

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 Tödting 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.

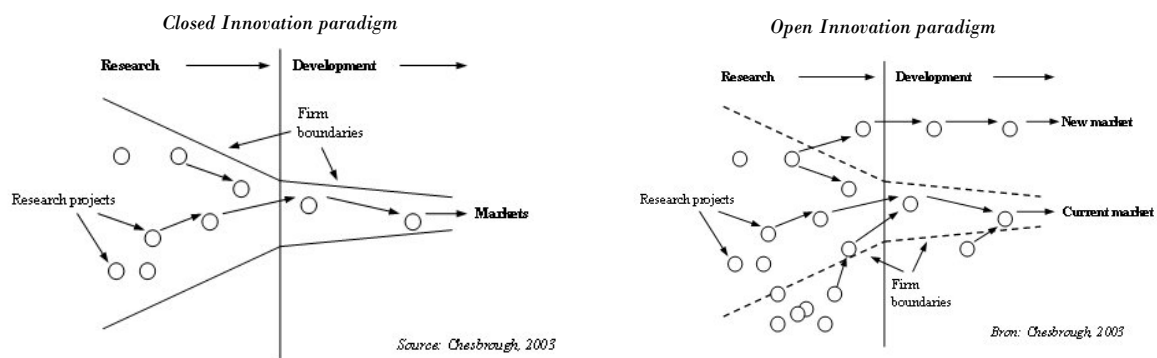


Figure 1 The closed innovation and open innovation paradigm (Chesbrough 2003)

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).

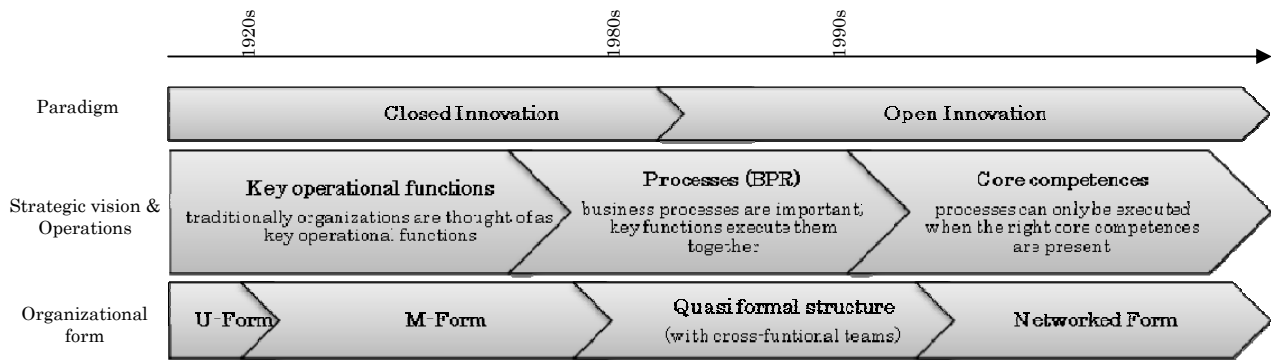


Figure 2 From closed towards open innovation

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 delay 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 Thornhill (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 embeddedness¹ 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 of 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 urgency².

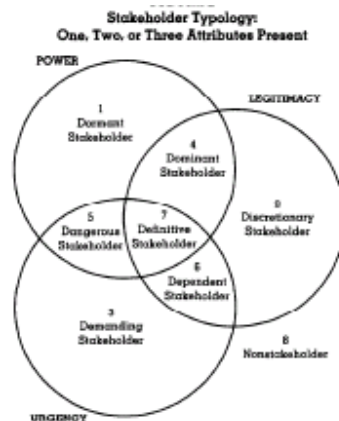


Figure 3 Stakeholder Model (Mitchell et al. 1997)

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 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.

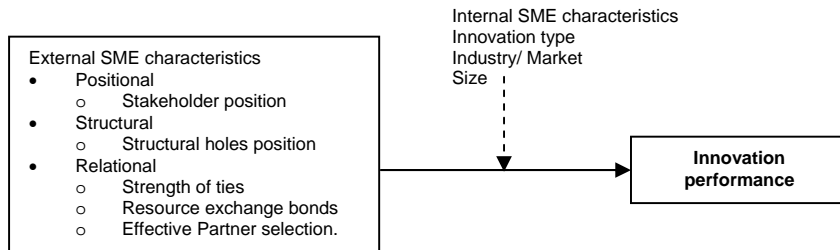


Figure 4 Research Model

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.

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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