4. Dissemination

This is about the patent as a source of information open to rivalling companies (as a consequence of being a publication), often inducing 'circumvention', but also to be shared between researchers within the company as a source of inspiration for or even as an inducement to terminate research. Management therefore need to find out to what extent information on patents of rivals is used (external patent information). To what extent information on its own patents is used, can not be assessed by the subject company other than by newer, rivalling patents. Operationalisation of this function therefore focuses on the following two questions:

- How is the internal dissemination of patent information organised?
- To what extent is the use and interpretation of patent information subject to regular meetings?

As attributed functions we distinguish:

5. Liability

The financial meaning of patent liability is that of securing a loan, for instance when working capital is needed for the company's future operations. We learned from the pilot study that, at least in The Netherlands, this is not regarded an option. Dutch tax policy prohibits sale & lease-back constructions with patents as securities ever since the so-called 'technolease' deal between Philips and the Rabobank was disapproved of.[14] Market valuation problems and claw back clauses that would prevent patents to be sold to third parties in case of insolvency would be the reasons.[15]

The patent as a corporate risk increasingly needs to be included in a strategic patent management conceptualisation. Large companies are required to incorporate patent risk management into their administrative organisation as a consequence of the Sarbanes-Oxley act, the new regime for Corporate Governance. But, the financial meaning of this patent function will not be part of SME patent practices.

However, the legal meaning of patent liability concerns the prevention of patent infringement and can result in either precluding the infringing company from using the specified technology or causing it to pay a toll for that use.[16] Since we are interested in both creating and exploiting patents, this managerial activity would have to be organised for and is to generate freedom-to-operate not to risk infringing rivals. In that sense it is the other side of the same coin of protection, but relating to third party ownership and, thus, a relevant illustration of our starting point of the patent as a sanctioned behavioural relation between rivalling technology producers.

6. Portfolio component

The patent considered as part of a set of more or less related proprietary technologies that serve the corporate future. The two defining characteristics of patents as intermediate products that imply relations between owners make them strategic not only in their external role, but also in their internal role. In that sense they represent inventions that should be related through their future translation into products that the organisation intends and is able to market. Portfolio management is in that view aiming at building coherence between the creation and exploitation and/or commercialisation of proprietary technologies; turning technology into business as effectively and efficiently as possible. In market terms this longitudinal relation is often expressed in the patent and market positions of the company.

Apart from such strategic coherence, decision-making about the patent portfolio will result in either one of these options for a particular patent: selling or out-licensing it or keeping it with the intention of further investing in the commercialisation of the technology under own or shared risk. In the exploitation of patents by smaller biotechnology companies, selling the patent is usually not an option, since young companies are first of all interested in building their portfolio rather than rationalising it. Selling a patent usually is an option to bio-pharmaceutical companies when there is a proper scale achieved in the portfolio and when there is sufficient longitudinal experience with the in-house capabilities to create patent positions. Moreover, in the

human health area, small companies often lack the resources to enter into lengthy and expensive developmental trajectories and therefore need to enter into co-operative modes of prolonged development and commercialisation of new product technologies.

However, in building an unsurpassable proprietary position, coherence in technology and business makes patents as portfolio components a pivotal part in strategising.

7. Asset

The patent as a financially valued means of producing gains to the owner. Though patents are bought and sold, the institutional conditions of valuation and accounting of immaterial assets are more problematic than to their material counterparts. There are three accounting bases for patents: their costs, potential revenues and as so-called real options. The main problems concern cost allocation and revenue recognition. Despite the shift in attention of business, policy makers and scholars, from material to immaterial production and monetisation in economics, there is no consensus between accounting standards organisations as how to formalise such immaterial assets as patents. As a result, companies that report on their proprietary technology yearly vary in the degree to which they activate patents. Some depreciate annual spending within the year in which they are incurred as costs; others do so over a maximum of three years. The statutory accounting principles applied vary as well (e.g. historic). And, if not activated, patents can be valued for other purposes. But, not all companies deal with their patents from a financial perspective. Therefore, in the questionnaire this function has been operationalised as a measure for the awareness of this financial perspective.

8. Performance indicator

The patent considered as an informational medium to represent the company's research performance and technology marketing potential. Analogously to publications in the public domain of science, patents are the predominant indicator for technological achievements in the private domain of science-based business. This brings important advantages to, in particular young, biotechnology firms as it can help them in building a trustworthy image towards potential investors, research partners and clients. Our operationalisation focuses on the two related questions:

- Are patents used to assess one's own and other companies' technological achievements? And
- To what extent are patents used in communication and strategic decision-making (for instance, in partnering)?

At the time when patent systems were erected through laws and treaties, patents were not granted to (large) companies to the extent that they are now. In the last two decades, patents are increasingly understood in the corporate context of management. Moreover, the changing innovation regime adds another dimension to increasing business interaction: patents as a subject to market transactions.[17,18] Despite the 'knowledge economy discourse', valuation practices have not yet been adapted in accountancy standards in the sense that such immaterial assets have become equivalent to material assets. At the moment that intellectual property would be valued not only for consolidation but also for transaction purposes, at least one pre-condition for the marketing of intellectual property rights would be met (intellectual capitalism[19]). As long as such institutional reform is lacking, the patent functions of 'asset' and 'liability' are more or less hypothetical in their interpretation for the managerial purposes as described above. Nevertheless, we believe that for analytical purposes this distinction should be made to enhance thinking about IP management and policy more in general.

4. The typology in a pilot study

For the purpose of improving the operationalisation of the conceptual framework, we performed a pilot study consisting of three interviews with four people, representing three Dutch firms active in the domain of pharmaceutical biotechnology. These are described in table 2.

<INSERT TABLE 2 HERE>

The first aim was to improve the scales we had defined up to then for use in a written questionnaire, in such a way that it would meet the 'discourse' in which managers think and communicate about patents. Because the planning dimension of the

typology is sensitive to socially desirable answering, we avoided using these categories in formulating the item scales of the questionnaire.

One of the main lessons we learned from the pilot was that the Liability function was not recognised by respondents for reasons explained in the previous section. We dropped this function from the questionnaire we used for our Dutch bio-pharma case, but decided to maintain this function in the typology framework since countries already differ in their tax regimes for valuation which may also change in the long term to meet demands of IPR markets in a knowledge economy.

Comments from respondents led to a fair number of essential reformulations of answer categories in the questionnaire. For the majority of items in the questionnaire, we used an almost one-to-one translation of the scales formulated in the typology framework. The items that we have addressed for each of the patent functions in our framework can be found in table 4. A full representation of both the framework and questionnaire (in Dutch) is available upon request.

5. The typology in a case study

For a 'proof of concept' of the typology the questionnaire was sent out among Dutch biopharmaceutical SME. A large part of Dutch Biotechnology consists of firms in the area of human health, including therapeutics/pharmaceuticals, diagnostics and preventive solutions.[20] By the end of 2003 there were 138 so-called dedicated biotechnology firms[II] in the Netherlands, of which 44% were active in human health biotechnology. About one-fifth of all dedicated biotechnology firms in the Netherlands consider therapeutics/pharmaceuticals as their primary or secondary target market.[21]

In order to reduce sectoral differences the sample was restricted to dedicated biotechnology firms involved in therapeutics/pharmaceuticals. Furthermore, we focussed on dedicated biotechnology firms that are R&D-driven and aiming at translating their R&D outcomes into proprietary therapeutical applications. Particularly such firms rely on the creation and exploitation of patents as their core business.[22] So, firms with contract research as their main activity were excluded.

[II] Dedicated implies that these firms are concentrating all their efforts on biotechnology research and commercialisation. Dedicated biotechnology firms are often relatively small- to medium-sized firms that have started to pursue the exploitation of a piece of proprietary biotechnology.

Finally, not only firms that already had patents granted or filed were included, but also firms without patents, but in the process of creating patent positions. We consider their perceptions and opinions of interest to this study as well. All together, a selection was made of 40 dedicated biotechnology firms in the field of therapeutics and/or pharmaceuticals. This set represents 29% of the total population of dedicated biotechnology firms in the Netherlands.

The questionnaire consists of twenty-three multiple choice items, complemented with eight questions concerning the year of foundation, firm size, the number of employees involved in R&D, the number of staff involved in IP management, the size of the patent portfolio, and general data about the firm and the respondent. Prior to sending the questionnaire, the firms were contacted by phone in order to identify the most appropriate staff members as respondent. The questionnaire was sent to the firms in June 2004. After three weeks a reminder was sent, followed by contact over the phone. In August 2004, a total response was gathered of twenty questionnaires of which four had to be excluded, because these were either part of a holding structure in which all IPR matters were dealt with at the corporate level abroad or firms that appeared to be too service-oriented, not involving patents in their activities at all. The included firms are relatively young, as the majority of them were created after 1996. Furthermore, the firms are relatively small in terms of total employment – only 3 firms have more than 10 employees – and thus also in terms of R&D efforts. Only two firms have no patents granted or filed yet; the others have patent portfolios consisting of at least one patent family. Most firms have appointed 1 or 2 staff members responsible for IPR matters; three firms have no formal IPR staff at all. Table 3 presents an anonymous description of the response to the mailing.

<INSERT TABLE 3 HERE>

Table 4 presents the item results per patent function differentiated to planning type.

<INSERT TABLE 4 HERE>

Incentive to innovate

The majority of firms in our sample show an inactive attitude towards the patent as an incentive, as they have not implemented any kind of reward mechanism for patenting

by their personnel. Furthermore, most stated that they are averse to spinning out research results with commercial potential, but not regarded as part of their core competency.

Appropriation of an invention

The overall picture of this function is fuzzy, as the respondents show considerable differences concerning the process.

First, the initiative to patent research results is in most cases a combined effort of managers, researchers and an (external) patent agent. This implies a predominantly active attitude, as the initiative to patent is not assigned to a single functionary which could increase the chance of non- or misappropriation.

Second, patenting is within six firms not a standard subject on the agenda of internal meetings, indicating inactiveness. Six others claimed a pro-active attitude, as patenting is a standard issue in their internal meetings in which all relevant actors are involved.

Third, a small majority reported not to have patentability included as a standard item of research proposals. But, six firms have made it mandatory and three of them also include exploitation or commercialisation prospects to be explicated in proposals.

Fourth, almost all have arranged the rights of ownership and exploitation of IP by means of contracts, mostly through standard formats and in consultation with the most relevant stakeholders and experts (active). However, only two indicated to also oversee compliance of their contract partners (pro-active). Three reported to have no contractual arrangements at all for ownership and exploitation (inactive).

Fifth, nine stated that they arranged secrecy issues by means of labour contracts or non-disclosure rules for both internal and external researchers, such as Ph.D. students employed by a university. They also reported that these arrangements and rules are well-known among employees and that they are supervised (pro-active). Six are used to arrange secrecy and non-disclosure with employees, indicating that no arrangements are made when hiring external researchers. One explicitly mentioned that no formal arrangements are made, nor that anyone had been appointed responsible for contractual affairs.

Finally, also relating to secrecy is the issue of publishing research results at conferences or in scientific journals. One firm reported having no arrangements at all, nor staff appointed to supervise publishing. Six reported relying on informal

agreements, having no staff responsible for supervision of publishing. But these also stated that such would be implemented if necessary (reactive). The majority has arranged publishing procedures and staff explicitly appointed the responsibility for supervising compliance. Most also reported that the procedures concerning secrecy are actually known and complied with by the firms' researchers (active).

Protection of intellectual property

To understand the following, it needs to be stated that all respondents but one reported never having been confronted with infringement, neither actively (another firm's rights) or passively (the rights of respondent's firm).

Ten of the sixteen firms reported not to have the responsibility for identifying infringement appointed to any internal staff or external agents. This means that the majority of firms is inactive and highly vulnerable. Given limited human resources, SMEs should consider outsourcing the identification of infringement to specialised agents. However, no respondent reported having done so.

Six stated not to do anything when infringement occurs or is likely to occur (inactive). Two others would react if a third party officially warns for infringement. Another six reported that they would provide as well as react to (early) warnings of infringement. Only one indicated to offer a license in such a situation.

Finally, firms' attitudes towards prosecution vary considerably. Three stated that they would never prosecute in case of infringement, thus staying inactive at all time! Four would only prosecute as soon as the firm experiences economic consequences resulting from an infringement. Two indicated to prosecute in any case, and six stated to prosecute only when no other solutions are left.

Dissemination of patent information

The majority show pro-activeness concerning the use of patent information, as they claim to use patent information for:

- Assessing the patentability of their own research,
- Generating new ideas and input for their research, and ultimately
- Gaining insight into their competitors' research strategies.

Two firms indicated not to use patent information at all. Five indicated not to have any source of patent information, such as freely accessible patent databases. Another

five reported to have access to patent information which is used mainly incidental and is not stimulated nor supported by the organisation. This is surprising as most firms claimed to use patent information pro-actively; how can you do so without having systematic access to patent information? Only six firms disseminate patent information on a more structural basis.

Patents as assets

Seven firms reported not to value their patents at all. Five indicated to value patents only on the basis of historical cost price or procurement price, and only for external purposes (e.g. a firm's annual report). Two claimed to use valuation principles for internal and external purposes. These firms value their patents for external purposes on the basis of cost price, but also on the basis of the expected returns or market potential for internal purposes.

The patent portfolio

Six firms indicated to start application procedures as soon as patenting seems feasible, however without evaluating it in relation to the existing portfolio. The majority reported to evaluate all potential patents on their technological and commercial merits in relation to the portfolio. However, no respondent reported to perform such evaluation ex-ante, i.e. before an invention occurs, for example by including patent paragraphs in new research proposals. This indicates a low level of technology analysis for patent decision-making.

Most of the firms stated to evaluate their patent portfolios on financial potential and perceived strategic value (pro-active). Furthermore, three evaluate their portfolio mainly on the basis of costs, while another three perform portfolio evaluations on the basis of financial value. Only one indicated not to perform any kind of portfolio evaluation at all.

The attitude towards licensing is operationalised by the number of licensing agreements (both in- and out-), in combination with the type of actor taking the initiative. None of the firms in the sample can be characterised as inactive with regard to licensing. However, two show very small numbers of licensing agreements and in these cases respondent firms were approached (reactive). Another eight were involved in multiple licenses where the initiative was taken by partners, but also by the firms' management, implying a more active role of the firm in exploiting its patent portfolio.

Finally, six reported that the identification of licensing opportunities is also done by the firms' researchers, together with management and external agents.

Patents as performance indicator

The use of patent information for assessing a potential partner's patent portfolio varies strongly in our sample. Four firms indicated not to use patent information at all when identifying and/or selecting potential partners. To another four this has only a limited priority. However, six indicated to use this kind of information with a high priority and two even with the highest priority.

The majority use patents (granted and filed) as a means to communicate about the firm's technological performance. Four firms do not communicate at all about their patents (inactive). Three only do so after they have been granted the patent and only to external parties (reactive). Three others communicate about their patenting after having filed a patent as well as after the patent has been granted (active). Five firms communicate both about patent filings and patents granted to external parties as well as within their own organisation (pro-active).

6. Conclusions

What we can learn from this study is not so much how biopharmaceutical SMEs in the Netherlands manage the creation and exploitation of their patents in general. The data gathered do not allow for generalisations. So, empirical insights presented here can only be considered indicative. In our view, the value of this study is rather in the typology itself. Operationalisation of the framework underlying it provides a rare conceptualisation of the organisation of strategic patent management, leveraging knowledge of large companies' practices to use for SMEs.

The typology can be used as an instrument for surveying patent-intensive sectors for policy making purposes. For instance, it could serve more targeted campaigns to promote the use of public patent databases. The same would go for tax regime changes as to stimulate innovation in a national or regional economy.

But it could also be used by venture capitalists for participation decisions. Not knowing whether an investment in the commercialisation of a proprietary technology is liable to infringement claims poses a business risk that is unacceptable to many investors.

The pilot study confirmed the relevance of seven of the eight functions. Except for Liability, respondents in these companies acknowledged each of the functions as relevant to both the creation and exploitation of patents (see also section 3.5). The typology as a whole was reported an eye-opener to respondents in the pilot study. However, not all respondents considered each patent function relevant in the sense that they also acknowledged a need to plan and organise for it. Such differences seem to vary strongly with firm size, age and technology ('organisational contingency').[23] We believe this variation is to a large extent also a consequence of differing levels of awareness and attitude towards patents and planning. Though awareness is generally low in SMEs, developing such managerial capabilities is particularly essential for bio-pharmaceutical companies because of the immense lead times of developing and commercialising new technologies.

The case study seems to validate the choice of dimensions of the framework; patent function and planning attitude. Concerning patent functions, we believe results confirm the relatively underdeveloped use of the patent to its full extent.[24] An example relating to Dissemination is this inconsistency: the majority of the respondents claimed to use patent information as input to innovation and strategic decision-making although only few respondents also reported to stimulate the use of patent information or to provide structural and free access to patent information sources in their organisations. In the last section, we will discuss this apparently contradicting phenomenon.

Overall, it seems that the companies in the sample are not aware of the opportunities offered by patents and the necessity of installing proper mechanisms and organisational arrangements in order to meet the demanding processes of creating and exploiting patent positions. We believe that companies in sectors that are highly science and technology driven, and in which patents are a condition-sine-qua-non to business, need to be fully aware of the strategic value of patents and act upon it by organising for it! In our experience, there is much professionalism to gain in the area of strategic patent management in SMEs that can be learned from their large counterparts in patent intensive businesses.

7. Discussion

A number of issues emerge from the study we have presented here:

1. The small size of the sample. As a result, no proper statistics could have been performed to test the validity and consistency of the typology. In the methodology used measures taken have therefore been extensively explained to build validity.
2. The influence of firm size. Since findings indicate that Dutch biopharmaceutical SMEs have an incomplete awareness of the functions that patents can fulfil, it could be argued that these firms can not manage the creation and exploitation of their patents professionally. However, one could also argue that our findings are mainly related to the limited means of SMEs. Filing and maintaining patents can be very expensive, and monitoring of infringement and protection of patents may well be beyond their financial stretch. But then the question also arises why firms want to own patents if they do not invest in their future value?
3. Sectoral or national differences. Such differences are caused by factors like laws and regulations, entrepreneurial spirit, technological regimes, patent awareness, public R&D, innovation policies, etc.[25,26] Undoubtedly, these factors will determine outcomes of surveys using this typology crosswise. And even within 'the biotechnology sector' differences might appear; we concentrated on the biopharmaceutical sector as a subset. Biotechnology companies serving agricultural and food markets have different patent management practices.
4. Value for universities and other public research organisations (PROs). The typology has proven to be useful in analysing patent management practices in patent intensive SMEs. PROs are increasingly expected to exploit their inventions by having them commercialised. This brings PRO management into a very similar position. To regard patents solely as a means of appropriating technologies will then harm the potential to give societal value to public research spending, risking loss of third party commercialisation for lack of activeness in their patent management practices.[27] Like most SMEs, such organisations are not in a position to market products at their own risk and expense, but certainly are supposed to exploit the rights to their inventions by actively marketing them.[28] A typology like the one we present here could help them in this process.
5. Lack of patent awareness. The question arises whose problem it is when a lack of awareness exists about patent management within companies, and even whose responsibility it is to take action in improving such practices? Is there a role for public policies or should it be left to competition and the capital market? First of all, this is a problem of any organisation that aims to create and exploit intellectual

property, regardless if it is a private or public one. Second, we believe that a lack of patent awareness in PROs can be detrimental to inventions with good potential that would be published about before patenting, making future investments in developing the technology senseless. The risk of not having such a usually immense investment paid back is too high for any pharmaceutical company and the societal value of possible improvement in quality of life would be lost.

Acknowledgements

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TABLES

Table 1 - A managerial logic of patent functions

Inherent function	utility purpose	attributed function
Incentive	investment	liability
Appropriation	positioning	portfolio component
Protection	exclusion	asset
Dissemination	reputation	performance indicator

Table 2 - The pilot study composition

Case (firm)	Foundation year	Employees	Patents/families
AM Pharma BV	Merger in 2002 between AM Pharma BV (2000) and PharmAAware (2001)	15	-/6
Kreatech BV	1990	30	150/9
Crucell NV	Merger in 2000 between Introgene (1993) and Ubisys (1996)	200	390/80

Table 3 - General characteristics of the firms that responded

Year of foundation	1 firm before 1991	1 firm in period 1991-1995	6 firms in period 1996-2000	8 firms in period 2001-2003
Total employment	5 firms with 1 to 5 employees	8 firms with 6 to 10 employees	1 firm with 11 to 25 employees	2 firms with more than 25 employees
R&D employment	10 firms with 1 to 5 employees	3 firms with 6 to 10 employees	3 firms with 11 to 25 employees	0 firms with more than 25 employees
IPR management staff	3 firms with no IPR staff	8 firms with 1 or 2 IPR staff members	4 firms with 3 to 5 IPR staff members	1 firm with 6 or more IPR staff members
Number of patents (pending and granted)	2 firms with no patents	6 firms with 1 to 5 patents	6 firms with 6 to 15 patents	2 firms with 16 or more patents

Table 4 – Case study results (in absolute numbers)

Item IP management	**Inactive**	**Reactive**	**Active**	**Proactive**
1 Incentive				
1.1 Stimulating spin-out activities	12	2	1	1
1.2 Presence of reward mechanisms	11	1	3	1
2 Appropriation				
2.1 Mix of staff taking initiative for patenting	-	3	9	4
2.2 IP as standard subject of internal meetings	6	3	1	6
2.3 IP as subject of research proposals	4	6	3	3
2.4 IP arranged in contracts	3	1	10	2
2.5 Arrangement of secrecy	1	6	2	7
2.6 Arrangement of the publication of results	1	6	2	7
3 Protection				
3.1 Identification of infringement	10	-	5	1
3.2 Way of preventing infringement	6	2	6	1
3.3 Moment of prosecution in case of infringement	3	4	2	6
4 Dissemination				
4.1 Use of patent information	2	1	4	9
4.2 Ways of disseminating patent information	5	5	2	4
5 Asset				
5.1 Valuation of patents	7	5	-	2
6 Portfolio				
6.1 Evaluation of potential new patent in relation to existing portfolio	6	-	9	-
6.2 Evaluation of existing patent portfolio	1	3	3	9
6.3 Licensing-in and licensing-out	-	2	8	6
7 Performance/Communication				
7.1 IP as criterion for partner identification/selection	4	4	6	2
7.2 Communication on patents	4	3	3	5

A multidimensional decision-making model for internationalization of high-tech SMEs in transition economies

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Abstract

Until now, international entrepreneurship has mainly used stage theory, institutional theory, transaction cost economics and the resource-based view to explain or describe the internationalization of SMEs in transition economy context. Following recent literature we contend that these approaches are highlighting interesting elements of decision processes for internationalization, but are not yet enough managerial applicable because of the uni-dimensionality of these theories. We provide a model in four steps which enables multidimensional analyses of internationalization processes. In this the strengths and weaknesses in the strategic, economic, cultural and social network capital of the focal firm are assessed. Shortcomings in these capitals can be complemented by their partners to increase chances of successful internationalization. This article is a deductive study on three innovative Russian high-tech SMEs. The first case illustrates a clear fit with a potential partner, the second case describes a poor fit and in the third case the firm would not benefit from internationalization.

Keywords

Entrepreneurship, Internationalization, Decision-making, (Russian) high-tech SMEs,

Introduction

International entrepreneurship has been defined as the "discovery, enactment, evaluation, and exploitation of opportunities – across national borders – to create future goods and services" (Oviatt and McDougall, 2005, p. 540). High-tech SMEs increasingly internationalize. They need to improve their chances of survival in this increasingly globalized world with its accelerating rate of innovation (Karagozoglu and Lindell, 1998; Oviatt and McDougall, 1994 and Spence, 2003). SMEs have relatively fewer resources than large firms, which could hinder internationalization (De Chiara and Minguzzi, 2002; Kalantaridis, 2004 and Reuber et al., 1997). According Katila and Shane (2005) the access to resources is critical for the commercialization of technology. High-tech SMEs encounter additional challenges, as they operate in niche markets and face shortened windows of opportunity. In this context, of special concern is internationalization from transition economies to developed economies. We define transition economies as post-socialist economies in transition towards market economies. Problems derive from underdeveloped infrastructure, cultural heritage, but specifically limited experience. Internationalization from transition to developed economies is underrepresented in extant literature, as this mainly covers internationalization from developed into transition economies. (i.e. Bruton et al., 2008; Danis and Parkhe, 2002; Fey and Beamish, 2000; Hitt et al., 2000; Hitt et al., 2004 and Luo,1997). Furthermore, big strategic companies have been studied more in this context than smaller firms (i.e. Bulatov,

1998; Luo and Tung, 2007; Vahtra and Lorentz, 2004; Yamakawa et al., 2008). Several authors have stressed the need for more research on the internationalization of SMEs from transition economies into developed economies to keep up with practice (i.e. Lu and Beamish, 2006; McDougall and Oviatt, 2000; Westhead et al., 2001; Wright et al., 2005 and Yamakawa et al., 2008).We contribute to the literature by looking at internationalization as a process of decisions. Furthermore, we add to the literature a multidimensional approach instead of the more used narrower views that tend to oversimplify the complexity of internationalization. Partnerships can help high-tech SMEs to obtain critical resources. This has the added advantage that small firms can use these resources without owing them, increasing flexibility (Reuber et al., 1997). After briefly discussing the main theories, our model provides a multidimensional, four-step approach to systematically analyze relationships with (potential) partners. Three Russian cases will show how this model can lead to better decision-making in internationalization. These cases create the possibility to make recommendations for other high-tech SMEs that want to internationalize.

This article is structured as follows: First, there will be a theoretical background to explain the current state in the literature. Then, the model will be described, after which the methods used are elaborated upon. The use of the model will be clarified by three cases in the Russian high-tech SME context. Last, a cross-case analysis will be presented, followed by a discussion and conclusion.

Theoretical background

Several theories are used to describe or explain internationalization. We will discuss a general internationalization theory, the three main theories used for internationalization in the context of emerging economies, and one theory on partnering.

A theory that explicitly focuses on the process of internationalization is stage theory (Johanson and Vahlne, 1977). Stage theory argues that initial internationalization activities take place in markets with small psychic distances to the home country, and that the less committed modes of entry tend to be used. The firm learns, and both international market knowledge and experience increase. This leads to an increase in commitments to the foreign market and the targeting of more distant markets (Johanson and Vahlne, 1977). This theory received much criticism from the scholarly world. It is pointed out that the theory is inappropriate for accelerated internationalization (Kundu and Katz, 2003; Crick and Spence, 2005; Ruzzier et al., 2006; Autio et al., 2000 and Rialp et al., 2005), which follow a different path than the gradual evolvement from domestic firm to MNE. (Oviatt and McDougall, 1994 and 2005).

Other than stage theory, Hoskisson et al. (2000), Wright et al. (2005) and Bruton et al. (2008) argue that institutional theory, transaction cost economics and the resource-based view of the firm are the three primary perspectives on internationalization of economies which they call emerging. These include but are not restricted to transition economies.

Institutional theory “emphasizes the influence of the systems surrounding organizations that shape social and organizational behavior” (Scott, 1995 in Hoskisson et al., 2000) including strategic internationalization choices (Yamakawa et al., 2008). Institutions are informal constraints and formal rules that structure political, economic and social interaction (North 1991). Hitt et al. (2004) defined institutions as “shared, collective understandings or rules of conduct reflected in laws, rules, governance mechanisms, and capital markets” (Hitt et al.,

2004, p. 174). Institutional theory has proven useful in transition economy contexts where institutions have a firm hold on society. Luo and Tung (2007) argue that emerging economy firms use internationalization to overcome institutional constraints in the home country. Nevertheless, institutional theory mainly focuses on external cultural influences. Contrary to this, De Chiara and Minguzzi (2002) stated that "the main obstacle to international activity often lies within the firm itself rather than outside it (…) as it has to do with internal resources and limited capacities" (De Chiara and Minguzzi, 2002, 145). Also, it does not describe the decision-process of internationalization, which is needed to offer guidance in decision-making.

The second theory used in transition economy context is transaction cost economics. Trade-offs between costs and benefits are optimized to decide whether to cooperate or to internalize. This approach is founded on the concept of bounded rationality and the risk of opportunism. Bounded rationality makes it impossible to fully understand all consequences of making a decision, and this influences the transfer of knowledge across organizational boundaries. The concept of opportunism implies that there is a risk in transferring knowledge, as others might behave in their own interests, using collaborative contracts for other purposes than those originally intended (Shrader, 2001). Transaction cost economics is a useful approach in explaining the form of international relations, but focuses less on the decision-process or the content of a relationship. It is strategically oriented in which financial resources play an important role, paying less attention to aspects as culture and social networks. Furthermore, the theory is widely applied in developed markets with strong legal frameworks and binding social norms. McDougall and Oviatt (2000) believe that "transaction costs arguments appear to be more applicable in individualistic societies". Transaction cost economics still requires research to be performed to be directly applied to transition economies (Hoskisson, 2000).

The third theory utilized for internationalization of emerging markets is the resource-based view. This theory argues that sustained competitive advantage can be achieved through valuable, rare, inimitable and non-substitutable resources (Barney, 1991). To realize full competitive potential of these resources, the firm must be appropriately organized (Barney, 2001). In international operations, a firm should choose a structure that is consistent with the "firm's emphasis on being responsive to local markets, on exploiting international integration opportunities, or both" (Barney 2001, p.547). Valuable unique assets permit firms with constrained resources to enter foreign markets (Oviatt and McDougall, 1994). The resource-based view provides a rather static explanation of international competitive advantage, in which the process of obtaining the necessary resources is not explained. Also, the types of necessary resources are undefined. It implies that all resources are good by themselves, as long as they comply with the previously mentioned characteristics. Moreover, the resource-based view tends to be internally oriented, whereas we argue that value creation processes take place in interaction and interdependencies with others. Håkansson (1987) believes that development and innovation take place in interplay between actors, in which counterparts can add value to the firm instead of being competitors (Håkansson, 1987; Håkansson and Snehota, 1995). In line with this, Groen et al. (2002) assume that links play an important role in identification and exploitation of opportunities in innovation processes of firms.

Based on transaction cost economics and the resource-based view, Gulati developed a network perspective to the study of strategic alliances. He believes that the resource-based view does not sufficiently address the process through which firms create the resources necessary for competitive advantage, and that performance is better understood by a relational than an atomistic view (Gulati, 2000). He argues that firms form alliances when they perceive

strategic interdependence between each other. There is strategic interdependence when one firm has resources that are beneficial to, but are not possessed by the other (Gulati, 1995). Gulati states that network resources are inimitable and non-substituble resources that are created and provided access to by networks (Gulati, 2000). Prior alliances, both direct and indirect, are a valuable source of market information. Firstly, they create awareness on the existence of viable partners, including their resources. Established partners are likely to have a reasonable understanding of the needs of a firm, thus being able to recognize opportunities for them. Secondly, they serve as a basis for trust between partners to counterbalance risks associated with forming alliances (Gulati, 1995). Referrals from third-party partners reduce hazards. Thirdly, prior alliances ensure that potential partners learn about opportunities at the right time (Gulati, 1999). This is especially important for high-tech SMEs that need to have access to resources in a short window of opportunity (Katila and Mang, 2003). This theory is very useful to the literature in that it focuses on the question with whom a firm is likely to collaborate, rather than when and why. However, the resources necessary to create strategic interdependence are unspecified. Furthermore, the importance of prior alliances for the creation of future alliances cannot be applied to start-ups without alliance history.

We conclude from the description of previous approaches that they do not describe decision-making processes for internationalization and focus on only one or two dimensions. Rialp et al. (2005) argue that studies on managerial decision-making are underrepresented. Only stage theory and the study of strategic alliances describe processes, but not on a decision-making level. In addition, we saw that they are unsuitable for high-tech SMEs that participate in accelerated internationalization or for start-ups without alliance history. Furthermore, we saw that institutional theory stresses cultural influences on the firm, that transaction cost economics is strategically oriented in which financial resources play an important role, and that in the resource-based view dimensions cannot be distinguished as such, and the networking aspect is underdeveloped. Yamakawa (2008) is one of the scholars to support that one single perspective oversimplifies the complexity of internationalization of emerging economy firms and combined insights are needed. Rialp et al. (2005) agree and believe that a single theoretic framework is reductionist. To address the two concluded problems we elaborate on a multidimensional decision-making process theory.

The model

As shown before, SME internationalization for firms in transition economies is multidimensional, meaning that multiple dimensions need to be taken into consideration when making decisions. In addition, internationalization is a process if decisions rather than a single decision. This means that several steps need to be distinguished. We recognize the literature previously described, but we take a more sociological approach that builds on the work of Parsons (1964). We acknowledge, in line with Crick and Spence (2005), that decision-making is not always a rational process. Yet, several studies have described that by decomposing and systematizing the decision process, decisions can improve. Our approach is based on a multidimensional decision-making model that distinguishes four steps that need to be taken. This model is presented in figure 1. We first discuss the dimensions and then turn to the four steps.

The dimensions

The dimensions are categorized into capitals according to the function that they have for organizations (Kraaijenbrink and Groen, 2008), originally distinguished by Parsons (1964) in his social system theory. The basic assumption of this theory is sustainability of a social

system over time, based on four mechanisms. These are goal alignment, adaptation, latency and integration. (Parson, 1964). In each of these mechanisms, a certain type of capital can be used:

1. Strategic capital. This refers to the set of goals of an actor in terms of mission and strategy and its ability to attain them.
2. Economic capital. Efficient economic allocation of scarce resources leads to more efficient processes.
3. Cultural capital. To regulate exchange, it is essential to have culturally structured and shared symbols.
4. Social capital. Networks provide connection to resource providers.

(Groen, During and Weaver, 2002; Groen et al., 2008)

Strategic capital is "the set of capacities that enables actors to decide on goals and to control resources and other actors to attain them" (Groen et al., 2008, p.62) through power, influence and authority. Strategic capital can reside both in people and in artifacts. The first step in the decision-making model is taken in this dimension.

Economic capital is a "set of mobile resources that are potentially usable in exchange relationships between the actor and its environment in processes of acquisition, disposal or selling" (Groen et al., 2008). Firms should seek the efficient scale for operations, or try to become more efficient than competitors by using money. It is important to note that resources are not in themselves tied directly to a particular goal (Kraaijenbrink and Groen, 2008).

Cultural capital was defined as "the set of values, norms, beliefs, assumptions, symbols, rule sets, behaviors and artifacts that define the actor in relation to other actors and environment" (Groen et al., 2008). Knowing how to do things effectively and efficiently leads to a fixed pattern of skills, and certain behaviors, values and methods of dealing with certain situations that are supported whereas others are not in terms of the goals set by the firm (Groen, During and Weaver, 2002).

Social capital is 'the set of network relations through which actors can utilize, employ or enjoy the benefits of capital that is controlled or owned by other actors' (Groen et al., 2008). Social capital is the network, through which strategic, economic, cultural and other social capital can be obtained. The resources themselves are not included in social capital.

Each type of capital contributes to the performance of the firm and none of the four is determining. Possession of superior resources gives firms a potential of competitive advantage, whereas increased performance is dependent upon the actions in which these resources are deployed (Kraaijenbrink and Groen, 2008). When firms do not have all of the four capitals themselves, they get it elsewhere. There needs to be a fit between the capitals of the partners, and shortcomings in capital in one firm can be overcome by strengths in these types of capital by another firm. This is in line with Hitt et al., (2004), who state that firms need to partner with others who can complement skills and capabilities, and with Yamakawa et al. (2008), who argue that strategic alliances can be effective in overcoming capability deficiencies.

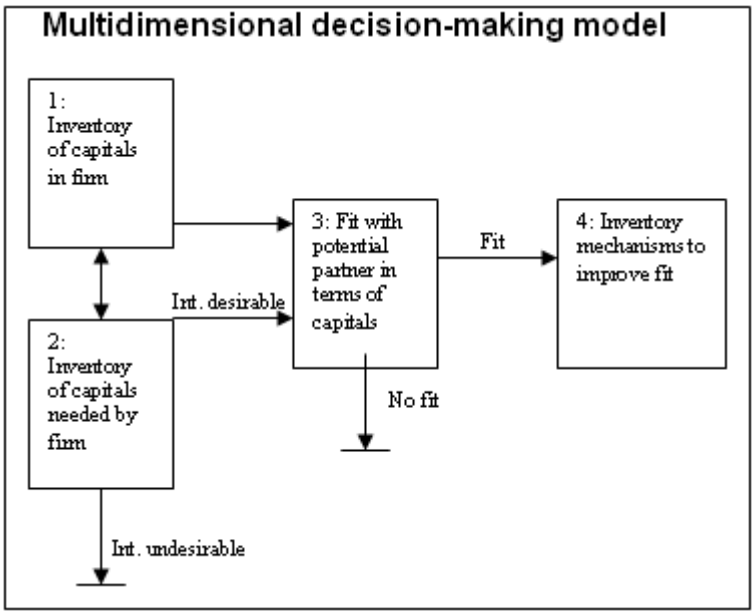

Figure 1: Multidimensional decision-making model

The steps

For internationalization with a partner, a series of decisions need to be taken. We distinguish four steps in which decisions are made in relation to the availability of the four capitals. The first step involves an inventory of business characteristics that are present in the firm in terms of strategic, economic, cultural and social capital. From this, weaknesses and strengths of the firm become apparent and the firm can identify in what areas additional assistance would be useful. Therefore, once the present business characteristics are known, an inventory can be made of strategic, economic, cultural and social capital that is needed by the firm. This is the second step. As stated before, shortcomings can be complemented by a partner. When an inventory shows that a firm does not have many needs in capitals, it might decide that internationalization with a partner is not a suitable option. When a firm does decide to internationalize, the third step evaluates the fit with a potential partner. More specifically, it assesses the extent to which strategic, economic, cultural and social capitals of the firms complement and align with each other. This is a critical step. If there are unacceptable differences, the firm should discontinue the process with this partner as it is likely to result in a dissatisfying experience for both parties. However, it is unlikely that a partnership is a perfect match in all aspects. Therefore, in the last step, an inventory needs to be made on suitable mechanisms for improving the match with a partner. Again, the strategic, economic, cultural and social capitals are used for this purpose. As firms and partnerships are dynamic, continuous evaluation of capital needs, fits and mechanisms is necessary.

Methods

Selection of firms

This paper studies a multidimensional decision process for internationalization, which justifies the use of a case-study (Yin, 1994). We selected our firms from a Moscow technology university located in a technology park 'Technopark' to show the use of the model. Our method was to choose firms that had complementary firms in a developed economy. Access to both parties was essential for the controllability and execution of testing the model. As we are associated with the University of Twente, the study took place in an experimental, artificial setting in which the developed economy was represented by the Twente region in the Netherlands. We could not depend on industrial codes for sector

compatibility because of incomplete registrations on the Russian side. Therefore, we consulted experts on entrepreneurial activity at Technopark and in the Twente region. These included the director of Technopark, the CEO of the Innovation Lab in Twente, and three project leaders and members of a selection committee of entrepreneurial support in Twente. Final selection of Twente firms occurred partly through self-selection. One of the members of the selection committee of entrepreneurial support in Twente sent an inquiry to his entire network of SMEs to ask whether or not they were interested in collaborations with any of the Russian firms. In addition, all consulted experts from the Twente side suggested firms that could be suitable for collaboration, and these were then approached individually. Of the in total 25 firms at Technopark, there were ten that operated in sectors that could also be found in the Twente region. Four of them did not see the need to internationalize with a partner and did not go beyond the second step. Five of the ten firms found a potential partner, but encountered differences between them that could not be overcome. They were not able to pass the third step. There was only one firm who found a potential partner with whom collaboration can work, and completed all four steps. To present a full spectrum of uses of the model, one firm in each of these three categories was selected to be described in this paper. These are *Radiodevice, Aqua* and *Simulator. Radiodevice* matches very well with the Dutch firm *Scentsystem*, whereas *Aqua* and the Dutch firm *Water* is a poor fit and *Simulator* is not interested in internationalization.

Measurements

Every dimension of the model is operationalized into various aspects. Firms might not be aware of certain shortcomings that they might have, making it difficult to assess what type of capital is needed from a partner. This problem is minimized by using as many indicators as possible for the operationalizations of the four dimensions, and by combining existing scales with perceptions from interviewees. The operationalizations and their indicators are summarized in Appendix A.

In strategic capital, we analyzed two interpretations of strategy; what are the goals of the firm and what is the capability of the firm to attain the desired goals. The type of strategy of the firm was defined by the typology of Miles and Snow, meaning that a firm could either be a prospector, a defender, an analyzer or a reactor (Miles and Snow, 1978). Furthermore, Slater and Narver (1996) imply that "a study comparing the strategic profiles of different orientations would be interesting and useful to their more complete understanding" (Slater and Narver, 1996, p. 170). There are five orientations: towards innovation, competitors, suppliers, alliance partners and customers. Orientation towards suppliers is not considered of relevance in this paper, which is why it is excluded. International orientation is included, as it is essential in this research to know to what extent the firms have the intentions to internationalize. Orientations towards competitors and customers are combined into marketing orientation. To objectively test qualitative data from interviews, the MKTOR scale of Narver and Slater (1990) is used. The original scale also included interfunctional coordination to measure alignment of strategy between departments. Our selection of cases forced us to exclude interfunctional coordination since all of our firms were too small to have departments. The capability to attain preset goals is analyzed by power, reputation and flexibility, as operationalized by Kerssens-van Drongelen and Groen (2008).

In economic capital, the financial position of the firm needs to be assessed. The traditional production factors are land, labor and capital (Smith, 1776). We consider all financial assets, both human and non-human, as financial resources. To see how much output is generated by these financial resources, financial performance of the firms is measured. This is done in

terms of return on investments, profits and revenues in relation to the results of the previous year and the expectations in five years time. Last, the operations of the firm are assessed by researching how most money is spent, in what areas costs could be cut according to the director, if the firm uses investments of others and what the firm's perception is on its own efficiency.

In cultural capital, skills and values are analyzed. According to Groen, Jenniskens and van der Sijde (2005), successful high-tech firms should possess technical skills and entrepreneurial skills. Entrepreneurial skills are divided into marketing, business administration and organization and financial management. The values of the firm are assessed by its entrepreneurial orientation. Qualitative data from interviews is added by the entrepreneurial orientation scale of Lumpkin and Dess (1996), based on the strategic posture scale of Covin and Slevin (1989). International orientation is included to research to what extent the firms are ready to internationalize.

In social capital, typical social network measures of ties are used. These measures can be divided into positional and relational aspects (a.o. Burt, 1982, 1992, 1997, 2005, Brass, 1995). Next to this, the degree of internationalization of the current network is taken into account, as well as the perceived importance of the current network to the firm and of the firm to the current network.

Information gathering

Information on the Russian firms was gathered through both secondary and primary research. Secondary research was done by means of desk-research. Written information provided by Technopark and the firms were extensively studied and the Internet offered valuable information on the activities of the firms. Primary research included in-depth interviews with the directors of the firms. To have close access, one of the authors worked at Technopark during a two-month period to execute the interviews. These were recorded and transcribed into detail. From this, systematic analysis was possible, as every sentence from the interviewee could be carefully tested for its applicability in one of the four capitals. Our research might suffer from single informant bias at the firm level, as it was not possible to interview additional employees. However, at a higher aggregation level it was possible to put the answers of the individual directors into perspective, as other directors were interviewed. The interviews were conducted in the Russian language to preclude language barriers. In addition to the Russian language skills of one of the authors, questions were translated from English into Russian by a native Russian academic that were checked by two other native academics. Some interviews were conducted by native Russian students of the Faculty of Innovation Management of the technical university. To limit interview bias, the interviews were structured by an extensively developed questionnaire and an interview protocol. The interviewers were trained to increase homogeneity in information gathering. Identical interviews were conducted with directors of the Dutch firms. In addition, they were also asked specific questions about their vision on collaboration with the pre-selected Russian high-tech SMEs. These interviews were held in the Dutch language.

The Russian firms

Radiodevice

Radiodevice produces small devices to measure radioactivity for daily use. No special knowledge in the field is required for operating the devices. The devices are cheaper than professional equivalents. They are used by individuals who are concerned about their health,

by ecological and metallurgical companies that cannot afford professional equipment, by banks and by schools for safety education. Radiodevice's strategy is to produce devices that measure radioactivity that are understandable for the lay person. It has not researched market needs or why current customers buy the product. Nevertheless, it is the philosophy of the firm to solve problems of customers rather than to sell goods. The strategy of Radiodevice does not contain active international aspects. The firm wants to internationalize if opportunities emerge, but considers the Russian market sufficiently big. It has one international patent that is valid in France, Germany, and Italy. Radiodevice currently has sufficient financial resources for operations. Nevertheless, it foresees lack in production space and investments if the firm wants to grow. Furthermore, it has already attempted to increase efficiency through the implementation of an automated production line and to outsource several aspects of the production process. The staff has extensive technological educational backgrounds and experience in technology. However, only the director took courses in marketing and business administration. Moreover, nobody at Radiodevice received education in the international management field. Although the firm's website is created in different languages, the firm does not have staff who speak foreign languages. Radiodevice has many irregular but long-term ties with resellers, product developers and its mother university. From its contacts, Radiodevice is able to obtain foreign language skills, marketing skills and supplies. It is looking for a long-term relationship with a foreign reseller.

Aqua

Aqua develops household filters and extra-productive systems for collective and industrial water purification. Its filters are mostly used by house-holders, in offices, kindergartens, schools, hospitals, hotels, restaurants and in the food industry. The unique selling points are its longevity and simple mode for ordinary users, prevention of bacterial breeding, high productivity rate of the filters and a really competitive price. Aqua has clear short-term and long-term goals to achieve a new quality level and to develop water purification systems with better technology and performance features compared to its competitor's models. The firm intends to internationalize. There have been previous attempts – although unsuccessful – and international production standards are met. Averagely small customers are responsible 60% of revenues and the firm has not actively tried to become well-known in the market. Moreover, the firm is flexible to sacrifice its strategy for network partners. The firm wants to grow rapidly within the next five years if new complex construction, increased manufacturing space and proper equipment can be financed. For this future growth, the firm foresees a lack of financial resources. In addition to that, Aqua generates the lowest revenues per employee with high overhead costs. The staff of Aqua have excellent technical skills, but not in marketing, financial management, international management or foreign languages. There are intentions to hire managers in marketing and finance, but not in international management or foreign languages. Aqua has stable contacts with others although the frequency of contacts is quite low. All contacts trade different resources with the firm. The firm is looking for a reseller.

Simulator

Simulator develops trainer-simulators to train personnel at nuclear power plants. It also creates tools for the development of such trainer-simulators. Its unique selling point is its effectiveness of trainer-simulators. Simulator aims to finish the development of a fully prepared trainer-simulator for digital industrial control. On the long run, it wants to consolidate its position in the Russian market. Although Simulator has collaborated with a German firm in developing trainer-simulators for nuclear power plants in Latvia and Switzerland, there are no goals in the international market. The nuclear power industry is a sensitive industry, and the firm argued that operations abroad can severely harm contacts in

Russia. Furthermore, Simulator uses its means efficiently. Nevertheless, it is difficult for the firm to have access to sufficient financial resources, as projects are done on contractual basis. A large part of Simulator staff consists of technical specialists. Finally, Simulator has long-term partnerships.

Cross-case analysis

This section provides a cross-case analysis of the three cases with respect to the multidimensional four-step decision model. The results are summarized in table 1.

Step	Radiodevice	Aqua	Simulator
1 Inventory of capitals in firm	• **Strat:**Large power base to attain goals, but goals are rather straightforward • **Ec:** Sufficient financial resources for current operations but in need of future investments • **Cult:** High technological skills. Low skills in marketing, business, international management and foreign languages • **Soc:** Stable network with irregular ties	• **Strat:** Clear goals but low power base to attain them • **Ec:** Sufficient financial resources for current operations but foresees lack in future investments. Low efficiency • **Cult:** High technological skills. Low skills in marketing, financial management, international management and foreign languages • **Soc:** Stable but weak network. Non-redundant use of ties	• **Strat:** Both specific and unspecific goals, mediocre power to attain goals • **Ec:** Few financial resources, but efficiently used • **Cult:** High technological skills, adequately skilled in financial management • **Soc:** Stable network
2 Inventory of capitals needed by firm	• **Strat:** Better strategic understanding, higher market orientation, active international strategy • **Ec:** New investments • **Cult:** Better skills in marketing, business administration, international management and foreign languages • **Soc:** Long-term reseller abroad	• **Strat:** Larger power base • **Ec:** New investments, more efficiency • **Cult:** Better skills in marketing, financial management, international management • **Soc:** Reseller abroad	• **Strat:** Foreign expansion can harm existing relations in Russia. Internationalization with help of a foreign partner is not advisable
3 Fit with potential capital	• **Strat:** Integration of devices with Scentsystem's software management platform. Clear strategic understanding, but demands solid strategy from partner. Help in formulating strategy in Dutch market • **Ec:** Potential access to investor • **Cult:** Low skills in marketing and international management. Different business skills. Language problem not solved • **Soc:** Agreement on long-term collaboration	• **Strat:** Potential partner Water has a larger power base, but goals do not closely align. Collaboration is not advisable.	
4 Inventory of mechanisms to improve fit	• **Strat:** Radiodevice should establish solid strategy • **Ec:** - • **Cult:** Both parties should improve marketing skills. Need to create patterns of doing business and should learn about each other's culture • **Soc:** Awareness of differences in pattern maintenance		

Table 1: Results cross-case analysis

Step 1: Inventory of strategic, economic, cultural and social capital present in the firm
The firms need to make an inventory of their business characteristics in the first step of the decision-making model. This needs to be done to create a better picture on what business characteristics are lacking and need to be present at the partner.

It was said that there is strategic capital when a firm is able to attain its goals. The director of Radiodevice noted that the firm has few competitors in its targeted segment, has patents to protect its intellectual property and other parties stay informed about the firm's activities. Furthermore, he stated that Radiodevice is able to persuade others to do something for the firm, but is not willing to sacrifice its goals for the benefit of others. Furthermore, the interview made clear that the firm is not dependent on a small number of customers, whereas it is responsible for a relatively large amount of revenues generated by its suppliers. From this, we conclude that there is a large power base, a good reputation and inflexibility to adapt goals for others, bringing Radiodevice in a solid position to attain its goals. The question is what goals to attain. The strategy to produce the devices is rather push-oriented. This is contradictory to the director's perception on the philosophy of the firm, which is to solve problems of customers rather than to produce goods. Furthermore, the MKTOR score of 6.1 on a scale from 1-7 indicates a high market orientation, although Radiodevice does not do market research. In addition to this, the director could not elaborate on a specified international strategy. Radiodevice has indicated that the Russian market is currently sufficiently big. Nevertheless, it has expressed a willingness to internationalize if any opportunities emerge. The firm would like to find resellers abroad to introduce the devices in foreign markets. The international patent and the website in foreign languages show the firm's international orientation. Economic capital of Radiodevice is sufficient for current operations. The director reported that there are enough financial resources to operate and financial performance is regarded as satisfactory by him. Nevertheless, he expressed his concerns about the future. More investments in property and production space are needed if the firm wants to growth. In cultural capital, there are little marketing and business administration skills. As the director pointed out, the Soviet era did not consider these skills as necessary, leading to the fact that there is a very young tradition in these skills. It is our belief that better skills in marketing and business administration would improve the firm's exploitation of opportunities that derive from its excellent technological skills. Moreover, low international management skills and lack of knowledge in foreign languages do not facilitate internationalization. Radiodevice is slightly entrepreneurial, as it scores 3.75 on a scale from 1-5. Finally, from the irregular contacts as described by the director, one could argue that the social network is weak. Nevertheless, relationships are said to be stable and the firm is able to obtain necessary resources from them.

Contrary to Radiodevice, Aqua has clear short and long-term goals in the strategic dimension, but has limited ability to attain them. The interview depicted that a high percentage of revenues is generated by few small customers and the director stated that the firm is very flexibility to adapt its goals for others. This leads us to argue that Aqua's power-base is low. The strategy of Aqua is production-oriented because market needs are not included. Nevertheless, it is rather innovative. According to the typology of Miles and Snow, Aqua is a prospector. Furthermore, the director believes that the firm prefers radical innovation over incremental innovation. Aqua also has intentions to internationalize. Similar to Radiodevice, it wants to find resellers to introduce the filters abroad. There have been previous, though unsuccessful, attempts to enter foreign markets. In addition, the director informed that the firm complies with international standards in production and production processes. So far, Aqua has not filed for international patents because of the expenses. The economic capital of

Aqua is not optimal. Through the interview it became apparent that most money is spent on production and salaries, but also on rent. The high overhead costs and low revenues per employee indicate inefficiency. Also, financial resources as forecasted now, are not enough to finance future growth according to the director. In addition to that, there is an imbalance in cultural capital. The opportunities that rise from excellent technical skills cannot maximally be exploited due to low skills in marketing and financial management. This is even more so in foreign markets due to lack in international management skills and knowledge of foreign languages. Aqua is slightly entrepreneurial, as it scores 3.35 on a scale from 1-5. In the last dimension, Aqua is said to have a weak but stable social network. This is because the frequency of contacts is low, but long-term. Aqua makes non-redundant use of its ties because different resources are traded.

Simulator has a clear short term goal, namely to finish the development of a trainer-simulator for digital industrial control. Contrary to this, the long-term goal is less specific, namely to consolidate its position in the Russian market. However, we argue that Simulator has a mediocre power base to attain these goals. The director indicated that the firm does not possess patents or certificates, and has never developed a product or service that has become standard in the industry. In this way, the negotiation position of the firm is not strengthened. On the other hand, Simulator publishes articles and participates in conferences and congresses, which increases the reputation of the firm. Also, the director believed that the firm is able to persuade others in the network to do something for them. Simulator does not have an active international strategy. Although it has previously collaborated with a German firm, the director explained that the firm prioritizes the Russian market. There are enough opportunities for trainer-simulators for nuclear power plants in the Russian market. In economic capital, the director noted that it is very difficult for the firm to attract enough financial resources, as work is done on contractual basis. However, according to the director, the few financial resources available are efficiently used. In cultural capital, we can argue that the technological skills are very high, since the entire staff constitutes of technological specialists. There is no information available on the amount of people in the firm who received training or education in marketing, financial management, business administration or international management, but the director believed Simulator to be extremely adequately skilled in financial management. Simulator has a slight entrepreneurial orientation, as it scored 3.1 on a scale from 1-5. In social capital, the director of Simulator stated that there are long-term strategic partnerships and the firm is able to obtain most of the necessary resources from its network.

This step in the model offers a systematic instrument for Radiodevice, Aqua and Simulator to highlight their strengths and weaknesses in the four types of capital. This offers a clear picture of what capitals are sufficiently developed, and what capitals are not. In this way, it is a systematic way to confront the entrepreneur with the business characteristics of the firm. The weaknesses in capitals can be translated into needs of the firm that can be fulfilled by a partner. Furthermore, as this step systematically describes the capitals, it enables the firm to identify what the capitals of the partner should look like to be compatible. This leads to step 2.

Step 2: Inventory of strategic, economic, cultural and social capital needed by the firm.
In the second step, the firm can make an inventory of needed strategic, economic, cultural and social capital in relation to the strengths and weaknesses of the capitals in the firm itself as highlighted by step 1.

The current strategy of Radiodevice is full of inconsistencies. The push-oriented strategy is contradictory to the firm's philosophy and market orientation. The firm is not aware of this, as it believes to have a solid strategy. The straightforward strategy could be more guiding if strategic understanding is enhanced. This also involves more attention for customers and competitors. In addition, an active international strategy would facilitate internationalization immensely. In economic capital, Radiodevice needs new investments for future growth, as the director foresaw lack thereof. The cultural capital can be increased through better marketing and business skills to exploit opportunities. Next to this, better international management skills and skills in foreign languages facilitate communication with foreign partners. To limit possibilities for conflict, a partner should have a compatible entrepreneurial orientation to Radiodevice. In social capital, the director indicated that Radiodevice is looking for a long-term reseller.

The strategic capital of Aqua could benefit from a partner with a larger power base, which increases the likelihood of attaining the goals of the partnership. In economic capital, Aqua is in need of new investments for future growth and its relative inefficiency of operations could be improved. Aqua has low marketing and financial management skills in its cultural capital, which do not facilitate the exploitation of opportunities derived from excellent technical skills. To facilitate interaction with foreign partners, Aqua could benefit from more international management skills. To prevent problems caused by different values and attitudes, the partner's entrepreneurial orientation should align with that of Aqua. Concerning social capital, Aqua is looking for a reseller.

In strategic capital, Simulator could benefit from a partner with a large power base, to increase its own potential to attain its goals. Nevertheless, it has indicated that partnerships with foreign firms can harm existing contacts with Russian partners because of the sensitivity in the market. In this way, foreign partnerships would not have added value to the firm, but even severely decrease Simulator's potential to attain goals. Therefore it would be better to remain in Russia, making further analysis of needs in capitals irrelevant.

The inventory of needs of Radiodevice and Aqua enables them to look for a partner who possesses business characteristics to complement these shortcomings. It is a systematic instrument on what type of partner to look for. Furthermore, this step analyzes the functionality of collaborating with a partner. Radiodevice and Aqua can clearly benefit from external parties in strategic, economic, cultural and social capital. However, internationalization with help of a partner did not prove to be a sensible decision for Simulator. In this sense, the model can also be a critical decision-making moment on whether or not to continue.

Step 3: Assessment of fit with a potential partner
Once a potential partner is found, the firms can assess the fit in terms of strategic, economic, cultural and social capital.

Scentsystem is a potential Dutch partner for Radiodevice who expressed interest in collaboration. Scentsystem protects ICT and production processes that need to remain active. Its software integrates processes and detects possible dangerous situations, after which early warning is possible. This could relate to temperature, ink supplies, spam, and so on. Another system detects changes in atmospheric composition such as humidity or bacteria. The firm wants to integrate its products with the devices of Radiodevice. In this way, changes of

radioactivity can be measured and integrated with other kinds of measurement. Both firms would be partners in product development where Scentsystem acts as an indirect reseller.

Radiodevice and Scentsystem complement each other in all four dimensions. In the strategic dimension, the activities of both firms complement each other very well. Also, Scentsystem has extensive knowledge of the Dutch market from lengthy experience, which it can transfer to Radiodevice in order to establish a strategy in this market. Furthermore, the director of Scentsystem stated that the firm consults experienced mentors for its strategy formulation and explained that the firm is very concerned with marketing its products effectively before developing new ones. The interview showed that the firm's competitive advantage is its flexibility and evolutionary development of software in accordance with market needs. From this information it could be argued that Scentsystem can guide Radiodevice towards higher market orientation. Nevertheless, it was pointed out by Scentsystem that it requires Radiodevice to have a clear vision and strategy. In the economic dimension, the director stated that Scentsystem can give access to a possible investor from its own network. In the cultural dimension, both have technological skills in their own area of expertise, so that both can profit from each other. However, neither firm is well skilled in marketing or international management. Furthermore, both firms have to be aware that their functioning in business administration differs from each other. They both obtained business skills in a different manner, which is likely to affect their behavior. Scentsystem received education in the field and has experience in doing business in a developed economy. Radiodevice did not receive any education in business, and staff needed to learn this intuitively after the Soviet Union collapsed. They have to adapt to each other's pattern maintenance. This is facilitated by a comparable entrepreneurial orientation between the two, as Scentsystem scores 3.5 compared to the 3.75 scored by Radiodevice. In the social network, both firms have pointed out contacts that the other party can benefit from. These are mostly distribution channels, investors and external partners. Both Radiodevice and Scentsystem prefer long-term collaborations.

Water is a potential Dutch partner for Aqua. Water develops systems for water purification in three fields. Firstly, the client specific systems purify ground water into drinking water, ground water into process water, or they treat waste water. Secondly, it develops standard installations and products, usually of considerable size. Thirdly, the firm offers service and maintenance on water treatment installations, whether built by Water or by its competitors. The firm believes that Aqua does not have much potential in the Dutch market because of the high quality of drinking water in the Netherlands. In this sense, it sees limited possibilities for collaboration in the BtoB segment in which Aqua's small filters could be integrated into the large installations of Water when a client or project requests such filters.

There are many differences between Water and Aqua. According to the director, the goal of Water is to be a real service organization, whereas Aqua is more production-oriented. This could cause friction in the strategic dimension. Nevertheless, Water expressed its willingness to help Aqua to define its strategy in the Dutch market, as the former perfectly understands the "do's" and "don'ts" of this market. However, it must be pointed out that Aqua cannot target its usual market segment in the Netherlands, because of the near universal access to high-quality drinking water. Furthermore, Aqua is more innovative than Water, as the latter stated that it is more concerned with its stability. In addition to this, Water has a larger power base than Aqua because of an impressive reference list and little flexibility in sacrificing its goals for others. Water would have more influence on Aqua than vice versa, enabling the former to attain its goals while severely limiting the attainment of goals for the latter. Given this misfit in strategic capital, there is little reason to believe that collaboration between Water

and Aqua would succeed. There is no purpose in continuing the decision process for internationalization.

This step in the decision-making process clearly shows the importance of alignment in capitals. The strategic capital of Aqua and Water do not align. Even if the other types of capital align very well, these mechanisms would not be directed towards attaining the same goals, limiting the potential for collaboration. For this reason, the process could better be discontinued. In this way, this step has proven to be a critical step. Radiodevice and Scentsystem, on the other hand, align in all four dimensions, even though not all to the same extent. This forms a basis to expect that collaboration between these two firms would be useful. It also provides incentives to assess the mechanisms that can be used to improve the match to become even more fruitful to both parties. This is done in the last step.

Step 4: Inventory of suitable mechanisms for improving the match with a partner
Once a match has been made, it is unlikely that both partners fit perfectly well. As there is always room for improvement, this step provides the opportunity to use mechanisms to create a maximally successful collaboration.

Scentsystem requires a solid strategy from a partner, which is why Radiodevice should be triggered to put more effort into formulating a guiding strategy. After this, both firms could negotiate the terms of their collaboration and establish clear joint goals that will facilitate the partnership. Next to this, both parties can secure access to financial resources in this partnership, as Scentsystem indicated it can introduce Radiodevice to a potential investor. This omits the need for mechanisms to improve the economic fit between the two. However, several things can be done to improve the cultural fit. First, lack in marketing skills is not compensated. Both firms could put more effort in improving these skills to overcome this gap. Second, both firms have different patterns of business administration due to the different manners in obtaining these skills. It is advisable to create patterns of business administration that are satisfactory to both. Last, this collaboration contains a low level of international management skills. To facilitate understanding between the two, Radiodevice and Scentsystem could both learn about each other's cultures. In the social network dimension, Radiodevice and Scentsystem have different manners of relationships maintenance. The interviews showed that Radiodevice has irregular contacts, whereas Scentsystem is used to more frequent contacts. It is suggested that they reach an agreement on frequency of contacts and the intensity of ties.

This last step in the decision-making model provides a continuous opportunity to improve a partnership in a systematic way. This also means that the firms should continually assess the partnership as was done in step 3, and continually asses the firm's own business characteristics. In this way, the collaboration adapts to changing circumstances and is more likely to remain successful on the long run. Furthermore, the continuous assessments provide a mirror to the entrepreneur on how to improve its own business characteristics.

Discussion and conclusions

International entrepreneurship literature uses several theories to explain and describe internationalization from transition economies to developed economies. Few of the studies in this context engage themselves with high-tech SMEs. Following Yamakawa (2008) and Rialp et al. (2005), we stated that current theories focus on only few dimensions or neglect the decision-making process aspect of internationalization, leading to difficulties in managerial

application. To provide a solution, we developed a multidimensional model on the decision-making process for internationalization of SMEs from transition economies. The basis of the model originally derived from sociology (Parsons, 1964, Groen, 2005). The basic assumptions are that value is created in networks and that partnerships should contain sufficient strategic, economic, cultural and social capital. We distinguished four steps for analyzing the international decision process: (1) inventory of strategic, economic, cultural and social capital of the firm; (2) inventory of strategic, economic, cultural and social capital needed by the firm; (3) assessment of fit between the firm and a potential partner and (4) inventory of mechanisms to use to improve the match between the firm and a potential partner. The second and fourth steps are labeled as critical steps, after which it is possible to discontinue the process. The model was illustrated by three cases. One of the cases, Simulator, did not prove suitable for internationalization because it would harm existing relations. We did not need analysis of all four capitals to come to this conclusion. To make the model more efficient, we suggest separating part of the strategic capital from the first and second step into an earlier step. This step would involve the decision of the firm to internationalize or not based on preferences or circumstances. The second step would still be a critical one, however. A firm can come to the conclusion that they do not have any needs in capitals, limiting the necessity to internationalize with a partner. The other way around is also possible; the firm might decide not to internationalize, whereas analysis of the capitals would show that internationalization would be desirable. Further research could shed light on how this problem could be solved.

This paper shows that it is very useful to recognize internationalization as a decision-making process in a multidimensional manner. Decomposition of this process into four systematic components enables entrepreneurs to take better decisions, and also confronts the entrepreneur with its own business characteristics in a clarifying way. In this paper, it became apparent that it would be better for Simulator not to internationalize. In a similar fashion, Aqua had intentions to internationalize, but the model showed that collaboration with Water is unlikely to succeed. Radiodevice, on the other hand, has excellent opportunities to collaborate with Scentsystem, as clarified by the model. Concerning reflection on own business characteristics, it became apparent that the three Russian firms have straightforward strategies, high technological skills, but low marketing and international management skills. Rather than solely focusing on synergetic effects from partners, the model provides clear insights into the firm's own strengths and weaknesses. Furthermore, it provides clear possibilities to continually assess a partnership, while providing an instrument on how to improve it to make it maximally successful. This was illustrated by Radiodevice and Water. Besides entrepreneurs, the model can also be used by external individuals such as consultants or investors. We have applied the model to transition economies, but believe it to be applicable to other contexts as well. From theoretical point of view, the model provides a more complete picture of the complex decision-making process for internationalization of a firm with use of a partner. Stage theory, institutional theory, transaction cost economics and resource-based view would not have provided the insights as are presented here, as they have narrower orientations.

This research is subject to several limitations. Partnerships need to possess sufficient capital to survive. The level of sufficiency is decided upon by the entrepreneur. In the future, more objective measures can be used. Next to this, we observed that the strategies of the firms were oriented on the short-term. Further research could shed a light on how measures on long-term strategies could be included and operationalized into the model. Furthermore, our study might suffer from single informant bias, since only one person per firm was interviewed. Nevertheless, multiple firms were interviewed, putting the responses of individual directors in

perspective. There was also asymmetry in information gathering as there was no fit readily-made with a Dutch firm when interviewing the Russian directors. When interviewing the Dutch directors, this fit could readily be observed. This influenced the level of hypothesizing on a potential collaboration with the other firm. Last, the interviewees might suffer from unconscious incapability, leaving them unaware of certain shortcomings that they might have. To overcome this, as many indicators – qualitative data and existing scales – per operationalization were used.

This paper served as an illustration of our model. This model supports decision-making, not the complete search trajectory of finding a potential partner. Further research could provide instruments to help entrepreneurs where to find their partners. Also, we urge for more research to test the validity of this model in different contexts. For example, currently we are working on existing companies in manufacturing industry who are searching for partners to create new business. In addition, as stated earlier, more research could elaborate on how an earlier step could be included to fine tune the order of analysis of the dimensions to prevent unnecessary evaluation of dimensions. Finally, additional research can shed light on the extent to which integration with other theories on internationalization is possible, and in which contexts. In so doing, more attention should be paid to the re-evaluation of models and theories that derived from developed economy context, to test their validity in transition economy context.

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Appendix A: Measurements			
Dimension	**Operationalization**	**Indicators**	**Question type**
Strategic capital	International orientation	Foreign goals, Protection intellectual property abroad, International standards, International conferences	Open questions Open questions Yes/no Yes/no
	Orientation towards innovation	Type of strategy (Miles and Snow), Preferred type of innovation	Closed-ended question Closed-ended question
	Market orientation	MKTOR (Narver and Slater, 1990) (interfunctional orientation excluded) Competitive advantages, Firm philosophy	Open question Likert-scale questions (1-7,0) Open questions Closed-ended question
	Orientation towards partners	Taking goals of partner into account in strategy	Likert-scale question (1-5,0)
	Power	Possession of IP, Standards in industry, Influence of customers, Influence over suppliers	Open questions Likert-scale question (1-7,0) Yes/no Closed-ended question Open question Open question Likert-scale question (1-5,0)
	Reputation	Publications, Participation congresses & exhibitions, Other firms stay informed or not	Yes/no Yes/no Likert-scale question (1-5,0)
	Flexibility	Adaptations of strategy for partner	Open question
Economic capital	Financial resources	Human assets, Facilities, Funding	Open questions Closed-ended question Open question Closed-ended questions Open question
	Financial performance	Return on investments, Revenues, Profits, Forecast in 5 years	Closed-ended question Closed-ended question Closed-ended question Closed-ended question
	Operations of the firm	Efficiency, Most money spent, Areas to cut costs, Using investments of others	Likert-scale question (1-5,0) Open question Open question Open question
Cultural capital	Technical skills	Number of technological employees, Technological background director Educational backgrounds Refreshment courses	Numerical question Open question Open questions Open questions
	Entrepreneurial skills	Education in marketing, finance, business administration, Adequacy in marketing, finance, business administration, Having another firm (for business administration) Educational backgrounds Refreshment courses	Open questions Likert-scale questions (1-5,0) Open question Open questions Open question
	Entrepreneurial orientation	Lumpkin & Dess (1996)	Likert-scale questions (1-5,0)
	International orientation	Education in international management, International experience, Adequacy in international management	Open question Open question Likert-scale question (1-5,0)
Social capital	Positional	Picture current network	Open question
	Relational	Picture current network, Important ties, Duration of relationships, Frequency of contacts	Open questions Open question Open question Open question
	Perceived importance	Importance of network, Importance of firm to network,	Likert-scale question (1-5,0) Likert-scale question 1-5,0)

		Willingness to share resources	Open questions
	Internationalization	Foreign contacts, Efforts to establish foreign contacts, Importance of international network	Open questions Open questions Likert-scale question (1-5,0)

Resource Scarce Intensive Strategies in the Early Internationalization of Born Globals

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Abstract

The purpose of this paper is to explore how Born Globals solve the resource scarcity problem typical for them. In this paper we will discuss how International New Ventures or Born Globals can increase their internationalization pace with the selection of resource scarce strategies. Our underlying assumption is that with the selection of suitable strategy, the Born Global can contribute to a decreased liability of foreignness and resource scarcity, and to an increased speed of internationalization. Based on the literature we are reviewing resource acquisition strategies, and three different resource scarce strategies, 1) an externalization strategy, including a co-option strategy, 2) a low entry mode strategy, and 3) an Internet strategy.

Keywords: Born Global, International New Venture, Resource Scarcity, Critical Incident Technique

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Resource Scarce Intensive Strategies in the Early Internationalization of Born Globals

1. INTRODUCTION

During the last decade a new type of firm has emerged, one that increasingly has attracted the attention of international business researchers, mainly because the new type emerged has been in contradiction with the traditional internationalization research. (See e.g. Alahuhta 1990; Jolly et al. 1991; Oviatt et al. 1991; Rennie 1993; Oviatt & McDougall 1995; Knight & Cavusgil 1996; Madsen & Servais 1997; Autio et al. 2000; Gabrielsson, Sasi & Darling 2004; Luostarinen & Gabrielsson 2004; Knight & Cavusgil 2005). BGs, as all new firms, are ventures characterized by resource scarcity. They enter international markets shortly after inception and experience high international and global growth. In particular it has been suggested that resource scarcity of BGs or INVs pose a critical challenge in terms of rapid globalization (Oviatt & McDougall 1995). Differences in resource availability compared to large global competitors have been reported as one of the major barriers to early internationalization of firms, such as INVs (Karagozoglu & Lindell 1998). The purpose of this paper is to explore how Born Globals, in their early globalization process, solve the resource scarcity problem typical for them.

The primary research questions are. How do Born Global firms actually overcome resource scarcity typical for them in their early globalization process? And what kinds of resource scarce intensive strategies do they use?

In the paper we will discuss how International New Ventures or Born Globals can increase their internationalization pace with the selection of suitable resource scarce strategies. Our underlying assumption is that with the selection of suitable strategy, the Born Global can contribute to a decreased liability of foreignness and resource scarcity, and to an increased speed of internationalization. Based on the literature we are reviewing resource acquisition strategies, and three different resource scarce strategies, 1) an externalization strategy, including co-optation strategy, 2) a low entry mode strategy, and 3) an Internet strategy.

The concepts international new venture (INV), entrepreneurial firm and venture are used as a synonym for born global (BG).

2. LITERATURE REVIEW

2.1. Resource Acquisition

The international entrepreneurship (IE) is "the process of creatively discovering and exploiting opportunities that lie outside a firm's domestic markets in the pursuit of competitive advantage" (Zahra & George 2001). IE is a rather recent research approach focusing mainly on the entrepreneur or the entrepreneurial firm in an international context (Dana et al. 1999).

At present venture growth models in the entrepreneurship literature are assuming a linear process of growth (Block & MacMillan 1985; Kazanjian 1988), and they do not take into account the influence of overseas operations on the process. Block & MacMillan (1985) defined the venture growth process in terms of milestones. The authors described ten typical milestones that new ventures pass, including concept and product testing, first financing, market testing, production start-up, and competitive reactions. Kazanjian (1988) introduced a four-stage model with dominant problems in each stage. In stage 1 resource acquisition and technology development dominates; In stage 2, production related start-up takes over; In stage 3 sales/market share growth and organizational issues dictate, followed by profitability, internal control, and future growth base in stage 4.

The importance of the entrepreneur in the resource acquisition process is widely recognized in the literature. Oviatt & McDougall conveyed that the entrepreneur's role in the resource acquisition process is significant (Oviatt & McDougall 1994). Research has shown that several INVs are started by entrepreneurs who have prior international business experience (Crick & Jones 2000), and they use their prior experience and network in the resource acquisition process. Despite the fact, that resources are vital to venture performance, resources alone are not enough, the entrepreneur must develop skills and choose venture strategy that make the best use of available resources (Chandler & Hanks 1994). Further, the founders must be able to ride the wave of product technology lifecycle (Moore 1994) and capitalize on the right moment.

In general young ventures, such as International New Ventures or Born Globals, have great difficulty obtaining external financing because they typically invest in riskier assets and in many cases there is information asymmetry between the entrepreneur and financier (Megginson 2004). Access to finance has been identified as a significant constraint on the development of technology-based businesses. The early phase of venture start-ups is most often heavily dependent on initial insider finance (savings, cash flow from revenues, retained earnings, bootstrapping), and informal external finances (angel finance). Also other informal

external finance (loans from relatives and friends) is important (Mason & Harrison 1999; Brophy 1997). Bootstrapping (cf. Bhide 1992) – defined here as starting and operating a business with little or no money or assistance from outside investors – becomes more important for these firms. Bootstrapping include sweat capital, i.e. personal commitment of resources by entrepreneurs to signal to other resource providers of his/her intentions towards building the venture. Successful acquisition of early stage financing, such as angel financing can be crucial to a fast-growth venture's survival, and ultimately to qualify as target for institutional venture capital investment (Freear & Wetzel 1992). Although important, institutional venture capital and business angel finance are used by only a small proportion of new and growing ventures, even among fast-growth ventures and new technology-based firms, especially in Europe (Harrison et al. 2004). European firms typically receive venture capital in a later business development stage, after the product has successfully been test-marketed, to finance full-scale marketing and production (Berger & Udell 1998). Thus, *seed and early start-up phase financing* in European growth firms, such as European Born Global firms, is heavily dependent on internal finance and government support.

Another of the primary difficulties for new ventures, in addition to scarce availability of equity and difficulty caused by information asymmetry, is the extremely cyclical venture capital industry. The vitality of the exit stage has a significant impact for the entire venture capital cycle, because it affects the monetary incentives of venture capitalists to invest and re-invest in. The reverse direction is important too, because the opportunities for exits influence the venture capitalists' ability to raise capital in the future. With the evaporation of the IPO exit route, alternative exit strategies become available, such as mergers and acquisitions (Bygrave & Timmons 1992).

2.2. Resource Scarcity

Rapidly globalizing firms, the so-called Born Globals, have increasingly drawn attention (Knight & Cavusgil 2005) since the early 1990s. The INVs enter international markets shortly after inception and experience high international and global growth, despite being constrained by resource scarcity typical for early ventures. Because of resource scarcity, these firms tend to use different kinds of internationalization strategies than the traditional internationalization literature advocates.

In the literature we found examples of three different types of resource scarce strategies used by INV. Firstly, an externalization strategy suggested by Oviatt & McDougall (1994). They propose that INVs in general uses "alternative governance structures", such as

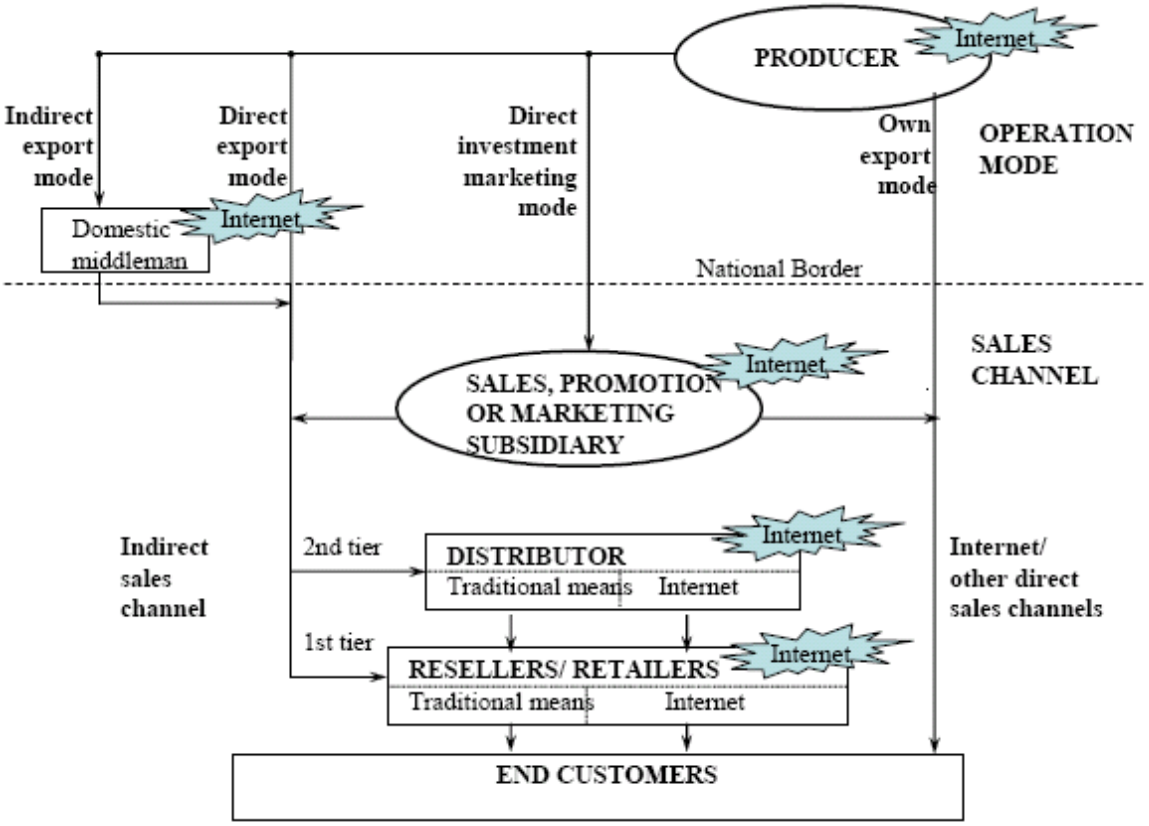
franchising and licensing, or even a network structure to internationalize. This enables firms to access critical resources without having ownership control over them. Starr and MacMillan (1990) highlight cooptation, the social role of contracting in securing legitimacy and resources for start-ups in early phases of its business life.

Secondly, INVs can internationalize a smaller percentage of their resources (McDougall et al. 1994) than a mature organization in general would. Typically, it means that INVs use entry modes requiring minimal resources. For example, most firms in Crick & Jones' study used direct exporting through international agents as their main international operation mode (Crick & Jones 2000). Shrader et al. found that U.S. firms entered several countries using low resource consuming entry modes, thus minimizing their international risks by maintaining a low dependence on any single foreign market (Shrader et al. 2000).

Thirdly, INVs are able to minimize the need for different international operation modes by using the Internet. Arenius et al. argued that the Internet can be used as a resource conserving strategy, and consequently has an instrumental impact on BGs globalization process. For example the Internet was important in marketing, and as a sales and distribution channel. Finally, the need to be physically present was reduced with the Internet (Arenius, Sasi & Gabrielsson 2005). Without the use of the Internet INVs would probably be forced to use other, more resource consuming strategic alternatives, such as using traditional agents and importers. Thus, the need to invest heavily in marketing to be able to grow would increase, slowing down the globalization process.

Figure 1 shows that the Internet can be used on three sales channel levels: (1) by the producers for exporting purposes; (2) by the foreign sales, promotion or marketing subsidiaries; (3) by the channel members in sales and marketing.

Figure 1



Source: Arenius, Sasi & Gabrielsson (2005, p.281).

3. RESEARCH DESIGN AND METHODOLOGY

In our multiple-case study (Yin, 1989) we developed ten case studies to gain more understanding of Finnish INVs and their resource scarce strategies. Most of the primary data were collected in a large project where over 130 potential Finnish Born Global was identified by interviewing several entrepreneurs, venture capitalists, business angels, and searching through various association member lists. We followed Jones (2001) calling for studies focusing on narrowly defined groups of firms generating rich data, and identified ten firms that fulfilled our criteria of belonging to the Finnish Information and Communication Technology sector in the metropolitan area of Helsinki, Finland. The firms met the Born Global criteria suggested by Oviatt & McDougall (1997). Different respondents, mainly founders / entrepreneurs and CEOs from the case companies were personally interviewed, as well as external informants, such as advisers, financiers, and customers.

The interviews were loosely structured, so that the respondents could talk freely about the firm's internationalization process. The respondents were asked to relate the story of how the firm's international involvement had evolved from the start until the time of the interviews. The "story of the internationalization process" theme was the only one explored throughout the interviews. The selected methodology enabled us to capture the process view of international involvement, in addition to acquiring some degree of longitudinal data through the respondents' stories. Using a process approach is significant, because an organization faces different task and resource requirements at different stages of its organizational development (Kazanjian 1988).

4. ANALYSIS AND DISCUSSION OF CASE

The case companies studied were founded between 1992 and 1999. This time period was characterized by several trends, which affected them. Housemarque was founded to capitalize on the growth of the PC game markets. Deregulation of the telecommunication markets was important for Iobox and Jippii. Futuremark, Kronodoc, AtBusiness and SSH benefited from the growth of the Internet. Solidtech was founded to capitalize on the changes in the information technology.

Whether the firms have the objective to become an international firm (Nedecon, AtBusiness, MatchOn, Jippii) or a global firm (Solidtech, Housemarque, SSH, Futuremark, Kronodoc, Iobox) appears not to depend on the year of founding. International firms are those that have rapidly internationalized within their home continent (Europe) by deriving over half of their sales outside their home country (Finland). Global firms refer to companies that have rapidly (mostly within two to three years) reached a stage where over half of their sales is generated external to their home continent (Europe) (see Gabrielsson, Sasi and Darling; 2004; p. 592).

The following interview material illustrates the objectives of the case firms (Table 1 in the Appendix).

Case Futuremark: The main strategy of the firm from foundation was to become "the standard" for test-programs. In our interview, the firm founder pointed out that they wanted to be part of the extremely growing Internet market and the more moderately growing PC market and become world leader in their particular niche, a target that the firm has attained.

Case Jippii: From the founding, internationalization has been one of the key factors in the company's strategy. "of course our target was to become international, but we will go

abroad when the time is right and then we will act quickly…" one of our respondents commented Jippii's internationalization strategy. It has been stated that one objective of Jippii is to be among 3-5 biggest Internet and telecom service providers in Europe by 2003.

Case SSH: The initial goal of SSH's top management has been to develop products for global markets. Our respondent said "that the main thing is that we have few competitors. In some cases, we have been part in developing the standard. This has helped us to create a good reputation as a firm in the forefront of security software." Actually, it can be said that being a global player was a given factor since Internet provides companies with a global business environment from the outset. Like in any other software company, after the rather long product development phase the products are released to global markets as soon as possible. This is due to the short product life cycles within the software industry where constantly new improved products appear to the markets.

4.1. Internationalization Pattern

We find that the time intensity in the internationalization process for of most of the case firms is low. Rather than increasing the country diversity (Jippii) or the mode diversity over a very short period of time, the case firms appear to act gradually, however in much faster pace than in traditional firms. In the case of Jippii, the high time intensity was the result of the chosen strategy of international acquisitions, which was enabled by the IPO in 2000. There is evidence that some firms rather quickly increase their level of international activities to a certain level, which they then sustain over a longer period (Futuremark). In the case of Futuremark, the case firm considered the U.S. market area as its main market area and has never even considered any other market areas. Since the U.S. market is a large and heterogeneous market area, and it takes a long time to develop successful activities on the market, the internationalization process of Futuremark has not develop since the year 2000, when it opened a sales subsidiary in the U.S.

The case companies took various amounts of time to commence international activities. Out of the 10 case companies, four firms could be defined as instant internationals, which had international activities at or immediately after firm founding (Futuremark, MatchOn, Housemarque, Iobox). Three firms operated on the domestic market between 1 and 2 years (Kronodoc, Solidtech, Jippii) and three firms took 3 or more years to commence international activities (SSH, Nedecon, AtBusiness). All the case firms fulfill the born global criteria of having commenced international activities during the first six years of their

existence (Oviatt & McDougall 1997). Three out of the four instant internationals were operating on the business-to-consumer segment at firm founding (Iobox, Futuremark, MatchOn). Since that, Futuremark has switched to business-to-business segment, and MatchOn was trying to change its strategy to a business-to-business just before it went into bankruptcy in 2001. All other case firms focused on the business-to-business segments. Probably the business-to-consumer segment requires many resources and such high level of resources is difficult to acquire in Finland.

Both Nedecon and AtBusiness, which took 4 years and 3 years respectively to commence international activities, are consulting firms. It may be that the internationalization of services, which requires internationalization of human capital, takes longer than internationalization of products. Particularly, products that need no local adaption, such as extreme games of Housemarque.

It appears that the gap time as defined by age at international entry does not correlate with the year of firm founding in our sample. That is, those firms that were founded earlier did not have a longer gap time between firm founding and commencement of international activities. Admittedly, we are only looking at a ten-year period (1990s), which was characterized by favorable trends in the ICT industry, which for a majority of the case firms was the reason for their existence.

One important decision during the internationalization process is the decision of the cross-border business mode. According to the traditional process view, internationalizing firms follow a pattern of gradually moving from the less risky cross-border business modes to the more risky, resource-consuming modes (Johanson & Vahlne 1977). On contrary, the international new venture literature emphasizes the hybrid modes (more cooperative modes), which generally are resource economical (Oviatt & McDougall 1994). In our case data, we find no evidence of linear development of the cross-border operating mode. The dominant international modes are export (direct) and opening an international sales subsidiary. The firms started using these operation modes simultaneously or one after the other. For example, Futuremark commenced export and created a sales subsidiary during the same year. Of those firms, that has used both export and sales subsidiary, Solidtech and Kronodoc, first used export and only later on a sales subsidiary (traditional Uppsala chain of operations). Iobox first relied on a sales subsidiary and then commenced export. The case firms can be divided according to their level of mode diversity.

Among the case firms we find very little evidence of an Uppsala development pattern (an establishment chain). Only SSH was has somewhat followed the Uppsala development

pattern by first using an indirect export mode (agent in Finland) and then commencing direct export and opening a sales subsidiary. Notably the last two cross-border modes were commenced simultaneously, and not sequentially as predicted by the Uppsala development pattern.

Only two out of the ten case firms made international acquisitions (Jippii, Nedecon). The internationalization strategy of Jippii was to acquire small local firms with one to two employees, which had a teleoperating license. The strategy that relied on acquisitions was resource consuming and to acquire the required resources, Jippii was listed on the Helsinki Stock Exchange in 2000 (at the age of 2 years). The same year the acquisitions were started. Also Nedecon relied on public offering to obtain financial resources for the acquisitions. It went into public in 1999 at the age of 5 years, and commenced international acquisitions in 2000.

Currently the case firms show various states of globalization. Truly global firms that operate on the home continent and on two others continents include Solidtech and SSH (Nedecon until Endero merger). Housemarque, Iobox, Futuremark, MatchOn (before it went into bankruptcy) and Jippii operated on one other continent in addition to their home continent Europe. Firms that operate only on European markets include Kronodoc and AtBusiness.

There is evidence that the development of country diversity is somewhat linear, rather than cyclical. Nedecon, AtBusiness and Kronodoc have started on the nearby markets, and approached only a few markets at the same time. On the other extreme, Jippii started operating a number of international markets simultaneously and rapidly increased the number of countries with physical presence. It has also approached nearby and distant markets simultaneously. Majority of the case firms has however, identified a few main market areas (or even a single market area) and focused on creating sales revenues on the selected few markets.

Once the internationalization process has started, the firms tend to remain operating on international markets. None of the case firms withdraws from the international market during the study period. Moreover, the firms show some evidence of structural inertia, by becoming stagnated with the markets they have chosen to target. For example, Futuremark has always considered the US as its main market area. It did not have the nerve to enter physically this market area at the beginning and first opened a sales subsidiary in UK, then moved it to Canada and finally, during the third years of international operations, moved the sales subsidiary to U.S. market, where it has since then remained.

4.2. The role of the Internet

Most of the firms, with the exception of Solidtech and Housemarque, we studied were using either Internet or mobile technology or both at a time when Finland was considered worldwide to be a test laboratory for these technologies. By using the Internet as sales and marketing channel, the case firms could decrease its liability of foreignness. First, the Internet decreased the costs directly associated with spatial distance. Once being developed, it is possible to distribute a software product to different countries using the Internet without any additional cost per unit of downloaded or distributed software. Internet as sales channel also decreased travel costs, which are among the first category of sources of liability of foreignness. Second, using the Internet as sales and marketing channel also decreases the costs resulting from the host country environment, such as the lack of legitimacy of foreign firms and economic nationalism. It has been proposed that Internet make firms stateless, thus removing the source of economic nationalism (perception of being alike).

Most of the case firms were able to decrease its liability of foreignness by staying in the Business-to-Business market or by moving from the Business-to-Consumer to Business-to-Business market. In fact, by using the Internet, the case firms studied could approach more market areas simultaneously, without the threat of distributing their resources too thinly on too many markets. The Internet turned out to be an effective tool to create market pull for a software product by raising the company's profile and getting other people talk about it, which is often called building mind-share. Because marketing is all about creating perceptions about a product in the minds of the customers, the battle for mind-share is critical for success. The usage of Internet turned out to moderate the effect of resource scarcity on firm internationalization, and thus to influence positively the speed of internationalisation.

4.3. Externalization strategy and founder's network

At the time of founding, the interests of the founders align with those of the firm. The obligations of the founders to the firm are general – to contribute all that they know that is relevant to the firm, should there be a need for them to do so. The firm and the founders are almost inseparable, as the firm is perceived as an institutionalized extension of the founder(s) (Casson 1996). Using existing ties lowers the firm's search costs of finding an attractive exchange partner. INVs also use their existing network ties to obtain referrals to new network partners and to increase their attractiveness. Relying on referrals has also been reported to

increase the likelihood that the firm and the network partner have complementary capabilities (Uzzi & Gillespie, 2002, Starr & MacMillan 1990). Firms are more inclined to engage in relationships with partners that have demonstrated their trustworthiness and cooperative ability in other relationships (Hill, 1990). By building on existing ties INVs can increase their attractiveness and add new relationships faster. This is particularly true for social relationships, which have been argued to be *path dependent* in the sense that prior linkages determine the formation of future linkages (Gulati, 1995; Walker et. al., 1997). Larson & Starr (1993) report how entrepreneurs select certain relationships and drop others, while other relationships continue to evolve, and new ones are added. They behave opportunistically to assess and acquire resources for the emerging organization.

The case firms were typically founded by a team of two or more persons, who knew each other well before start-up, with the exception of SSH. In most cases their relationships were that of friends (cf. Rasmussen et al. 2001). Many of them had met during their studies, such as the founders of Kronodoc and Solidtech. Others had met later on in their business career, as the founders of Housemarque and MatchOn. The founder (s) of the firms were in average very international, and they were able to contribute to their firms internationalization and technology knowledge, access to resources, such as funding and personnel, and to customers. The founder teams also tended to combine different backgrounds, such as technology and business. They were also able to provide their firms with credibility and trustworthiness, crucial for firms internationalizing early.

5. CONCLUSIONS

In the literature review we concluded that INVs typically use resource conserving strategies. Most of the firm using Internet and mobile technology chose the US as their main market immediately or after a short time span. We can say that in terms of Internet technology Finland and the US were having the same time reference, whereas in terms of mobile technology the US lagged behind Finland, thus explaining why the firms with main emphasis on mobile technology were slower to enter into the US. Solidtech's main emphasis was on PC technology, where Finland was lagging behind the US. The differences in reference time might explain why Solidtech chose to move their headquarters to Silicon Valley. Finnish game developers, such as Housemarque, acted in a very successful business area in Finland, but with very small actors. Contrary to the other firms we studied, Housemarque had difficulties in finding suitable personnel and had to train their personnel

themselves. We found that both the home market and the target markets should have a common reference time (i.e. the development of a particular industry trend should be on the same level) and that this particular area needs to be studied in more in detail.

Our respondents identified three different areas extremely important in marketing, use of the Internet, the work done in standard development, and high-profile business users.

Finance was typically not an obstacle among our case firms. However, after the IT market recession and stock market crash in 2000, demand for software products reduced considerably and case firms acting in more resource consuming segments, such as the Business-to-Consumer area or in consulting got into financial troubles

In our analysis we found several important critical issues that are consistent with the earlier research, but there are also differences. In the analyzed cases, reputation building was extremely important. Born Globals, typically suffer from a double liability, liability of newness (Stinchcombe 1965) and liability of foreignness. Liability of newness, typical for new ventures is intensified by a liability of foreignness. Our case firms typically overcame the slowing effects of both liabilities by heavy reputation building, especially in the start-up stage, by using the Internet, through co-optation and by using important customer references in marketing and sales.

In the literature review we presented three different types of resource scarce strategies. Firstly, an externalization strategy, secondly, a low resource consuming foreign entry mode strategy, and thirdly, an Internet strategy, that minimize the need for different international operation modes. Firstly, externalization and cooperation was important for the case firms, typically through the founder's and customer's networks. We propose that the founders opportunistically focus on international relationships, and develop their personal one-dimensional relationships into a business network of multidimensional relationships. Secondly, the resource scarce strategies employed by our case firms are very much consistent with the literature presented earlier in the start-up stage. The case firms however, tended to use hybrid, resource economical strategies in the development stage, even when subsidiaries where established abroad. Thirdly, Internet as strategy was clearly important for most case firms, because it acted as reputation builder, as distribution vehicle and finally as mode to service remote, smaller markets.

The growth process of the case firms is not linear as suggested by the literature. There has been a continuous process of product development, entering new markets and servicing new customer groups, from OEM to end-customers.

The criticality of resource acquisition, as suggested by Kazanjian (1988) did not emerge in the case firms. Instead, the resource scarce strategy build-up by the case firms typically enabled the firms to concentrate on developing the best possible product, the money was clearly not a big issue for the firms in the beginning. So instead of entering into a phase of stability in the last stage as suggested by Kazanjian (1988), the firms are entering into a stage of instability in the maturity stage. Fortunately, also IT architecture evolution and new legislation will set tighter requirements for security and increase security spending by government agencies, banks and corporations and open up new opportunities for the firms. Currently the ICT industry is like any mature industry: there are a lot of players and tight competition. On the other hand, in the IT industry there is always room for creativity and innovation.

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Table 1: Case Firms

Solidtech	Finland 1992	Private, acquired by IBM in December 2007	Information management solutions
Nedecon	Finland 1994	Merged with HSE listed Endero in 2001	IT consulting services
Housemarque	Finland 1995	Private	Game developer
SSH Communications Security	Finland 1995	Listed on HSE 2000	Security software for networks
ATBusiness Communicatiuon	Finland 1996	Management buy-out 2006	Internet-based CRM Solutions
Futuremark	Finland 1997	Private	PC 3D test program
Kronodoc (form. Single Source)	Finland 1997	Private	Web-based project management tool
Jippii Group	Finland 1998	Foreign business sold to UK LSE listed iTouch	Tele and Internet services
Iobox	Finland 1999	Acquired by TerraMobile in July 2000	Europe’s first wireless web portal
MatchOn Sports	Finland 1999	Failed in 2001	Portal with sports entertainment and news

DIFFERENCES IN SOCIAL NETWORKS BETWEEN HIGHLY AND MEDIUM TO LOW INNOVATIVE SPIN-OFFS: DO THEY LEAD TO DIFFERENT GROWTH?

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Abstract

University spin-off firms are believed to contribute to innovation of the (regional) economy through entrepreneurship, knowledge transfer and linkages with larger firms. Social networks play a vital role in the early years of spin-off firms, but there is virtually no knowledge on the critical characteristics of these networks, and on differences between highly innovative and medium-to-low innovative spin-offs in this respect. First, we highlight theoretical viewpoints on social network formation, Next, we discuss the methodological aspects of the empirical study. This is followed by a comparative descriptive analysis of social networks and two separate estimations of job growth for highly innovative spin-offs (HIS) and medium-to-low innovative spin-offs (MLIS). The results indicate an overall smaller role of social networks for HIS, as well as a different role of strength of relationships and importance of local partners for HIS compared with MLIS.

Key words: university spin-offs, social capital, social networks, innovation strategy, growth.

1. Introduction

In recent years, enhancing the survival and growth of university spin-off firms has received a renewed attention from policymakers and university managers. The main arguments for such policy include the contribution of these firms to diffusion of new technoloy, improved university-business links, and in particular cases, their role in restructuring regional economies. University spin-off firms can be defined as a particular type of spin-offs, created for the purpose of commercially exploiting knowledge, technology or research results developed within a university (Pirnay et al., 2003). In fact, spin-offs are varied in characteristics as well as in strategy. Some spin-offs aim to commercialize a cutting edge technology and strongly invest in the development and market introduction of this technology. These types of spin-offs may be the first firm entering the market (first-mover strategy) (Lieberman and Montgomery, 1988). Through investing in highly novel technologies or products, they may benefit from acquiring superior resources and capabilities, particularly a unique market position. By contrast, late-moving spin-offs choose to introduce renewed or improved product/services in existing markets on the basis of a relatively modest investment in research and development.

In general, support arrangements for university spin-offs do not differentiate between highly innovative and medium/low innovative spin-offs. Support provided by universities or incubators is often merely focussing on basic support such as room in an office, daily administration, facilities for a meeting, a soft loan, etc. In addition, research on university spin-offs has primarily discussed the incubation process in terms of organization, process and financial aspects and only a limited amount of research has examined social aspects related to business incubation (Totterman and Stern, 2005). Despite a growing interest in the role of business incubators as creators and supporters of functional business networks (Aernoudt, 2004; Bøllingtoft and Ulhøi, 2005; Hansen et al., 2000), the question what types of social networks bring benefits to the growth of spin-offs remains largely unanswered, particularly with regard to different levels of innovativeness of these firms.

The present paper attempts to reach two aims. First, it compares characteristics of resource deficiency and of social networks providing access to missing resources for highly innovative spin-offs and medium-to-low innovative spin-offs. Second, the paper explores how different characteristics of social networks play a role in the growth of these categories of spin-offs. The remaining paper is divided into five sections. Section 2 highlights various theoretical viewpoints on innovation strategy and social network formation. The next section (section 3) will be concerned with methodological aspects, including the variables and statistical model, and with characteristics of the sample. The results of the comparative analysis of resource deficiency and characteristics of the social networks are next (section 4) and this is followed by the results of two separate growth models, with a focus on the influence of different social network characteristics on growth (section 5). The last section (section 6) presents a discussion in the context of policy practice and future research.

2. Theory: Innovation Strategy and Social Networks

2.1 Introduction

In the literature of strategic management, much attention has been paid to the question of whether firms can create competitive advantages through their decision when to enter new markets (Liebermean and Montgomery, 1988). As a result, the strategy of being the first in the market ("first-mover strategy") has become the subject of articles in many business publications. The basic concept of this strategy is simple as by being the first to enter a new market, firms gain advantages over actual and potential competitors. Firms pioneering brands possess advantages over the following brands because consumer preference rests with the first brand that performs adequately (Schmalensee, 1982). In terms of organizational learning, first movers are also more likely than their followers to experience extensive learning and thus have better access to opportunities (Glazer, 1985). Other (related) first-mover advantages addressed in the literature are establishing a uniqueness in the market; using switching costs to lock up sales; setting up exclusive distribution channels; defining the standards for new technology; securing patents; and controlling other scarce resources critical for success in competition (e.g. Kerin et al., 1992; Lilien and Yoon, 1990; Mascarenhas, 1992). However, a

first-mover strategy also bears the risk of a smaller likelihood of success than a later mover. If a firm enters early, it may not be able to recover its entry investment before competitors imitate the product and perhaps even improve it. In addition, first movers may miss the opportunities which are obscured by technological and market uncertainties and from which late movers take advantage (Lieberman and Montgomery, 1988). Overall, the literature on first-movers seems not conclusive on the benefits from a first-mover strategy.

Regardless the different levels of innovativeness and times to enter the market, young spin-off firms need to access resources in order to fullfill their chosen product-market strategy (e.g. Barney, 1991; Barney et al., 2001). At the same time, young spin-offs need to acquire particular capabilities through learning, and one of these capabilities is to establish and maintain useful social networks through which external resources can be accessed. In general, organizations, whether established firms or start-ups, are part of a network and are dependent on external actors (Pfeffer and Salancik, 1978). Studies on growth of small firms indicate that developed networks of strong relationships with various partners may give advantages in gaining resources (Hoang and Antoncic, 2003). Networks provide entrepreneurs with avenues for negotiation and persuasion, enabling them to gather a variety of resources (e.g., market information, social support, venture funding and other financial resources) held by other actors (Nicolaou and Birley, 2003). Birley (1985) observes an extensive use of social networks in the early stages of the venture generation process, which in the case of university spin-offs may include family, friends, previous colleagues and employers, and former professors. It is particular in these stages that social capital is needed to facilitate interaction, including the norms of reciprocity and trustworthiness that arise from them (Coleman, 1994; Putnam, 2000).

In the current paper, social networks are defined as networks of important '*partners*' that potentially provide valuable resources for firms' growth. As young spin-offs frequently lack critical resources, especially market-related knowledge and skills (van Geenhuizen and Soetanto, 2004), they attempt to fill resource-deficiency by seeking a solution through '*partners*' (e.g. friends, colleagues, former professor, etc). Relationships with '*partners*' may be essential to gather relevant knowledge, to get external support and services, and to achieve access to those resources that are not available in-house (Birley, 1985). Thus, in the early years of spin-offs' life, social networks are important and cannot be neglected. Moreover, as spin-offs employ different innovation strategies, it is likely that the characteristics of their social networks also differ.

2.2 Dimensions of Social Networks

In describing social networks of spin-off firms we follow Nahapiet and Ghosgal (1998). Accordingly, the dimensions of social networks can be divided into a structural, relational and cognitive dimension. These dimensions are not mutually exclusive and in fact, they may be highly interrelated. In addition, we also focus on the social and spatial dimension of social networks.

Structural: Tightness of Networks

Studies on the influence of network structure on the performance of new firms are not conclusive. Several studies stress that linkages with tight networks are more advantageous in the early years of firm growth (Gulati, 1995) while others emphasize the importance of being connected to loose networks (McEvily and Zaheer, 1999). According to Granovetter (1992) firms enjoy large advantages if they have partners who are connected in sparse (loose) networks. A loose network structure brings on benefits from diversity of information and brokerage opportunities created by lack of connections between separate clusters in the networks. This leads into a concept named *Structural Hole* (Burt, 1992). Actors who occupy brokerage positions between clusters have better access to information. Structural holes separate non-redundant sources of information, sources that are more additional than overlapping. By being connected in a network rich of new information and opportunities, entrepreneurs enjoy benefits regarding (1) enhancing business opportunities, (2) achieving access to resources that can merely be obtained through the linking knot, and (3) receiving references on partners that may give access to new business networks.

In contrast, the literature of small business development emphasizes the importance of dense or tight networks. Tight networks are described as networks in which all partners are connected to each other. If partners know each other well and interact frequently, they are more likely to convey and reinforce norms of exchange and are better able to monitor behavior and enforce sanctions in the network. In business, such networks will reduce risk and enhance the opportunity of building cooperation and getting access to resources from other partners connected in the network. Partners in this kind of network are familiar with each other's interests and build trust and credibility on each other. Therefore, tight networks are beneficial for the transfer of complex (fine-tuned) and tacit knowledge, to achieve legitimacy or reputation, and perform joint problem solving (Coleman, 1990; Uzzi, 1996). If we focus in on highly innovative spin-offs (HIS), we may assume some contradictory trends. Tight networks may be beneficial for HIS because of the strong need for technological learning and tacit knowledge as a vehicle in this learning. On the other hand, HIS may avoid such social networks because of the need for protection of the invention and risk of spread of secret information in the network. In general, highly innovative ventures place more emphasis on knowledge accumulation and learning than medium to low innovative spin-offs that focus largely on access to external resources such as financing, manufacturing capacity, existing market and distribution channels (Liao and Welsch, 2003).

Relational: Strength of Relationships

While the above characteristics refer to the structure of networks, strength refers to the value of the relationships as appreciated by partners in the network. The strength of relationships varies according to the time invested herein. Usually, strong relationships are based on a long-term and intense interaction. Typical examples of strong relationships include friendship and family ties. Granovetter (1995) defines the strength of relationships on time and emotions invested in

a relationship, as well as reciprocity between the partners. As people know each other better and become emotionally involved, they will develop a relationship in which they put trust, commitment and willingness to support each other reciprocally. This type of relationship is important for entrepreneurs trying to market an unproven product yet facing limited resources. In such a highly uncertain situation, entrepreneurs will heavily rely on close friends or family members for learning, protection and support. Highly innovative spin-offs, particularly first-movers, typically work under highly uncertain conditions and accordingly may depend on close relationships with partners.

The theory of social networks, however, also presents a contradictory argument. Granovetter (1973) argues that new information is obtained through casual acquaintances rather than through strong personal relationships. Since strongly connected partners are likely to interact frequently, much information that circulates is the same. Conversely, *weak ties* often include links with partners who move in social circles other than those of the focal persons. Weak ties are an important source of information about activities, resources and opportunities in distant parts of the social system, and are often more important in spreading new information or resources because they tend to serve as a bridge between otherwise disconnected social networks. Accordingly, tt is through weak ties that spin-offs can recognize novel information, which leads them to new resources and exploiting new business opportunities.

It is difficult to speculate whether weak ties are more important in the growth of highly innovative spin-offs compared to other spin-offs. The contradictory trends previously addressed in the context of loose networks may hold true for weak ties as well.

Cognitive: Knowledge Content

The third dimension of social capital - labelled “cognitive dimension” by Nahapiet and Ghoshal (1998) is rarely discussed in the mainstream literature on social capital. Nahapiet and Ghoshal define the cognitive dimension as resources providing “shared representations, interpretations, and systems of meaning among parties”. The knowledge content that flows through social networks may change over time. Starr (1990) and Larson and Starr (1993) posit that in the formation of new firms, networks follow a three-stage sequence of development, in which each stage is facing distinctive changes in the content of the relationship and information and the governance mechanisms in managing the relationship (Hoang and Antoncic, 2003). In the first stage, entrepreneurs attempt to identify those contacts that will provide critical resources, particularly the use of ties with family, friends, and colleagues. In the second stage, the content becomes more complex as it covers many aspects, including those dealing with economic purposes. In the third stage, the network content of the relationship becomes more crystallized and is characterized by more and a higher quality of information exchange between partners. For university spin-offs facing a lack of critical resources, establishing such specific networks seems to be an essential requirement that allows a solid growth.

It is however very difficult to measure the above cognitive dimension in the networks of spin-offs. Using a partial approach, the current study measures the richness of knowledge content achieved from partners. If spin-offs receive relatively rich (heterogeneous) knowledge from their partners, they employ quality relations delivering specific knowledge (information). On the other hand, if spin-offs receive more homogeneous knowledge, it seems that there is redundant knowledge indicating a relatively poor situation. Particularly, highly innovative spin-offs may suffer from the last situation because they need specialized knowledge due to their technology focus. However, it is difficult to speculate which type of networks are the best for highly innovative firms regarding their growth.

Social: Heterogeneity of Contact Background
With regard to the social background of network partners the following is found in the literature. Marsden (1987) shows that partners from a diverse social background - integrating several spheres of society - facilitate more beneficial actions than partners from a similar social background. Accordingly, with regard to spin-offs' growth, the more heterogeneous the partners, the larger the variety of resources, such as know-how, information and expertise. Heterogeneity in partners' backgrounds increases the likelihood of obtaining valuable information, knowledge, guiding spin-offs more quickly to different resources.

Regarding the different innovation strategies, we may speculate that highly innovative spin-offs preferably employ more homogeneous partners. Within their specific technology field, very small numbers of players are involved. This situation may not be the same for medium to low innovative spin-offs, as they have to diversify their networks to gain opportunities for cost-reducing processes, manufacturing and marketing channels.

Spatial: Geographic Proximity of Partners
In studies of network creation, networks are assumed not to randomly link individuals. Rather, people interact most frequently with those in close geographic proximity and with whom they share common backgrounds, interests and affiliations (Gertler, 2003). Because both physical and social location strongly influences people's activities, proximity on these dimensions increases the likelihood of interaction and communication (Blau, 1977). More specifically, close geographic proximity decreases direct costs associated with frequent and extended interactions necessary for maintaining social relationships (Zipf, 1949), particularly close personal networks. To put it in a slightly different way, a network of partners that is clustered in space provides larger opportunities for partners to actively interact with each other and to benefit from knowledge spillovers compared with a network over large distances (e.g. Audretsch, 1998; Camagni, 1991). As the geographic distance between spin-offs and their partners increases, the opportunity of face-to-face interaction is smaller and it is more difficult to maintain effective relationships because of higher costs of coordination.

In spatial innovation theory, it is believed that knowledge concerning new technologies diffuses within the confines of areas containing many individuals working in similar fields. When people with common professional interests cluster in physical space, informal, social and professional networks emerge and serve to disseminate information (Piore and Sabel, 1984; Saxenian, 1994; Sorenson and Stuart, 2001). Hence, entrepreneurs in locations densely populated with specialists in their fields often form networks that contain many close, casual, and indirect ties with colleagues. These networks may convey information about new technological developments, unresolved technical puzzles, and emerging market opportunities. In this case, highly innovative spin-offs may receive more benefits from partners that are located in close proximity than medium to low innovative spin-offs.

In this respect, the literature once more gives a contradictory argument. In the management literature it is emphasized that highly innovative firms step into knowledge relations on the basis of their individual knowledge needs and specialization, and on the basis of their capability to identify new knowledge and absorb this new knowlegde. Accordingly, the scale of interaction may vary from local to global, and is not limited to the local (van Geenhuizen, 2008).

2.3 Other Factors Involved

Aside from network characteristics, we assume that some other factors influence growth of spin-offs as well (Soetanto and van Geenhuizen, 2009). The model components explored in the current study are given below:

- Structural characteristics of the spin-offs (age)
- Location of the spin-offs
- Resources and capabilities (resource deficiency, network capability, support received)
- Strategy (sector, level of innovativeness, social networks)

We are particularly interested in the question to what extent the growth of spin-off firms can be understood by the characteristics of the social networks.

3. Methodological Aspects of the Study

The study draws on a survey of university spin-offs of TU Delft (Delft, the Netherlands) and NTNU (Trondheim, Norway). We delineated the population of spin-offs from these universities on the basis of three criteria, i.e., located in Delft/Trondheim or surrounding area, survived in 2006, not older than 10 years, and used at least one type of support from the university or respective incubation organization. Data were collected using a semi-structured questionnaire in face-to-face interviews with the entrepreneurs. This approach has led to 100 valid questionnaires. We measured social networks using the so-called *ego-centric* approach. The ego-centric approach focuses on individuals, rather than on networks as a whole. It starts with a selection of focal nodes or egos, and identifies the nodes to which they are connected. In

this research, the focal nodes are the entrepreneurs and we identify the partners with whom they interact and discuss business affairs on a regular basis. This kind of approach can be quite effective for collecting relational data from large populations.

The analysis contains two steps, first a comparative analysis of resource deficiency among highly innovative (HIS) and among low-medium innovative spin-offs (MLIS) and secondly an exploration of a linear regression model on growth focusing on social network characteristics for both categories of spin-offs. HIS are defined as those ones that spend at least 35% of their turnover (or income) (on average 50.4%) on research and development. We take average annual job growth as an indicator for growth. The way in which we measure the various independent variables in the regression model can be found in Appendix I.

In the regression analysis, we use two control variables, i.e., age in years and a dummy for location. The reason to include age is because age is most likely correlated with growth. The location dummy indicates a location of the spin-offs either in Delft or Trondheim, meaning a location in a poly-centric pattern of cities in the large metropolitan area of the Randstad (NL) versus a single city at a quite large distance from other cities in Norway. It is likely that spin-offs in Trondheim face more difficulty in growth, because they miss proximity and easy contact with launching customers and other potentially valuable partners at a short distance.

In the remaining section, we examine the characteristics of spin-offs in the sample (Table 1). The sample encompasses 52 HIS and 48 MLIS. With regard to job growth, HIS stay behind MLIS witness 0.7 versus 1.0 fte on average per year. The difference in job growth becomes clear if we consider various growth classes. 65.3% of HIS experience a slow growth, i.e. less than 1 fte per year, wheres MLIS experience such growth for 50.0%.

The relatively slow growth of HIS may follow from their specific R&D strategy, in which new R&D projects are undertaken in networks with the university or large firms, meaning than growth takes place in the networks and not in the firm. The relatively slow growth of HIS should also be seen in relation to the age structure of the sample: HIS are much younger than MLIS (50.0% of the first category is younger than four years versus 16.7% of the last category) (Table 1). The different age structure of course, raises questions on the causal background. A potential explanation could be a relatively high mortality rate among HIS. They take ususally bigger risks and have larger needs for investment capital. A higher mortality rate seems only part of an explanation, because generally mortality rates of university spin-offs in Europe are low. Mustar et al. (2007) estimate that six years after establishment only 25% has died. Another explanation is that the creation of HIS is a relatively recent trend in Delft and Trondheim. Just recently, universities in Delft and Trondheim introduced strong initiatives to support the creation of spin-offs especially the highly innovative ones. In addition, the size of the spin-offs (at the time of the sample) complies with the above patterns: HIS are relatively small compared with MLIS, witness 53.9% versus 31.3% including less than 5 fte, and 15.4%

versus 31.3% including more than 10 fte. With regard to the type of support received, HIS tend to make more often use of value-added support (like individual training of the entrepreneur and support in networking) than MLIS, witness shares of 61.5% versus 37.6% respectively.

Table 1. Characteristics of the sample (a)

	HIS	**MLIS**
Sample size	52	48
Average Growth (jobs)	Mean: 0.7 (S.D: 0.73)	Mean: 1.0 (S.D: 0.88)
	t-test: 1.69*	
Growth		
- Less than 0.5 fte per year	21 (40.4%)	17 (35.4%)
- 0.5 – 1 fte per year	13 (25.0%)	7 (14.6%)
- 1 – 2 fte per year	12 (23.1%)	16 (33.3%)
- More than 2 fte per year	6 (11.5%)	8 (16.7%)
Average Age (years)	Mean: 4.1(S.D: 3.11)	Mean: 6.2 (S.D: 2.60)
	t-test: 3.54***	
Age		
- Less than 4 years old	26 (50.0%)	8 (16.7%)
- 4-6 years	16 (30.8%)	23 (47.9%)
- More than 6 years (to 10 years)	10 (19.2%)	17 (35.4%)
Size (fte)		
- Less than 5 fte	28 (53.9%)	15 (31.3%)
- 5-10 fte	16 (30.7%)	18 (37.5%)
- More than 10 fte	8 (15.4%)	15 (31.3%)
Average R&D (% of annual turnover)	19.1%	50.4%
Support received		
- (1) Mainly conventional support	20 (38.5%)	30 (63.5%)
- (2) Limited extra added-value support	22 (42.3%)	9 (18.8%)
- (3) Extended extra added-value support	10 (19.2%)	9 (18.8%)

a. HIS: highly innovative spin-offs; MLIS: medium to low innovative spin-offs.

4. Resource Deficiency and Social Networks

University spin-off firms are usually short of resources. In some cases, this may take such proportions that the firms' survival and growth are in danger. Therefore, we will next examine which obstacles to growth have been faced most frequently by the two categories of spin-offs in our sample. We limit ourselves to the five most frequently observed obstacles per category of spin-offs (Table 2). There tend to be a different orientation in resource deficiency: HIS suffer most from lack of marketing knowledge (57.7%) and lack of investment capital (46.2%), whereas MLIS suffer most from lack of skills to deal with management overload (43.8%) and a combination of lack of marketing knowledge and sales skills, and skills to deal with uncertainty (each 41.7%). These different trends in resource deficiency comply with an image of HIS spending most of their time and resources to research and development, thereby neglecting the market and skills to enter the market, and developing a relatively large demand for investment capital beyond what can be satisfied.

Overall, the average number of obstacles faced by the two categories of spin-offs is almost similar, that is around 3.3 per spin-off firm. However, if we focus on the main obstacles (market-related knowledge, financial and management obstacles) MLIS have reported much more frequently to face these obstacles compared to HIS, witness a score of 2.1 versus 0.6. Previous research indicates that HIS tend to suffer quite strongly from the main obstacles only in their first years and are able in next years to solve or prevent the rise of these obstacles; this is different from MLIS that tend to remain struggling with serious resource deficiency through their life (van Geenhuizen and Soetanto, 2008).

Table 2. Obstacles to growth (current and past)

Categories		HIS		MLIS	
		Freq.	% (a)	Freq.	% (a)
Market-related knowledge	Marketing knowledge	30	57.7 (1)	20	41.7 (2/4)
	Sales skills	19	36.5 (5)	20	41.7 (2/4)
	Forecasting future markets	15	28.9	16	33.3
Financial	Cash flow	20	38.5 (4)	]13	27.1
	Investment capital	24	46.2 (2)	19	39.6 (5)
Management	Management overload	14	26.9	21	43.8 (1)
	Dealing with uncertainty	21	40.4 (3)	20	41.7 (2/4)
All obstacles		178		156	
Average number of obstacles per firm		3.4		3.3	
Main resource deficiency		0.6		2.1	

a. Share of spin-offs facing the obstacle.

The way in which we measured the various network characteristics can be found in Annex 1. Overall, the differences between social networks of HIS and those of MLIS are relatively small (Table 3). With regard to tightness of networks and strength of relationship, the two categories of spin-offs show roughly the same scores. This is also true for richness in content of knowledge. This finding seems to contradict assumptions on differences caused by the spin-offs' strategy. It is only with regard to heterogeneity of partners' background and proximity of partners that significantly different scores can be observed. HIS interact with more homogeneous partners and partners at a close distance than MLIS. We may explain this difference with the higher levels of risk HIS deal with and their relatively younger age, urging a stronger reliance on networks connected with the local university and local expertise in the technology field concerned.

Table 3. Characteristics of social networks

	Tightness	**Strength**	**Heterogeneity of partners**	**Spatial proximity**	**Richness in content**
HIS (52)	Mean: 0.51 S.D: 0.36	Mean: 2.15 S.D: 0.37	Mean: 0.56 S.D: 0.20	Mean: 0.65 S.D: 0.80	Mean: 1.96 S.D: 0.56
MLIS (48)	Mean: 0.59 S.D: 0.36	Mean: 2.13 S.D: 0.42	Mean: 0.49 S.D: 0.14	Mean: 0.86 S.D: 0.96	Mean: 1.82 S.D: 0.56
Significance test	-0.78	-0.23	-1.97**	1.30*	-1.48

* p<.10; ** p<.05;*** p<.01

5. Unraveling the Role of Social Networks in Growth

In this section, we examine to what extent the previously discussed social networks influence the growth of spin-offs, aside from the influence of various types of support and main resource deficiency. Overall, Table 4 shows that all models pass the statistical F test and the R-square (the goodness of fit) of the models shows a relatively high value. In the final model concerning HIS, five beta-coefficients are significant. The final model fails to confirm the influence of age, location, networking capability, support and strength of relationship on growth. With regard to MLIS, seven beta-coefficients are found to be significant. The beta-coefficient of age is insignificant. Thus, for MLIS, there is no evidence that age, location and interaction with predominantly local partners influence growth. In addition, Table 4 shows that by adding the five network variables the two final models (model 3) strongly improve in terms of explanatory power. It also shows that the significance of the beta-coefficient for age (HIS, model 1) and the one for networking capability (HIS and MLIS, model 1) decreases in the full model (model 3) including resource deficiency, support and network variables. Location is found not to be significant in any model.

If we focus on network characteristics in the full model, the following trends become clear:

- Based upon a different *sign*: strong relationships have a negative influence on growth of MLIS, but not on the growth of HIS; and, a large importance of local partners has a negative influence on growth of HIS, but not on growth of MLIS.
- Based upon a different *significance level*: the significance levels among HIS are lower than for MLIS, suggesting that HIS perform more independently and rely less on social networks.
- HIS and MLIS are broadly similar in that tight (dense) networks and networks with flow of poor knowledge have a negative influence on growth.

Thus, the above trends indicate that HIS employ more local partners than MLIS and this tends to have a negative influence on growth, and that HIS interact more often with homogeneous partners, a situation that also exerts a negative influence on growth. At the same time, the impact on growth tends to be modest as HIS rely less on social networks compared with MLIS.

Table 4. Results of the linear regression model estimation

	HIS			**MLIS**		
Structural characteristics	1	2	3	1	2	3
Age of spin-offs	.34***	.28**	.09	.16	.15	.08
Location	.05	-.09	.15	.11	.09	.09
Resources/capabilities						
Networking capability	.41***	.34**	.07	.48***	.40***	.14*
Main resource deficiency		-.21*	-.18**		-.45***	-.25***
Support received		.29**	-.01		.30***	.14*
Network characteristics						
Tightness of partners network			-.25*			-.30***
Strength of relationships			.07			-.19**
Homogeneity of partners			-.18**			-.20**
Poor knowledge content			-.22*			-.29**
Importance of local partners			-.22*			.03
N	51	51	51	49	49	49
F	9.08	9.87	13.08	5.43	9.75	21.49
Significance of F (Prob>F)	.00	.00	.00	.00	.00	.00
R^2	.31	.46	.75	.26	.50	.83
Root MSE	.65	.58	.42	.75	.63	.39

*p < 0.10 * *p<0.05 *** p<0.0

6. Conclusion

This study has the aim to increase understanding of the role of social networks in the growth of university spin-offs in two ways, through a comparative analysis of network characteristics among highly innovative spin-offs and medium to low innovative spin-offs, and through the estimation of a growth model using regression analysis for the two categories of spin-offs separately. Overall, it is found that social networks do play a significant role in the growth of spin-offs but to a smaller extent for highly innovative spin-offs compared to medium to low innovative spin-offs.

We can summarize the main results as follows: (1) highly innovative spin-offs tend to interact more often with homogeneous and local partners than medium to low innovative spin-offs, and (2) both situations tend to influence the growth of the first category of spin-offs negatively. Besides contributing to current research in the field of new entrepreneurship, this finding can be used to improve the policy in supporting university spin-offs. Support concerning networking, i.e. to learn to identify optimal network partners, to establish a relationship with them and to maintain these relationships as long as these are worth, needs to be provided to highly innovative spin-offs. Changing their networks to include more non-local partners and partners with a heterogeneous background, should be one of the aims of such specific support.

In general, tight (dense) networks need to be avoided, aside from homogeneous partners and poor knowledge content.

This is a first comparative research on influence of network characteristics on growth of highly innovative spin-offs and medium to low innovative spin-offs. We could observe various interesting trends, calling for the development and testing of hypotheses. In addition, we face a lack of knowledge on how spin-offs in different life-cycle stages may benefit from network building. Network characteristics may change over time and the best (or optimal) value of network characteristics is not known. Here lies an interesting field of new research.

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Appendix 1

	Measurement of indicators
Tightness	Measured by dividing the number of existing relationships by the number of potential relationships among partners. A high value indicates a tight network and a low value indicates a loose network.
Strength of relationship	Measured based on summation of three kinds of indicators suggested by Burt (1994) (i.e. frequency of interaction, duration of relationship, and founders' assessment of quality of the relationship). A high value indicates a strong relationship and a low value indicates a weak relationship.
Poor content	Measured based on different types of knowledge content flowing to ego (i.e. product development, technical advice, managing a new firm, etc). A high value indicates a rich content and a low value indicates a poor content
Homogeneity of partners	Measured based on different types of partners' background (e.g. academic, business). A high value indicates that many partners originate from the same background and a low value indicates that partners have diverse backgrounds.
Importance of local actors	Measured by the number of partners at a large distance divided by the number of local partners. A low value indicates a large importance for local partners.
Main resource deficiency	Measured by the number of main obstacles (market knowledge, financial and management) experienced by spin-offs during the years 0-4.

How University Incubators may be Overprotective and Hindering the Success of the Young Firm: Findings from a Preliminary Study

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Keywords: High-tech Entrepreneurship, Incubator, Spin-off Support, University Spin-offs

Abstract

This paper investigates to what extent university spin-offs benefit from their parent organization. Drawing on the resource based view and social capital theory we identify the support factors that may turn to interference with the spin-offs business goals. This study has a case study approach and data is collected among university spin-offs at the TU Delft. Preliminary findings provide insight in the extent to which support is valuable and when it can hamper the progress of the spin-off creation. Understanding the dynamics of the support can help improve the spin-off incubation programs.

Introduction

University spin-offs (USO) are typically founded by one or more scientists who have participated in academic research programmes that resulted in a scientific finding and that finding shaped the basis for their spin-off (Pirnay, 1998). Scientists bring to the spin-off their scientific experience and expert skills. Nevertheless, spin-offs start with some major disadvantages related to their newness and smallness. Spin-offs are constrained by their relatively small financial base, and lack of business experience, track records and assets. Support activities, that can be found in the universities, from which the spin-off emerged, can help spin-offs to overcome their liabilities of newness and smallness (Hansen et al., 2000; Gassman and Becker, 2006). Empirical research by Wright et al., (2006) and the Lambert Report (Lambert, 2003) reveals that while universities are increasingly keen to create spin-out companies; far too few of these grow and succeed. Given these observations, this paper examines the role of university support and illustrate how there may be times when the university is inadvertently overprotective of its young firm and thereby contributing to the problem of poor performance of university spin-outs.

Supportive University Infrastructures

The parent organization can be supportive through the transfer of explicit resources and implicit routines and legitimacy to the spin-off. We conceptualize parent support into tangible and intangible assets (Dierickx and Cool, 1989). Tangible support refers to all physical assets, such as the provision of intellectual property rights, finance, and accommodation. Intangible support is more oriented to the provision of expertise and coaching, such as guidance and advice. Compared to incumbents, technological start-ups are less resource-rich firms that generally seek technical, managerial and financial resources through alliances with established market firms (Hitt et al., 2000). Consequently, the common consensus is that if spin-offs receive support from their parent organisation, they can enjoy a competitive advantage. This support, however, does not sit comfortably with the equally clear evidence from Wright et al., (2006). Yet, little empirical research is conducted that analyses to what extent specific support activities are beneficial to university spin-offs. We suggest that the success of university spin-offs follows an inverted U-shape with the extent of support activities as provided by their parent organisation.

Research Method

The data for this study is collected from case studies at the Technical University of Delft. Since 1988 the university has offered a program of support for university spin-out companies. Since this time the level of support has varied, but it has included interest free loans, accommodation in a university building, support from academic faculty, and education courses. Among these university spin-offs we conducted our field study. Face to face semi-structured interviews have begun with the founders and entrepreneurs of a sample of these university spin-outs.

Results

Our preliminary findings from this on-going study reveal that parent support can benefit the spin-off if it concerns activities that help the spin-off entrepreneur to focus on transferring academic knowledge to commercial ends. In addition to delivering benefits, incubators can unwittingly hamper the progress of spin-offs if the focus is too much on certain aspects of support. The findings provide insight in how support contributes to remoteness from commercial environment, product myopia, imbalanced networks and cushion effects. Clearly getting the balance right between support and interference is clearly a difficult judgement for the university incubator managers. Being aware of those areas where support is turning to interference is valuable, and helps to understand to what extent support is beneficial to the university spin-off.

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LIFE SCIENCES IN THE NETHERLANDS: GROWTH DESPITE THE TIDE?

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Abstract

This paper examines the policy program in the Netherlands that aimed to improve the conditions for knowledge valorization in the life sciences. The Netherlands is an interesting case to study because the country hosts one of the largest numbers of newly established firms in the life sciences in the EU, while growth in this segment has remained limited due to a large share of small and vulnerable firms. The target number of newly established firms set in the program could easily be achieved and the program was able to improve the business climate for new firm establishment. However, the program could not improve conditions for growth of new firms because it could not achieve a comprehensive turn in the business climate, due to the short cycle-time of the program (4/5 years). In addition, the program did not take advantage of existing critical mass in the largest cluster or from any other competitive strength of particular clusters. However, regional competitive strength is now increasingly enhanced by regional initiatives.

Key words: life sciences, new firm formation, policy, institutional change, The Netherlands.

1. Introduction: Large Business Opportunities but also Huge Risks

Traditionally the term biotechnology was used to encompass technologies connected to recombinant DNA techniques and cell fusion (OECD, 1989). However, more recently the focus has broadened and covers: “the application of science and technology to living organisms, as well as parts, products and models thereof, to alter living or non-living materials for the production of knowledge goods and services” (OECD, 2006, p. 7). Currently, the most important technological trend is genomics, including the functioning of genes and metabolism in the cell, and systems biology (MEA, 2003; Ernst & Young, 2005). Results from new genomics research combined with improvements in existing technology, like cloning, cell and tissue culturing, and genetic modification, may imply drastically new approaches in identifying and curing diseases. In addition, biotechnology in health care increasingly connects with three other generic technologies, namely informatics and computational science, e.g., in data-mining in searching of new hits and in remote diagnostics and clinical trials; new materials technology such as in new types of artificial bone and tissues; and nanotechnology, such as in bio-sensors.

The combination and integration of the above technologies open ways to entirely new applications in products, processes and services, and provide a wide range of new business opportunities. The medical challenges to fight diseases of an ageing population and the strategy of large pharmaceutical companies to introduce new drugs

in the market in an era of expiring of many of their lucrative patents, as well as progress in the production of healthy food, add to these business opportunities.

Aside from clear business opportunities, newly established research firms are facing huge risks to survival and these risks are much stronger than in any other high-technology sector (Audretsch, 2001; Van Geenhuizen, 2003). For example, there is the threat of failure in research, early or later in a long and intensive development and testing time of new medicines. Then, these firms face the danger of not acquiring sufficient investment capital after initial rounds (equity gap). A large failure risk of start-ups may also be caused by customer resistance, but this applies mostly to agricultural and food applications, not to medical applications. In the context of start-ups adopting various strategies dealing with opportunities and risks (Barney, 1991) it is important to make a distinction between different business models, i.e., the product model, the tool model and the service model (BioPartner 2004; Mangematin et al., 2003). Product companies are highly innovative and undertake large R&D efforts in developing and bringing new products to market. Tool companies focus on developing platform technologies, like in functional genomics, and usually generate revenues through out-licensing and royalties. By contrast, service companies perform research on contract or offer standard or customized services to product and tool companies, and generate revenue from the start. There is also the hybrid company that typically combines activities of two or more of the previous models, particularly by adopting “safe” activities enabling to finance R&D internally, like sales of accepted products from manufacturers and routine contract research (e.g., Walsh, 1993). Another popular strategy of small firms to reduce risk is collaboration with large pharmaceutical industry, with the aim to improve financial position, to gain experience in testing and trial procedures, and to achieve access to marketing and global distribution channels (e.g., Powell, 1998; Senker and Sharp, 1997). More recently, we observe an increase of merging (acquisition) and alliances within the biotechnology sector, causing innovations increasingly to emerge in network configurations of firms (Salman and Saives, 2005).

Forecasting studies have indicated a large growth of economic sectors on the basis of application of life sciences. For example, global markets of sectors in which life sciences constitute a major part of the new technology were estimated to amount over 2000 billion Euro in 2010, including 820 billion in the pharmaceutical sector (EC, 2002). Against this background, the government of the Netherlands realized at the end of the 1990s that - despite an affluent new knowledge production and well-developed infrastructure for clinical trials - new entrepreneurship in the life sciences was lagging behind, due to serious institutional obstacles in the sector and a rather modest entrepreneurial culture in general and particular at universities. Note that scientists in the Netherlands are not very willing to leave their (comfortable) academic positions to get fully engaged in business activity (Enzing et al., 2005). In addition, universities did and do not receive a budget from the Ministry of Education, Culture and Science intended to develop the activity of knowledge valorization, particularly of enhancing spin-off development. In this sense, the position of universities as actors in the innovation system in the Netherlands has been and is relatively weak. On the other hand, since the mid 1990s the Ministry of Economic Affairs has implemented various tools to enhance the emergence and growth of high-technology start-ups, among others at universities. The dedicated action program for the life sciences fits into this

broader policy effort as a sector-based initiative (MEA, 2000; MEA, 2001). The action program employed a twofold aim, that is (1) to increase the economic utilization of (academic) life sciences knowledge through newly established firms (i.e. a total of 75), among others by (2) improving the business culture for new firm formation, particularly at universities.

This paper examines whether the above aim could be reached and whether various aspects of the policy were realistic. It starts with a discussion of the support program and with an analysis of potentials of the sector and of the actual size and spatial distribution of the segment of small, dedicated firms. This is followed by the focal analysis, i.e., of growth of this segment and changes in its structure (firm size, business model), and of underlying institutional aspects, the last mainly on the basis of an evaluation study by national policymakers and the design of a follow-up policy (MEA, 2006). The conclusion provides a set of learning experiences from the Netherlands' case study.

2. Action Plan Life Sciences

The Action Plan Life Sciences employed the principle of differentiating financial support to start-ups according to the stages of establishment and early growth, and included five lines in a comprehensive approach (Table 1). The aim was to support the establishment of 75 biotechnology firms in the years from 2000 to 2004, with a total budget of 45 million Euro. Of course, these are modest numbers, also if the budgets of two additional support programs are taken into account, but it needs to be realized that the Netherlands economy is relatively small (a GDP in 2005 of $ 595 billion) and that the country has just the size of some of the large biotechnology regions in the world, like the Boston area and the San Francisco-Bay area. However, a research initiative in the field of genomics (Strategic Action Plan Genomics) aimed at building a strong national research infrastructure was granted a budget of 189 million Euro for the years 2002-2007.

To implement the Action Plan Life Sciences, an intermediary organization was established, named BioPartner. BioPartner was also founded as a learning organization to scan the market and technology environment of biotechnology; to monitor the outcomes of its program lines and instruments, like characteristics of new entrants (product pipeline, business strategy, financial expectations).

Table 1 Program lines of Action Plan Life Sciences

Program lines	Details
1. First Stage Grant (pre-seed fund) *11 million Euro*	To stimulate researchers to apply for a patent and undertake applied research. It serves salary needs of researchers, costs of patenting, etc. up to 250.000 Euro for a maximum of 2.5 years.
2. Facilities Support (facility fund) *5 million Euro*	To provide loans to universities (research organizations) for pre-financing advanced life sciences facilities to enable start-ups to use these facilities against a reasonable price.
3. Start-up ventures (seed fund) *11 million Euro*	To provide investment capital on the condition that private parties also invest substantially (50% matching). The fund invests up to a maximum of 227.000 Euro and possibly another 227.000 in a subsequent financing round.
4. BioPartner	To provide laboratory, offices, R&D and pilot plant facilities and

Incubators) *11 million Euro*	shared services in university-linked incubators, and to facilitate easy access to universities and other companies (in *six* different places).
5. BioPartner Network *7 million Euro*	To facilitate and stimulate entrepreneurship through advice, information, scouting, training programs, and creating networks, e.g. founding of special chairs at the university and master classes.

Source: adapted from MEA (2000) and BioPartner (2005).

The policy may be qualified as follows:

- *Comprehensive*: a range of conditions underlying entrepreneurship are addressed, including public relations, entrepreneurial skills, accommodation and research facilities, seed capital, etc.
- *Network-oriented*: networks are addressed in two ways, i.e., as a tissue underlying biotechnology business in general and as a means for small start-ups to gain resources.
- *Stage-based in terms of company growth*: the financial incentives are differentiated for the pre-seed stage and seed-stage.
- *Cluster-based*: academic hospitals and medical schools are seen as anchors for new company starts and this holds for six larger and small clusters.
- *Strong self-learning*: the organisation monitors the external environment as well as the impacts from own instruments, and adjusts instruments if necessary.

Note that the cycle-time of the Action Plan Life Sciences was quite short, that is four/five years, and that the action plan was followed by a set of somewhat adapted program lines within a generic technology policy (named Technopartner).

3. Life Sciences in the Netherlands: Potentials, Size and Spatial Pattern

With regard to innovation output, the Netherlands holds an intermediate position in the European Union. Output as a result of research at universities, in large firms and small dedicated firms can be measured by the number of patent applications in the field, and can be seen as an indicator for a potential to be commercialized in the near future. As a percentage of the national total the Netherlands was in 7th position in the EU for the years 1996 to 1998, but felt back to a lower position in 2002 to 2004 (Table 2). The previous indicator reflects the level of specialization within a country. The next indicator shows the importance in the global playing field. In the EU, the Netherlands is in 4th position, following Germany at a large distance, and United Kingdom and France at a shorter distance. The overall impression is that based on numbers of biotechnology patents, particularly the world share in 2004, the Netherlands has a reasonably good position. However, patent position is only part of the story, the entrepreneurial climate, and integrative and relational ability in a country is the other part (e.g. Swan et al. 2007).

Table 2 Biotechnology patents (highest ranking countries in EU) a)

Country	**1996-1998, Share (%) in national total**	**2002-2004, Share (%) in national total**	**2004, Share (%) of country in world total**
Belgium	13.3	9.2	1.0
Denmark	12.7	12.8	1.8
UK	9.5	6.7	4.2

Ireland	7.2	4.3	0.2
France	7.1	5.2	4.0
Spain	6.2	6.9	1.0
Netherlands	6.0	4.4	1.9
Switzerland	5.4	5.5	1.1
Austria	4.5	4.6	0.6
Italy	4.5	3.5	1.2
Germany	3.9	5.1	10.0

a) Patent applications filed under the Patent Co-operation Treaty (EPO)
Source: OECD Science, Technology and Industry Scoreboard (2007).

The specific development of the life science sector in the Netherlands in comparison with other European countries is shown in Table 3. The Netherlands is in place five with regard to the number of firms and in place six/seven if this number is 'corrected' for the size of the economy, but the average size of the firms is the smallest among the top-ten countries and half the size of the average for the EU (22.9 versus 44.6). In addition, the Netherlands does not belong to countries with the more robust public biotechnology firm pipeline. In this respect, United Kingdom, Switzerland and Denmark are leading. What might have influenced this situation as a factor specific for the Netherlands - and different from for example, Switzerland - is that no large domestic pharmaceutical industry has been acting as a driving force, pushing small life science firms forward into next growth stages. This is a limiting factor because the growth particularly of medical life science firms is partly shaped by relations with downstream industry that provides demand (Senker and van Zwanenberg, 2001).

Table 3. Life sciences in Europe (10 highest ranking countries) (2004) a)

Country	**Firms**	**Firms/ billion GDP ($)**	**Employment**	**Average employment per firm**	**Product pipeline b) (medical)**
Germany	538	0.193	16.094	29.9	39
UK	457	0.208	21.134	46.2	211
France	233	0.110	9.142	39.2	36
Sweden	138	0.390	3.942	28.6	25
Netherlands	124	0.208	2.837	22.9	6
Denmark	117	0.461	18.461	157.8	50
Switzerland	90	0.246	4.990	55.4	109
Belgium	84	0.230	3.654	43.5	8
Spain	81	0.072	2.201	27.2	n.a.
Finland	66	0.342	2.160	32.7	7
Europe	2163	0.161	96.459	44.6	523

a) Use of a somewhat different definition compared with BioPartner (Table 4-6) that is, established biotechnology companies are also included.
b) Product pipeline gives the number of products in four stages (preclinical and Phase 1 to Phase III) for public firms only.

Source: Adapted from Critical 1/EuropaBio, 2006, except for product pipeline (Ernst & Young, 2006).

The domestic pharmaceutical industry in the Netherlands is either focused on generics production or on bulk compounds without a strong interest in life sciences, or it is has moved parts of R&D abroad (van Geenhuizen and van der Knaap, 1997). Aside from this, the domestic life sciences industry itself is not yet sufficiently strong to adopt such a role. It is only recently, that two domestic, medium-sized pharmaceutical companies attempt to adopt such a role, i.e. DSM Biologicals with a focus on

healthcare and food, and AKZO Pharma with a focus on particular drugs research. These circumstances have hampered the development of a bioscience *megacentre*, capturing major parts of the healthcare value chain (from exploration through examination to exploitation) in the Netherlands.

With regard to spatial patterns within countries, the literature indicates that the research-intensive life sciences industry (particularly in the medical field) is more than any other high-technology industry clustered around public scientific institutes as knowledge and facility providers, like universities, research hospitals and laboratories, and (mainly in the US) venture financing (e.g. Audretsch, 2001; Cooke, 2001, 2004a; Powell et al., 2002). In the 1980s and early 1990s, the idea of advantages from a clustered location for innovativeness and growth, including knowledge spillovers from the local university (academic hospital), was widely accepted. However, later empirical studies revealed overall weak relationships of the clustered firms with local knowledge institutes or revealed mixed evidence (e.g., Lawton Smith, 2004). For example, for the US Bagchi-Sen et al., (2004) reports a continued importance of proximity to university research but - with regard to factors affecting business performance - a relatively low importance of collaboration with knowledge institutes compared with in-house conditions towards product development. These results may gave rise to the idea that close proximity to knowledge institutes merely matters in the incubation stage of new firms. In later stages, relationships with local knowledge institutes may weaken when the firms enter global relationships and markets (van Geenhuizen, 2008).

The largest single cluster in the Netherlands is in the region of Leiden, midway Amsterdam and The Hague in the Western part of the country (Randstad). In measuring the size of clusters, official industrial statistics cannot be used because the companies are dispersed over different sectors in such statistics. Therefore, we made use of sector reports on life-sciences in which most companies are listed (BioPartner, 2001-2005). With approximately 30 dedicated life-science firms (note 1) Leiden is larger than other clusters, like Amsterdam and Groningen (between 15 and 20 firms) (Table 4). The cluster of Leiden at large encompasses around 45 firms when foreign subsidiaries, pharmaceutical industry, medical devices and consultancy firms are included.

The knowledge institutes in Leiden today include various faculties of the University of Leiden and its medical school and research hospital, two Higher Educational Institutes, an institute of applied sciences in prevention and health (TNO), and two national research centres of which one in genomics. Note that the relatively small size of the Leiden cluster, from an international perspective, should be seen in the context of the polycentric system of cities in which Leiden is located (Randstad). Thus, within a short distance from Leiden, one finds the life science clusters of Amsterdam (30 km), Utrecht (40 km), Delft (35 km) and Rotterdam (45 km). If defined as a *system* or *network* of clusters, the number of dedicated life science firms amounts to 80 (Table 4), but this is still small compared to various centres in the world. Already in 2000, the number of dedicated biotechnology firms amounted to 141 in Boston, 152 in San Francisco and Silicon Valley, 120 in Munich (Germany), and 94 in San Diego (Cooke, 2004a). Only Cambridge (UK) hosts a smaller amount of companies, i.e. 54.

Table 4 Approximate size of life-sciences clusters in The Netherlands (end 2005)

Location	Nr of firms	Details
Leiden	30	Within a distance of 5 km from knowledge institutes. Focus: *general and medical.*
Randstad: Amsterdam, Leiden, Delft, Rotterdam, Utrecht as a *network*	80	A distance of 20-40 km in-between the clusters (65 km. max.). Focus: *general and medical.*
The Netherlands	165	Max. distance of about 300 km (Groningen – Maastricht). Focus: *general and medical,* and *agro/food* (mainly in Wageningen).

a) Dedicated life-sciences firms.
Source: Adapted from BioPartner 2005.

Contrary to many assumptions on benefits from a clustered location, a recent study indicates that a location in a cluster in the Netherlands has no positive influence on innovativeness and growth. However, there are signs that a clustered location merely in Leiden has a positive influence on innovativeness (van Geenhuizen and Reyes-Gonzalez, 2007). Apparently, the largest cluster provides various beneficial qualities. Unique for Leiden, due to its older age as a cluster and its larger size, are the availability of a pool of specialized workers, the presence of specialized services, and accumulated knowledge concerning start-up processes and global networking (van Geenhuizen, 2008).

4. Dynamics and Structure of the Sector

This study - because it is limited in scope – does not allow to perform a formal *ex-post* evaluation of the Action Plan Life Sciences that is methodologically sound. Thus, causal relations between the policy and actual developments cannot be established because it is unknown how the sector would have developed without the policy. Also, with the exception of the number of newly established firms, it is impossible to identify to what extent goals have been reached because most of them were stated in a qualitative way. In addition, only a few reference cases of policies (policy lines) in other countries are available for comparison. The article examines whether the previously indicated aims could be reached and whether various aspects of the policy itself were realistic. The remaining section focuses on changes in *size* and *structure* of the segment of dedicated life sciences firms.

Compared with the late 1990s, there has been a clear increase in the number of entrants in the years of the effective policy. In 1998-2004 this amounted to 144.4%, bringing the total population of dedicated life-science firms at almost 160 firms (Table 5). In the years before the launch of the policy, the average annual growth of entrants was 11.5 whereas growth turned out to be almost twice as large in the years of the effective policy, i.e. 22. The launch of the program in 2000 was expected to result in the creation of 75 new firms. After five years, a total of 102 new firms could be established, thereby surpassing the initial expectations. When taking into account that the program was largely implemented in years of a macro-economic downturn, as reflected in a decrease in the overall level of new entrants in the Netherlands economy, the quantitative results are even more surprising (Table 5).

Table 5 Population and entrants of dedicated life-science firms

Years	Population (index	New entrants per year	New entrants per year all

	numbers)	(index numbers) (a)	sectors (index numbers)
1998	57 (100.0)	9 (100.0)	71.463 (100.00
1999	74 (129.8)	14 (155.6)	77.797 (108.9)
2000	97 (170.2)	24 (266.7)	88.014 (123.2)
2001	118 (207.0)	21 (233.3)	80.269 (112.3)
2002	126 (221.1)	18 (200.0)	68.961 (96.5)
2003	138 (242.1)	17 (188.9)	68.947 (96.5)
2004	157 (275.4)	22 (244.4)	76.252 (106.7)

Source: BioPartner, 2001-2005; MEA, 2003; EIM, 2006.

The increase of the population of firms in the years 2000 to 2004 (61.9%) was coupled with a stronger increase of employment (112%) and turnover (164%) (Table 6). Nevertheless, the growth of the sector manifested itself mainly in the small segment. This development is confirmed by figures on the size-structure. A large majority of dedicated life-science companies employs less than 10 fte and the share of this segment has increased between 2000 and 2004 from 65% to 73% (Table 7).

Table 6 Size-indicators and financial performance of dedicated life-science firms

Indicators	Period/Year	Outcome
Firms		
Population of firms	2004	157
Total increase of population (%)	2000-2004	+ 61.9%
Nr of new entrants	2000-2004	109 (22 on average) a)
Employment		
Size of employment	End of 2004	about 2.150 fte
Total increase of employment (%)	2000 – 2004	+112%
Financial performance and R&D		
Turnover	2004	190 million Euro
Total increase of turnover (%)	2001-2004	+164%
Net result (loss)	2004	- 75 million
R&D expenditure	2004	118 million
Total increase of R&D expenditure	2000-2004	+115%

a) Due to definitional issues, the sum over five years is slightly more than the number of entrants of each individual year as recorded in annual reports.
Source: Adapted from BioPartner, 2005.

This observation, together with a net result of a loss of 75 million Euro in 2004, points clearly to an early stage of the sector, dominated by relatively small and highly vulnerable firms. At the same time, there has been a shift in business models, on the one side to product companies (from 11% to 27%) introducing a higher level of innovativeness (and risk-taking) and on the other side to hybrid companies (from 49% to 57%) as a risk-aversive strategy, the latter leading to an overall majority of firms employing a hybrid strategy (Table 7).

Table 7 Size and business models among dedicated life science firms

Type of result	Period/Year	Outcome

Size structure		
<10 fte		73%
11-25 fte	} End of 2004	14%
26-50 fte		6%
> 50 fte		7%
Change in structure		
Share of firms < 10 fte	2000 - 2004	from 65% to 73%
Business model structure		
Service		8%
Tool	} End of 2004	8%
Product		27%
Hybrid		57%
Change in structure		
Service	2000 - 2004	from 33% to 8%
Product	idem	from 11% to 27%
Hybrid	idem	from 49% to 57%

Source: Adapted from BioPartner, 2005.

Of course, there are various success stories in terms of size and innovation in 2005, like *Crucell* (210 jobs after 11 years, including predecessor *Introgene*, and even much larger after the acquisition of *Berna Biotech* in Switzerland), *Octoplus* (90 jobs after 9 years), *Pepscan* (20 jobs after 6 years) and *Galapagos* (70 jobs after 5 years, including a site in Belgium) (BioPartner, 2005), but this does not change the nature of the sector.

Overall, we observe that in the period 2000-2004 90 dedicated lifescience firms were established and that 19% of them could not survive or were aquired/merged within this period (Table 8). It is difficult to say whether the survival rate is high or low because the age at exit is not exactly known (it differs between 1 and 4 years). We could speculate that the survival rate is about 80% four years after establishment and this rate comes close to what Mustar et al. (2007) observe for all categories of spin-off firms in the EU six years after establishment. However, most dedicated life-science firms get confronted with the equity gap just after the first years, meaning that the survival rate might seriously fall down in the years that follow.

Table 8 Established dedicated life-science firms and exits (2000-2004)

Established firms	Failure	Merged/acquired
90	9 (10.0%)	8 (8.9%)

Source: Biopartner Sector Reports; MEA, 2005.

By considering the recent past, we may conclude that the Netherlands life-science sector (dedicated firms) has remained in an early growth stage. The sector today primarily consists of small and loss-making firms with fewer than 10 employees. This situation, of course, gives rise to some interesting questions about institutional change and about other aspects of the action plan.

5. Improvements but no Turn

The Action Plan Life Sciences had a cycle-time of four/five years. In general this is too short to achieve institutional transformation, including formal and informal institutions. The cycle-time is also considered too short compared with the time-to-market of product firms in the life sciences (MEA, 2005a). When considering

institutional aspects of the action plan in more detail, the following five points need to be addressed:

(1) There was a positive change in the business climate concerning start-ups in the life sciences, particularly at universities, but there was no turn.
(2) There was no change in supply of venture capital in later stages, indicating a remaining risk-aversive attitude of investors.
(3) Pressure from strong regulation and long-lasting procedures, like in the agro-segment of life sciences has remained.
(4) The traditional policy model of equity (equality) was employed in the distribution of support over six locations, whereas regional economic policy was already in favor of the efficiency model (MEA, 2005b).
(5) A strong international orientation was missing, despite the small and open economy and increasing trend of globalization (van Geenhuizen, 2003).

Concerning the first point, the action plan was clearly able to contribute to reducing obstacles to starting up new firms in the life sciences. In terms of entrepreneurial culture, awareness has been increased and universities have adopted a more pro-active attitude with regard to valorization of life sciences knowledge (see, note 2 for the instruments used). The situation of what Swan et al. (2007) name a nation's integrative capabilities (the ability to move between basic science and clinical development) and relational capabilities (the ability to collaborate with diverse organizations) has clearly improved. However, the overall entrepreneurial climate has not yet improved in such a way that we can talk about a turn in this climate, due to the short time-span of the action plan (MEA, 2005a).

Concerning the point of financial support to start-ups, the policy was rather effective in the first stage (seed-stage) in which practical knowledge is translated into a feasible business plan. Of all applications for seed-fund in the four years of the program, 67 (52.3%) could be granted and this is more than later stage funding so far. However, it can be questioned whether solid entrepreneurship - in terms of the ambition to grow and take risks – could be introduced through this first-stage funding. The emphasis might have been somewhat too strong on gaining numbers of new firms (quantitative side) instead of gaining competitive firms (qualitative side).

Conditions affecting the supply of venture capital seem not to have changed. Thus, action line Start-up Ventures could not trigger the market, in which venture suppliers remained reluctant. Of all applications only 38 (17.0%) could be accomplished through finding matching funds. Note that this percentage will increase because various applications were still pending at the time of this study. It is difficult to say whether this result so far is a failure or success. The relatively small numbers of co-financed participations clearly stayed behind the number of granted applications of the first-stage grant, suggesting a trend of stagnation, but should also be understood in the context of the economic downturn in the years involved, facing a refraining from high-risk investments and a move to later stages. The lack of funding in early years following the start is also not a typical problem in the Netherlands (Ernst & Young, 2006). The equity gap is a hurdle in many European countries, stemming from a fundamental timing mismatch, particularly in new drugs research. As previously indicated, taking a drug candidate from discovery to product launch can last about 15 years, yet the life of a typical venture fund is about 10 years. Thus, the long road

between private investment and an IPO - an initial public offering, as a popular exit option – stretches beyond the preferred time horizon of venture funds. In this context, it may be questioned whether the short cycle-time of the action plan (four/five years) could ever have improved the situation. What became clear is that even with granting the venture funds, the equity gap for individual firms could not be sufficiently closed (MEA, 2005a). Overall, the size of venture capital investment is relatively small in the Netherlands, i.e., clearly smaller than in the Nordic countries and in the large EU countries (OECD, 2006) (Table 9). It is approximately ten times smaller than in the US and one-fifth of the share in the UK and Sweden.

Table 9 Biotechnology venture capital investment (2003) (US and the top ten EU)

Country	Venture capital investment (% of GDP)
United States	0.031
Denmark	0.024
Norway	0.022
UK	0.016
Sweden	0.015
Switzerland	0.009
Finland	0.008
France	0.007
Germany	0.005
Belgium	0.005
Netherlands	0.003

Source: Adapted from OECD 2006.

However, there are recent signs that venture capital firms active in the Netherlands are willing to take some more risk, meaning that they select the most promising ventures and withdraw from them somewhat earlier compared with the common pattern (Personal Communication, 2006). Thus, the situation of a general risk-aversive culture on the side of venture capitalists seems slightly improving. In addition, in the follow-up policy since 2005, venture funds investing in risky firms were given the opportunity to receive a loan and this has already doubled the amount of available venture capital in the first year (MEA, 2006).

With regard to the next point, pressure from long-lasting and complicated procedures and tight regulation (the last influenced by a powerful ethical lobby against transgenic breeding and genetic modification of plant varieties) changes have been minor. This situation has pushed some start-ups to leave the country (e.g., Enzing et al., 2005), and seems to have contributed to a rather poor position of the Netherlands in Europe in the area of trait field trials of new GM plant varieties (comparable with patents), for example, 6 for the Netherlands as compared with, for example, 120 for Spain, 42 for France, 24 for Germany, and 17 for Sweden (in 2002-2004) (OECD, 2006). The follow-up policy since 2005 addresses various important improvements in this respect, like shortening the time for application for permits and licences (to the average European time as maximum) and reducing and simplifying the laws concerned (MEA, 2006).

The fourth point – the distribution of six incubators over the country - reflects an old institutional model in (regional) economic policy in the Netherlands, namely the one following the idea of equity, in which each candidate receives the same support. Thus, the cluster of Leiden - where opportunities appeared to be better than elsewhere - was

not ‘favored’ in the action plan. The alternative model, i.e. efficiency in terms of strengthening what is already strong in a frame of increasing international competition, like adopted in the latest regional-economic policy document (MEA, 2005b), was not at stake. As a result, the action plan might have missed a chance to create the critical mass needed in a strongly competitive market and might even have caused duplication between clusters. In a situation of, for example, three large incubators and a strong specialization of each of them, critical mass might have been created more quickly and the competitive power and image towards foreign biotechnology actors might have been stronger. Overall, it is plausible that policies addressing a certain degree of *competition* between regions and giving priority to the best performing ones, like in Germany on the basis of the *BioRegio* policy and later contests of R&D cooperation, lead to better results (Cooke, 2002; Eickelpasch and Fritsch, 2005). In fact, some of the incubators in the Netherlands faced difficulties in finding tenants, caused by the relatively high (market-conform) prices and supply of cheap laboratory room by the knowledge institutes in their own buildings (MEA, 2005a). Note that an alternative development path would have been to start with a virtual network organization connecting various local biotechnology research and coordinating emerging initiatives of technology transfer at the universities, with finding entrepreneurs as a second step (LIFEscience, 2006). This model was employed in Flanders in Belgium, where the Flanders Interuniversity Institute for Biotechnology (VIB) was established already in 1995, connecting and coordinating initiatives at the four Flemish Universities (VIB, 2006).

The final point, the lack of a strong international orientation, has prevented a clear positioning of the Netherlands’ life sciences abroad and may have contributed to missing chances for cooperation by small firms. As previously indicated, it is typical for the Netherlands - at least in the medical/pharmaceutical segment - that corporate partnering is often immediately in a global playing field due to missing domestic partners. This situation seems somewhat changing today due to a greater ambition of some domestic firms to cooperate with small ones. Nevertheless, a budget to create better opportunities for collaboration abroad, including support in connecting, checking and negotiation of the best time and terms for collaboration, could have helped. This issue has been explicitly addressed in the follow-up policy in a new action line (MEA, 2006). Thus, small firms are now stimulated to participate in large fairs, exhibitions, and fairs abroad, and in individual partnering and matchmaking activities abroad.

Most recently, the need to prevent fragmentation of initiatives and research in medical life sciences was recognized as is witnessed by the establishment of the national Top Institute Pharma (TI Pharma) and its location in Leiden. This institute aims to achieve leadership in areas critical for the international competitiveness of the Netherlands’ pharmaceutical and biotechnology industry, among others by connecting and merging results from fragmented disciplines, programmes and locations (www.tipharma.nl).

Overall, given the above circumstances, it may be speculated that the landscape of the Netherlands life sciences could have been different if there had been a focus in the beginning on two/three larger clusters or networks of clusters selected upon *competitive* initiatives and co-ordination from the beginning. More importantly, the size structure might have been more favorable with a smaller amount of small and

vulnerable firms due to a stronger impulse per cluster. The same might be true if a stronger impulse was given to a smaller number of firms through a tighter selection and a longer period of financial support than 4/5 years while using the same budget as in the original program.

On the other hand, the Action Plan Life Sciences has helped to establish and improve the breeding ground for highly professional initiatives in regions that have adopted life sciences as a spearhead in economic development. This holds true, for example, for the region of Leiden in cooperation with Delft in the Province of South-Holland, benefiting from a long-standing experience, a strong knowledge infrastructure, and presence of various grown-up life science firms, and for the region of Maastricht in Limburg, the Southernmost province. This region benefits from the operating base of DSM, the world largest supplier to the life sciences industry, and from cross-border cooperation opportunities with universities and academic hospitals in Hasselt, Liege (Belgium) and Aachen (Germany).

6. Conclusion

This paper presented the results of a critical examination of the Netherlands' policy to enhance entrepreneurship in the life sciences, implemented in 2000 to 2004, and some new lines in the follow-up policy. It can be concluded that the aim of the life sciences policy, i.e., to improve the climate for the establishment of dedicated firms and to establish 75 of such firms, was achieved but that a basic turn could not be realized. The increase of the number of newly established firms exceeded the aim and was impressive compared with other EU countries, but it has led to a large segment of small and vulnerable firms, many of them suffering from an equity gap. It seems reasonable to ascribe this development to the following factors: a relatively short cycle time of the policy (4/5 years), missed chances by the policy to benefit from some unique circumstances in the largest cluster (Leiden) and from a selection of the best regions based on competition, a weak international orientation of the policy, and various disadvantages in procedures and regulation, the last falling beyond the competence of the program. A somewhat too strong focus of the policy on numbers of firms (in stead of competitive strength) may have added to the outcomes. In fact, the previous insights are the experiences from which lessons can be drawn by other small and open economies facing a relatively weak entrepreneurial culture.

Given the situation of a relatively large population of small firms facing some intrinsic weaknesses, it is uncertain whether the sector will be able to move to a mature stage including the emergence of medium-sized and larger companies. Alternatively, the sector may face a shakeout among small and vulnerable firms or face small firms remaining small and decreasing their R&D effort. The Action Plan Life Sciences ended in 2004 and was taken over by a generic program in which most of the above learning experiences as well as the problem of equity gap were explicitly addressed and attempted to be solved. The question remains whether a national policy can substantially help preventing the equity gap, in the way suggested in the previous section or by reducing the timing mismatch through a model in which a public support fund is responsible for the first (five) years and market parties for the following years within their time-horizon. Such a policy or any other financial support policy (like fiscal measures) may perform better if there is a *selection* procedure of most promising firms. Here lies a field of research, i.e., of success and

failure factors of life-sciences start-ups in survival and growth, and of ways to predict success from characteristics at an early age. Another research line would be to identify how the adoption of the hybrid business model may help to avoid the equity gap. The hybrid model may be adopted in the first years to build a solid business after which the firm moves to a higher level of innovativeness (product model). Overall, a close examination of small life science firms in the Netherlands drawing on a longitudinal panel design is necessary in order to study how these firms take hurdles in moving into next growth stages, for what reasons they fail and in what respects support policies need to be adapted. Results from such a study may also help to clarify whether the policy in the Netherlands has led to outcomes that stay behind or just fit into a more general slow and incremental pattern of life sciences development outside the megacentres. The monitoring preferably also takes a broader scope than merely dynamics of the firms. By including labor market impacts, other indirect impacts in the regional economy, and improvements in health- and medical care and in agriculture, policies to enhance the sector will gain a larger legitimacy and support.

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Notes
Note 1. Dedicated life science firms are newly established, entrepreneurial firms in life sciences, excluding diversified firms, foreign subsidiaries, consultancy and medical devices firms.
Note 2. For example, the organization of master classes, the initiation of professor chairs at universities in biotechnology business, and the appointment of several scouts to track and trace promising research.

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Harvesting the results of the mentoring process of knowledge intensive startups

WORKING PAPER!

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Abstract

Mentoring is often used by business development programs to assist startups. In this paper we look at the perceptions of protégés and mentors about this process, hereby different business development programs in Europe were incorporated. It was hypothesized that there is a relationship between contact frequency and amount of support delivered to the protégé. This hypothesis was partly supported. Furthermore we hypothesized that if the amount of support is higher that the positive associated outcomes like trust and benefits to the protégé also will be higher. This hypothesis was mainly supported for the benefits of the protégé. Last also the relation between short and long term outcomes was hypothesized. The research showed that there is a relation between the benefits and the profoundness of the relation in the long term. The corresponding implication for program managers are discussed below.

Introduction

Mentoring as a research subject has received a lot of attention in the past few years. It is considered of crucial importance by many authors for the career, academic, and psycho-social development of people (Bierema, 2002). Especially the impact of structural factors surrounding mentoring relationships, and characteristics of mentors and protégés have received a lot of attention by authors (Young & Perrewé, 2000). Despite this interest in mentoring, the focus on mentoring has been narrow in the sense that most articles about business mentoring are about mentoring for career development (Whitely & Coetsier, 1993; Ritchie & Genoni, 2002). Mentoring for self-employed has got less attention, although some articles are written about it (Waters et all, 2002; Sullivan, 2000; Akmaliah et all, 2007). This is remarkable because in these articles the benefits of mentoring to the survival and growth of small and medium sized enterprises is acknowledged (Wikholm et all, 2005; Cull, 2006). The added value of a mentoring relationship for a small and medium sized enterprise even seems 'longer-term' (Sullivan, 2000). For new ventures this is applicable as well, researchers name it as one of the most important support factors for new ventures besides business incubators (Akmaliah et all, 2007; Bellini, 2002) and its practical relevance is underlined by the presence of a mentoring part in most business development programs.
Despite this presence, the role of mentoring in assisting people who start their own business has received "scant empirical investigation" (Waters et all. 2002). As a result, it is difficult to say whether the principles of career mentoring will be applicable to mentoring of startups and if the benefits are really 'longer-term'.
This is even more problematic because the existing empirical data about mentoring as a business development mechanism derives from just one certain business development program like for the research of Waters et al. (2002). The present study tries to fill this gap by drawing up the

experiences of more then one business development program by investigating different business development programs for knowledge intensive startups across Europe. These formal programs are linked to different Universities in Europe and all have mentoring as an important part of the program. This makes it possible to research mentoring for starting entrepreneurs in a more comprehensive way, not just based on one program. The corresponding findings thus will be less narrow applicable than empirical research done before. The research thereby focuses on the mentoring process and it short and long term outcomes instead of antecedents or structural factors, something suggested by several researchers (Young & Perrewé, 2000). By researching the mentoring process essential factors for successful relationships can be identified (Young and Perrewé, 2000) and the empirical research can help to link the mentorship phases, functions and outcomes, something seen as important by Chao (1997). The exchange itself is examined by investigating the link between the degree of mentoring, the perceptions of the received support and the resulting short and long term outcomes.
To ensure that the research is unbiased we incorporate the perspectives from both the mentor and protégé into the research, like suggested by Gibb (1994) and Young and Perrewé (2000).

Theoretical background & Hypotheses/ Theoretical foundations

What is Mentoring?
Mentoring takes place in a variety of socio-economic contexts (Sullivan, 2000) and with different objectives like psycho-social development (Baldwin Grossman, 1998), academic development (Young & Perrewé, 2000) and career development (Whitely & Coetsier, 1993). Its precise role may change dependent on this context and associated objectives of the mentoring relationship (Sullivan, 2000). Therefore in the literature there is very little agreement about an universally accepted definition of mentoring (Broadbridge, 1998; Sullivan, 2000; Bierema et all., 2002). By some authors mentoring is seen as an one-ton-one relationship between an "experienced person and a less experienced person that provides a variety of developmental functions" (Waters, 2002; Tabbron et all., 1997). That this definition may be too narrow can easily be derived from the fact that in another context, namely for group mentoring, this definition won't hold. With group mentoring (or co-mentoring) "the mentoring function is supplied by a more or less tightly constructed group of professional colleagues" (Ritchie et all., 2002). Furthermore, there is the difference between mentoring and coaching that is that is not always that clear. Things that are seen as mentoring by one author, can be seen as coaching by another. For this research we distinct mentoring from coaching following Tabbron et all. (1997) who argue that coaching "has a more immediate performance-based focus". Mentoring, as said before, takes place in a variety of socio-economic contexts and as such its precise form and role may differ. Above already one-to-many (group mentoring) was distinguished from "one-to-one" but there are more different forms that can be identified in the literature. One example is the difference between face-to-face mentoring and remote (tele)mentoring. The latter has been defined as "a computer mediated, mutually beneficial relationship between a mentor and protégé which provides learning, advising, encouraging, promoting, and modeling, that is often boundary less, egalitarian, and qualitative different than traditional face-to-face mentoring"(Bierema et all, 2002). These different forms can arise in one relationship, for instance when someone's mentor e-mails his advice to his protégé because he has no time for a face-to-face meeting at a certain day. This kind of mentoring has arisen thanks to the advancements of information communication technologies (ICT). Video conferencing and chatting have become normal in the past years and so has e-mentoring.
Apart from the means of communication another different forms of mentoring identified in the literature namely peer mentoring and hierarchical mentoring. In these peer mentoring is seen as a mentoring relationship between two individuals who hold a comparable position in terms of status and experience (Ensher, 2001). With hierarchical mentoring, in contrast, the protégé holds a lower position in terms of status and experience then his or her mentor.

One distinction that is found in almost every article about mentoring is the distinction between two main forms of mentorship: formal and informal. (Young & Perrewé, 2000; Waters et all,2002; Broadbridge,1998; Wikholm, 2005). The difference in these two lies primarily in the way the relationship is arranged. With formal mentorship programs the relationship is arranged by a third party who sees the pairing of two (or more) members (of an organization or program) as important for the development of at least one of the two. Often this relationship is the result of a "formal organizational policy" (Broadbridge, 1998) or a "conscious effort by decision-makers to pair together members of an organization" (Young & Perrewé, 2000). Informal mentor relationships in contrast are arranged by two (or more) people themselves, they choose to enter into an relationship from which they can benefit in the development on certain aspects like career development or academic development. "It is a private arrangement between two individuals" (Broadbridge, 1999)that often is the result from "a personal bond between two individuals that develops from common interests, goals, and accomplishments". (Young & Perrewé, 2000). According to some research there is a difference between the length of such programs, while formal programs typically run over one year, informal mentoring relationships can last from three to six years (Kent, 2003).

Stages of mentor relationships

Kram (1983) identified four distinct stages of evolution through which a mentoring relationship progresses: Initiation, cultivation, separation and redefinition. The initiation is the first phase in which the mentor relationship is started (Chao, 1997). This first 6 to 12 months are characterized by fantasies of both the mentor and the protégé about each other when considering the development of the relationship (Kram, 1983).

Cultivation is the next phase, during which the range of functions that is provided is maximized (Kram, 1983). This phase normally lasts from 2 to 5 years and the mentor and protégé get to know more about each other's competencies which helps them to optimize the benefits of the mentor relationship (Chao, 1997).

In the phase following, the nature of the relationship changes. The protégé acts more independent, both are separated structural and psycho-social and the support provided by the mentor decreases (Chao, 1997). This so-called separation phase last between 6 and 24 months and is succeeded by the redefinition phase. In this phase the relationship evolves towards a new significantly different form or ends entirely (Kram, 1983). The time needed to develop through all these stages normally is, according to a study by Kram (1983), 5 years. The different phases named above are associated with different forms of support (Chao, 1997; Young & Perrewé, 2000), namely career-related support and psycho-social support. These different behaviors will be explained in the next section.

As a result of these differences between phases found by other researches, when studying a mentor relationship it is important to determine in which phase the relationship progresses. Not only to give an complete overview, but also because it can give us some better understanding of the different phases.

The focus of this study is on formal mentoring programs in a business setting with the mentor being more experienced then the protégé. The corresponding relationships are based on Kram's theory (1983) in the initiation or cultivation phase. We will research the link between the frequency of contact, the perceptions of both the mentor and the protégé on the functions enacted and the perceived outcomes. Hereby the perceptions of the received support is based on the perceived exchange behaviors and the resulting outcomes. In the next section an explanation will be given of the specific variables that are of importance for our research, the theory that makes up our research model and the related hypotheses.

Role behaviors and Outcomes of the relationship

Degree of mentoring

Degree of mentoring in this research is the frequency and quality of contact. The frequency of contact often is named as something that can be determine if a mentoring relationship will be successful or not and may affect the dynamics of the mentoring relationship(Bierema et all., 2002; Allen et all., 2003). This is underlined by the research of Waters et all. (2002) who found that the frequency of contact was positively associated with perceived support. As a result of this relationship, one can say that a lack of contact may be detrimental (Waters, 2002). Not surprising frequency of mentoring in studies on certain forms of mentoring is seen as one of the variables that should be investigated to explain differences in outcomes and quality of a relationship (Whitely et all, 1991; Dubois, 2005) therefore our first hypothesis is:

H1: The frequency and intensity of the support is of influence on the amount of support that is received by the protégé.

Role behaviors

Mentoring support is divided by Kram (1983) into career-related and psychosocial functions. Career-related functions are directly related to the protégés career advancement (Chao, 1997). These functions help the protégé to acquire the skills and knowledge required to succeed in an own business (or organization) (Sullivan, 2000). These function include sponsorship, coaching, exposure-and-visibility, protection and challenging assignments (Kram, 1983).Psycho-social functions are more related to the clarity of identity and competence (Chao, 1997). These functions support the protégé in developing effectiveness in a professional role, a sense of competence and confidence (Sullivan, 2000). These functions include role modeling, acceptance-and-confirmation, counseling and friendship (Kram, 1983). Although some of the constructs in these distinction still are being improved, these distinction still is made by a lot researches on mentoring (Young and Perrewé, 2000;). It even is used by a lot of researchers to research the functions in the mentoring exchange process (Waters, 2002; Wikholm, 2005 ;Johnson, 1999; Scandura, 1998). Young and Perrewé (2000) for example examined the career-related support and psychosocial support among mentors and protégés in the later stages of a (non-business) formal relationship.

For our research we will look at the role of career-related and psychosocial support in earlier stages of the mentoring relationship. The phases incorporated are, based on Kram (1983), the initiation and cultivation phase. The relationships under investigation are formal mentoring relationships that exist for a year as part of a business development program. Following Kram (1983)we propose that the relationship at that time probably is somewhere at the end of the initiation phase and/or at the beginning of the cultivation phase. At this time the psychosocial support and career-related support become more important according to Chao (1997). In their article Waters et all (2002) tried to establish the difference between psycho-social support and career-related support. They tested the hypothesis that “mentors will provide higher levels of the career-related function than the psycho-social function” (Waters et all., 2002). This hypothesis was rejected but could be interesting to look at for more then one program. So our next Hypothesis is:

H2: The perceptions of the mentor and protégé about psychosocial and career-related support given to the protégé are in line with each other

Short term outcomes of the relationship

The outcomes of the mentoring relationship have been examined in different ways. Outcomes that were studied were for instance business success (Waters et all, 2002), career outcomes (Whitely, 1999) and relationship effectiveness (Young & Perrewé, 2000). According to some researchers it may be more interesting to study the outcomes on a psychological level because this outcomes will help researchers to understand the mentoring process even better (Young and Perrewé, 2000). Mentoring research could benefit from this integration with psychological research so that the theory in the area of mentoring could be advanced (Russel & Adams, 1997). Therefore, following Young and Perrewé (2000) we will focus on the perceived relationship exchange quality to look at the outcomes of the mentoring. These focus can help us also to get some more insight into the question why some relationships are successful whereas others are not (Young and Perrewé, 2000). To determine these outcomes we will focus on two factors related to perceived relationship exchange quality, the perceived benefits and trust. Trust is chosen following Young & Perrewé (2000), who identified it as an outcome of the mentoring relationship. Perceived benefits is one of components of relational quality identified by Allen et all. (2003) along with satisfaction with the relationship and relational depth.

Perceived benefits

The benefits of mentoring have received a lot attention among researchers (Broadbridge, 1999). This is especially true in career mentoring where mentoring has been linked to (among others) career satisfaction (Whitely & Coetsier, 1993; Chao, 1997), career satisfaction and promotion (Whitely & Coetsier, 1993). When talking about mentoring for the self-employed, the outcomes have been examined to a lesser extent. Waters et all (2002) have linked to self-esteem and business success but further little research in this area exists. In the literature mentoring often is seen as a two-way learning relationship from which both the mentor and protégé benefit (Ritchie 2002); (Clutterbuck 2002). Theorists in the field of career mentoring have identified a number of potential benefits associated with becoming a mentor (Ragins & Scandura, 1999). The primary benefit according to Ragins & Scandura (1999) is “the sense of satisfaction and fulfillment received from fostering the development of a younger adult”. These benefits can be split up in a number of variables that make up this satisfaction: Contribution to future generations that gives a sense of immortality, internal satisfaction from making a productive use of skills and wisdom, self-rejuvenation, career advancement, tangible, work related benefits, obtain valuable work-related information and feel challenged (Ragins and Scandura, 1999);(Broadbridge, 1999). These benefits can be translated to mentoring for self-employed but one should take into consideration that for an starting entrepreneur the benefits for his business are seen as most important. This is the purpose of the different business development programs and therefore also of the mentoring part of those programs. The perceived benefits for the entrepreneur examined in this study, therefore, are those benefits associated with a direct or indirect impact on the business of the entrepreneur.

H3a: If the perceptions of support to the protégé are higher, the associated benefits for the mentor and protégé also will be higher

Trust

Trust is a variable that is seen as critical for relationship exchange quality (Young and Perrewé, 2000) and one of the essential components of cooperative relationships like a mentoring relationship (Bierema et all, 2002; Smith et all, 1995). According to McAllister et all (1995)belief that the trust in a

relationship between people, sometimes referred to as interpersonal trust can be divided into Affect-based trust and Cognition-based trust. Hereby with affect-based trust the foundations for trust are affective, consisting if the emotional bond between people (McAllister, 1995). Trust is cognition-Based in that people choose who they will trust based on knowledge available (McAllister, 1995). According to Young & Perrewé (2000) engaging in sufficient amounts of role behaviors that meet expectations will result in trust. This seems logical while the dimensions of trust identified by McAllister (1995) are quite similar to the types of role behaviors, career-related (Cognition-based) and psycho-social (affect-based). In this way we arrive at our next Hypotheses:

H3b: If the perceptions of support to the protégé are higher, the associated trust in the other party for the mentor and protégé also will be higher

Long term impact

In our opinion it is also of importance to see whether the relation is continued after the program. This can tell us if the development of the relation in case of a business development program is in line with the findings of Kram (1983). As said before the relationships during in the business development program are in the initiation and cultivation phase following the theory of Kram (1983). Hereby the outcomes of the relationship determine whether both parties are willing to continue the relationship therefore we propose the next hypotheses.

H4a: If as a result of the relationship the benefits were higher then the profoundness of the relationship in the long term also will be higher.

H4b: If as a result of the relationship the trust in the other party was higher then the profoundness of the relationship in the long term also will be higher.

Impact of different types of mentors

In the programs under study different types of mentors are used. These different types can be divided into business mentors and scientific mentors. Business mentors in essence are meant to assist the protégés with business related problems while scientific mentors most of the time are linked to the University and support the protégés in a more scientific way. It would be interesting to see whether there is a difference between the amount if support delivered by the different types of mentors because this insight can be used by program leaders of business development programs to improve their programs. We therefore propose the last hypothesis:

H5: Different types of mentors give different amounts of support

Method

Sample

This study focuses on a particular form of mentoring, mentoring as a mechanism to support starting entrepreneurs at Universities. Data was collected from two separate groups of individuals who were in an formal mentoring relationship as a result of a business development program at a Universities. Hereby participants of these business development programs were targeted as protégé questionnaire. People who were paired with participants of these programs to assist them during the program as a mentor in the scientific or business field were targeted for the mentor

questionnaire. The business development programs, more specific the mentoring part, under study are conducted at universities in the Netherlands, Sweden, the UK, Ireland and Finland. The programs differed in the sense that some programs only assigned a business mentor to the entrepreneurs while others assigned both to them. Ultimately 206 entrepreneurs were contacted of which 70 responded, a response rate of 33%. Some of these entrepreneurs had filled in the questionnaire for one mentor and others for more then one. For the mentor sample 120 business and scientific mentors were contacted all linked to the same programs as the entrepreneurs. 38 of them responded which gives a response rate of 32%.

Operationalization of the research variables

In this section the operationalization is given of the research variables as those are used in the different questionnaires. A summary of this operationalization is given in table 1. The operationalization is divided into three parts; the role behaviors, the mentoring outcomes and the long term impact.

Role behaviors

Following other research the role behaviors are tested by dividing them into two types: psychosocial support and career-related support. For the psychosocial support the scale of Waters et all (2002) is used. This scale consists of 4 items with a response scale ranging from “A slight extent” (1) to “A large extent” (5). All 4 items are tested on the perception of the respondent on the support received and given. Two examples of items are “To what extent do you get personal satisfaction from the relationship you have with your mentor?” and “In the opinion of my mentor the extent to what he/she gets personal satisfaction from the relationship is?”. The Chronbach alpha for the psychosocial support from the protégé perspective was 0,885 and for the mentor 0,725.

For the career-related support we used a modified version of the Waters et all. scale for career-related support. This is because during our interviews with program managers of some business development programs we came along the so-called TEMO-model that is used by some programs to mentor/coach their participants. TEMO stands for Technical Matters, Economical (Financial) Matters, Market and Organizational Matters. All these parts work together to achieve the Vision/Strategy of the entrepreneur. We modified the Waters by inserting the TEMO parts and the corresponding Strategy into the Waters model to come to a 5 item scale with the same response scale ranging from “A slight extent” (1) to “A large extent” (5). Again these items were tested on the perception of the respondent on the support received and given. One example item is “To what extent do you provide your protégé with advice about Technical Matters?”. The Chronbach Alpha for this scale was 0,779 for the protégé sample and 0,760 for the mentor sample.

Mentoring Outcomes

As said before, mentoring outcomes are among others trust and perceived benefits by the protégé and his/her mentor. To test the trust as an outcome of the relationship the trust scale of Butler (1991) was used following Young & Perrewé who used it in their research. This scale consisted of 10 items on a 4 point likert scale ranging from Agree (1) to Don’t agree (4). An example of an item is “My protégé is honest”. For the protégé sample the Chronbach alpha turned out to be 0,949 and for the mentor sample 0,910.

For the perceived benefits we used the mentor benefit scale developed by Ragins & Scandura (1999) and translated this for the protégé. The scale consists of a 7 point Likert scale ranging from "Strongly disagree" (1) to "Strongly agree" (7), 10 items for the mentor and 8 items for the protégé. One sample item is "The rewards that come from the mentoring relationship with my mentor more than compensate for the costs." The Chronbach alphas in this case were 0,959 and 0,864 for the protégé and mentor sample respectively.

Long term impact

This scale consisted of 5 items tested on a 4pt-Likert scale with sample items like "the relationship with my mentor has developed into a collaborative relationship". This long term impact only was tested for the protégés. The Chronbach Alpha for the protégé scale was 0,839.

Variable	Operationalization	Origin	Measure
Trust	Availability Competence Consistency Fairness Trustworthy Integrity Loyalty Openness Promise fulfillment Overall trust Receptivity	(Butler, 1991)	4pt-Likert
Mentor/protégé Benefits	Creativity Internal satisfaction Career advancement Trust Recognition Obtain valuable information	(deducted from, Ragins, Scandura, 1999)	7pt-Likert
Psychosocial support	Personal satisfaction Personal development Emotional support Friendship	(Scale mentoring in new business, Waters 2002)	5pt-Likert
Content / Career-related support	Technical Matters Economic/Financial matters Market matters Organizational Matters Strategic Matters	(Combination of career-related support out of scale Waters, 2002 TEMO-model)	5pt-Likert
Long term impact	Contact Advice Collaboration Shareholder		4pt-Likert

Table 1: Operationalization of the research variables

Procedure

The questionnaire is constructed based on the theory given above. A Dutch, English and Swedish version of the questionnaire were thought of, but ultimately an English and Dutch version were

made one for the protégé and one for the corresponding mentor. These questionnaires were checked by several specialists and some target respondents before it was put out.

Analysis & Results

The two resulting samples of this study were analyzed separately. Descriptive statistics and correlations were calculated for all variables and are presented in table 2 for the protégé and table 3 for the mentor's sample. The different hypotheses were tested with non-parametric tests and linear regression.

	N	Means	SD	1	2	3	4	5	6
Contact frequency	74	2,3	0,872	NVT					
Psychosocial support	73	12,32	4,65	-0,454**	(0,885)				
Career-related support	66	14,33	4,86	0,239	0,430**	(0,779)			
Protégé benefits	65	38,6	12,004	-0,369**	0,788**	0,594**	(0,959)		
Trust	71	13,9155	5,557	0,284*	-0,573**	-0,260*	-0,517**	(0,949)	
Long term	62	14,47	4,234	0,400**	-0,653**	-0,340**	-0,676**	0,513**	(0,839)

Table 2 For protégé * correlation significant at the 0,05 level (2-tailed), ** 0,01 level

	N	Means	SD	1	2	3	4	5
Contact frequency	35	2,26	0,561	NVT				
Psychosocial support	26	12,46	3,037	-0,383	(0,725)			
Career-related support	28	16,75	4,23	-0,327	0,219	(0,760)		
Trust	32	14,19	4,86	0,438*	0,075	-0,10	(0,910)	
Mentor benefits	26	43,077	9,81	-0,429*	0,624**	0,085	0,316	(0,864)

Table 3 For mentor * correlation significant at the 0,05 level (2-tailed), ** 0,01 level

Perceptions of support given

Before looking at the short term impact of the mentoring relationship for the protégé we first studied whether the perception of psychosocial and career-related support received and given differed between the protégé and his or her mentor. The Mann-Whitney test (see table 4) showed that for psychosocial support the perceptions match and for career related support they do not. In the perception of the mentors the amount of career-related support they give is significant higher then the amount the protégés say they receive. The second hypothesis therefore is only partly supported.

Variable	N	Mann-Whitney U	Z	Asymp Sig (2-tailed)
Psychosocial support	99	918,000	-0,247	0,805
Career related	94	648,500	-2,285	0,022*

Table 4: * significant at the 0,05 level

Frequency and support

Hypothesis 1 stated that the frequency and intensity of the support were of influence on the amount of support that was received. This hypothesis were tested using regression analysis, below the results of this analysis are given, beginning with the protégé.

Protégé

For the protégé the regression showed a significant relationship for the frequency and intensity with the psychosocial support (see table 5). For the career-related support only a relationship was found for the intensity of the relationship. The frequency didn't show a significant relationship.

	Psychosocial support		
Variables	Bèta	Adj. R^2	F
Frequency	-1,267**	0,467	29,942
Intensity	2,018**		
	Career-related support		
Variables	Bèta	Adj. R^2	F
Frequency	-0,230	0,301	14,131
Intensity	2,328*		

Table 5: relation between frequency and support Protégé ** significant at the 0,05 level

Mentor

For the mentor sample no relationship was found between the frequency, intensity and the given psychosocial and career-related support.

	Psychosocial support		
Variables	Bèta	Adj. R^2	F
Frequency	-1,867	0,133	29,942
Intensity	0,341		
	Career-related support		
Variables	Bèta	Adj. R^2	F
Frequency	-1,867	0,026	1,363
Intensity	0,357		

Table 6: relation between frequency and support Mentor ** significant at the 0,05 level

Short term outcomes

Hypotheses 3a and 3b were about the short term outcomes of the relationship, trust and benefits and their relation to the amount of support received by the protégé. These relationships also were tested with regression analysis which results can be found in table 7 for the protégé.

Protégé

For the protégé sample only the relationship between psychosocial support and trust was significant. Career-related support didn't show a significant relationship with trust and the hypothesis therefore only is partly supported for the protégé sample. Between the amount of support and the protégé benefits the relationship turned out to be significant for both career-related and psychosocial support. This supports the hypothesis that when the protégé received more support he also will enjoy more benefits as a result of the relationship.

	Independent: Trust		
Variables	Bèta	Adj. R^2	F
Psychosocial	-0,574*	0,271	12,361
Career-related	-0,190		
	Independent: Protégé benefits		
Variables	Bèta	Adj. R^2	F
Psychosocial	1,504*	0,685	66,239
Career-related	0,953*		

Table 7: Protégé *significant at 0,01 level ** significant at the 0,05 level

Mentor

For the mentor there is only a significant relationship between the psychosocial support given and the benefits they experience themselves as a result of the relationship. The amount of trust in the partner in contrast turned out to be independent of the given psychosocial and career-related support (See table 8). The same is true for the relationship between career-related support and mentor benefits.

	Independent: Trust		
Variables	Bèta	Adj. R^2	F
Psychosocial	0,113	-0,073	0,181
Career-related	-0,108		
	Independent: mentor benefits		
Variables	Bèta	Adj. R^2	F
Psychosocial	1,788*	0,294	5,791
Career-related	0,213		

Table 8: Mentor *significant at 0,01 level ** significant at the 0,05 level

Long term outcomes

In hypothesis 4 we proposed that if the outcomes in the short term were higher, the likely hood that the relationship continued and changed into a more profound relationship was higher. We tested this for the protégé sample using regression analysis. The results of this analysis can be found in table 9. This results showed us that there is a relationship between the benefits a protégé

experienced as a result of the relationship and the profoundness of the relationship in the long term. Trust by contrast didn't show a relationship with the continuation of the relationship in the long term.

	Independent: Long term			
Variables	Bèta	Adj. R^2	F	
Trust	0,05	0,420	21,625	
Protégé benefits	-0,220*			

Table 9: Protégé *significant at 0,01 level ** significant at the 0,05 level

Difference between support of types of mentors

Last we looked if there is a difference between the scientific mentor and the business mentor. We proposed that there was a difference between the perceptions of the protégé for the different variables between the support received from a scientific mentor and a business mentor. The differences in these perceptions were tested using the Mann Whitney test, from which the results can be found in table 10. The results show that protégés have the same perceptions for all variables except for the career-related support for which the difference was significant. The mean ranks (table 11) show that the amount of career-related support received is higher for the business mentor then for the scientific mentor. The protégé thus indicate that they receive more career-related support from there business mentor then from their scientific mentor. Hypothesis 5 thus is only supported for the career-related support.

Variable	N	Mann-Whitney U	Z	Asymp Sig (2-tailed)
Psychosocial	73	574,5	-0,631	0,528
Career-related	66	315,5	-2,135	0,033*
Contact frequency	74	557,5	-1,181	0,238
Trust	71	587	-0,183	0,855
Protégé benefits	65	484,5	-0,302	0,763
Long term	62	361	-1,280	0,2

Table 10: Protégé * significant at the 0,05 level

	Mean ranks					
	Psychosocial	Career-related	Contact frequency	Trust	Protégé benefits	Long term
Business mentor	35,77	37,43	39,61	36,35	32,42	33,74
Scientific mentor	38,98	27,06	34,22	35,46	33,87	27,70

Table 11: Mean ranks corresponding to the perceptions about the different mentors

Discussion

This paper studied the results of a mentoring program as a business development mechanism for knowledge intensive entrepreneurs. The cases under study consisted of business development programs all over Europe with different arrangements when looking at the form of mentoring (scientific or business). Interesting is that the study not only deals with characteristics of the relationships such as exhibited role behaviors and frequency of contact but also looks at the short and long term impact of the relationship and the difference between the support of a business mentor and a scientific mentor.

Frequency and Role behaviors

First the relationship between frequency/intensity of contact and the amount of support given was researched. The results of the questionnaire indicated that only for the perception of the protégé the frequency and intensity are of importance for the amount of psychosocial support they receive from their mentor. For career-related support only the intensity of the relationship turned out to be of influence. The results for the mentors didn't indicate a similar perception about the relationship between the frequency/intensity of the contact and the support they delivered to their protégés. The results for the protégés indicate that contact intensity probably is more important for the perception of provision of psychosocial and career-related support then the contact frequency. This is in contrast with the findings of Waters et all (2002) who argued that especially frequent contact is of importance in the first stages of a mentoring relationship to ensure that it fulfills its function, supporting the protégé.

Outcomes of the relationship

Outcomes of the mentoring relationship have been studied by a number of researchers but for the most researches this was restricted to the short term outcomes. The long term effect of these outcomes on the continuation and profoundness of the relationship has not been studied yet. Here we did both. For the short term outcomes we looked at Trust and Benefits. The results indicate that according to the perceptions of the protégé there is a relationship between the provision of psychosocial support and the amount of trust in the partner. This is in line with the findings of Young and Perrewé (2000). Further the results indicated that there is a relationship between the provision of career-related and psychosocial support and the benefits a protégé has of the relationship.

The perception of the amount of support they provided for the mentors didn't turn out to be related to outcomes like trust in the partner and benefits for themselves. Only the psychosocial support they provided to their protégé was of influence on the benefits they say they got themselves out of the relationship

For the long term outcomes we looked at the continuation of the relationship and whether it had deepened after the relationship. The benefits a protégé had encountered as a result of the relationship turned out to give a good indication of the long term continuation and profoundness of the relationship, while trust did not. The benefits of a relationship in the short term thus determine whether a mentoring relationship will continue in the long term.

Difference between types of mentors

Another interesting thing to look at was whether protégés indicated the same frequency of contact, provision of support, short term outcomes and long term outcomes. It turned out that for all variables except career-related support according to the perceptions of the protégés the results were the same. Career-related support received from the business mentor was seen as higher then from the scientific mentor.

Limitations

Although the research is done with all possible prudence, some marginal notes have to be made. First there is sample. Ideally it had consisted of mentors and protégés that were in a mentoring relationship together. In this way the results of the two could have been paired and compared to come to results that are even better. Then there is the size of the current sample. Preferably this would have been a little bit higher, especially for the mentors. Further some countries can be a little bit overrepresented (The Netherlands, Sweden). This is a result of the contacts of the authors and the willingness of other business development programs in Europe to participate. Further the differences between the organization of the mentoring programs can have been of some influence although the matching etcetera happened in a similar way across all the programs.

Implications for programs/managers

The above research has some interesting implications for program managers of business development programs. First there is the relationship between the intensity of the relationship and the amount of support delivered by the mentor. This logically makes the matching of the mentor and the protégé even more important because good matching will ensure an intensive relationship. Frequency of contact in these is of less importance, so it is the question whether forced contact will help the relation to fulfill its functions. Mentoring cannot be forced, forcing people to pair up only rarely leads to positive outcomes (Bierema, 2002). Secondly there is the minor difference between the support of scientific and business mentor and the outcomes of this support. This makes it logical for a program manager to reconsider the use of both a scientific and business mentor in a program because it could be that their support overlaps.

Further research

Ideally further research should consisted of paired up mentors and protégés. This is quite difficult as the current research showed but will give the best results. An interesting subject to look at would be the matching of the mentor and the protégé. If different ways of matching could be related to the outcomes of the relationship this could help program managers to improve their programs. Another interesting subject to research would be e-mentoring. This kind of mentoring doesn't incorporate face to face contact which could make psychosocial support somewhat more difficult. It therefore is interesting to research if it works in the same way as 'normal' forms of mentoring.

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