

**The research entrepreneur  
- an analysis of the research environment.**

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Paper to be presented at  
The Third *Organization Studies* Summer Workshop:  
'Organization Studies as Applied Science: The Generation and Use of Academic  
Knowledge about Organizations'  
7-9 June 2007, Crete, Greece

## *The research environment*

The production of scientific knowledge is currently a broadly discussed topic. Not only because scientific knowledge is crucial for the development of science but also because of the emerging interest of society in scientific research. Researchers therefore try to find a balance between the future role of science and society in the production of knowledge.

The production of scientific knowledge always requires a specific organisation. Such an organisation creates settings in which researchers can perform scientific research. These settings include e.g. a transparent system of sharing research results made public as scientific information. This organisation is formed by the research environment consisting of researchers justifying scientific information.

The researcher claiming intellectual property strives for recognition and reputation in his research environment [Merton, 1957; Hagstrom, 1965, 1974] as well as other rewards resulting from it e.g. tenure [Altbach, 1996]. Scientific information, just like any information for an organisation, gives the researcher competitive advantage. The recognition increases the researcher's power in competing for heterogeneously distributed strategic resources and thus in the researcher's strategic positioning. This is because society is more likely to share strategic assets with recognised researchers, as they seem to be more credible and productive. Furthermore, the researcher having a high reputation is able to direct this society.

Scientific information is thus an integral part of research. Scientific information is not a final product but an intermediary product accepted by the scientific community as being worthy of further scientific effort and scrutiny [Popper, 1963]. Scientific information is not a goal in itself. The information produced in scientific research is being created in order to add value to existing scientific knowledge. This value, however, is only an added value if it's shared. Sharing information is then in line with scientific ethos according to which science should be universal implying that nobody should be excluded from it. And scientific knowledge as a common property has to be shared otherwise it does not exist [Merton, 1973]. Therefore, the researcher being accountable to the research environment makes his research results public by means of a scientific publication. These results can then be falsified in future research [Popper, 1934].

As already mentioned before, scientific research is nowadays of interest not only for researchers but also for society, more specifically the societal environment. This societal environment plays one of the major roles in setting the research policy and research directions. By setting the research directions this environment has an impact on the scientific knowledge production.

This impact has been studied e.g. by Knorr-Cetina [1981], Gibbons et al. [1994], Ziman [1994], Wilts [2000], and Laudel [2006]. All claim that the production of knowledge is affected by a relationship between the researcher and his societal environment.

A relationship established between the researcher being part of the research enterprise<sup>1</sup> and his societal environment determines the creation of scientific knowledge in terms of choices the researcher has to make in research such as e.g. the choice of research goals, as well as in terms of sharing governance in a research

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<sup>1</sup> The research enterprise is defined as either an individual researcher or a group of researchers performing activities contributing to scientific research. These activities include scientific activities as well as organisational activities embedded in the societal environment of such an enterprise.

project [Wilts, 2000]. Like in any relationship between organisations, a main parameter determining this relationship is the strategic positioning of the researcher in the societal environment. Like any organisation, the researcher positions himself in the strategic relationship in order to attain his long term, strategic goals. The overall strategic goal of any researcher is to contribute to scientific knowledge by scientific research. To perform research activities, the researcher makes strategic choices that lead to the strategic positioning of the researcher given his specific goals. The strategic choices of the researcher concern the directions of research as well as the acquisition of and matching of strategic resources offered by the societal environment. The strategic position that the researcher establishes to attain his strategic goals, is expressed in the relationship between the researcher and his environment. In this context the researcher, besides being an individual researcher can be an actor at different levels of aggregation: research at large, the research institute, the research group, the individual researcher.

At present, two modes of such a relationship of researcher and his environment are known. These are the 'ivory tower' and 'strategic research', known also as mode1 and mode2 [Gibbons et al., 1994]. In this paper<sup>2</sup>, we present an analytical approach to these two well-known modes also leading to a new mode, mode 3 - the research entrepreneur. The research entrepreneur, compared to the researcher in mode2, is much more leveraging in the relationship with the societal environment. The research entrepreneur is directing the environment by creating demand for his scientific products instead of supplying on the demand of the environment.

In this paper we will report on results from a study conducted in a research environment specifically selected for its high competitiveness, i.e. the fast developing domain of Nanoscience, more precisely, the case of the MESA+ Institute for Nanotechnology at the University of Twente.

### ***Strategic positioning of the researcher***

The strategic relationship between the researcher and his societal environment is being established with the goal to create added value. Such a strategic relationship can therefore be maintained if and only if the relationship results in the creation of added value. The partners decide to collaborate because without such a collaboration they would not be able to create added value. Establishing this strategic relationship is a process of negotiation between these two partners on sharing heterogeneously distributed strategic resources and on governing the directions of research. The researcher decides then to give up governing research to a certain degree and accepts sharing resources to a certain degree.

These two negotiated aspects in the relationship known as organisational autonomy and strategic interdependence are used in strategic management research to analyse strategic alliances, joint ventures, mergers and acquisitions between business partners [Haspeslagh, Jemison, 1991]. As the strategic relationship is considered as an evolving process resulting in a deliberate and established collaboration, it is comparable with the abovementioned relationships.

Strategic interdependence is defined as the deliberate sharing of heterogeneously distributed strategic resources (financial and human resources,

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<sup>2</sup> The earlier version of this paper was presented at the 40<sup>th</sup> Anniversary SPRU conference in September 2006 [<http://www.sussex.ac.uk/Units/spru/events/ocs/index.php>]

research facilities, and scientific knowledge) between the partners in order to achieve a joint strategic goal. Strategic interdependence is a necessary but not sufficient condition for an effective collaboration, meaning that close collaboration goes hand in hand with a position of high strategic interdependence, and vice versa.

Organisational autonomy is defined as self-governing in deciding about the directions of research in a competitive environment, including setting research goals, in which scientific knowledge is being created and scientific information is being used. A high position in organisational autonomy allows the researcher to make autonomous strategic decisions regarding setting goals and establishing how to attain these goals. A position of high strategic interdependence does not necessarily exclude a position of high organisational autonomy of the researcher. A strategic position is defined then as a combination of positions in organisational autonomy and strategic interdependence.

Organisational autonomy is not so much about managing research but more about setting research goals. For instance, applicable products produced by the researcher are in principle not intentions of the researcher. In such a situation the researcher fits his own research goals to the societal environmental (whose intentions is to produce applicable scientific products) because he is driven by his strategic goals.

Collaboration is defined as management of research, as organising activities leading to goal attainment. This being the case, collaboration integrates the goal of the strategic relationship: added value creation, strategic interdependence and organisational autonomy into a system. Collaboration of research includes managing financial, human resources and research facilities of the research enterprise as well as managing exchange of scientific knowledge between the partners.

The strategic relationship between the researcher and the societal environment is seen in this paper as a social system [as proposed by Parsons, 1962, 1964]. This being the case, all the aspect of the relationship: added value creation, strategic interdependence, organisational autonomy and collaboration are functions performed by the partners in the relationship. These functions are interrelated with each other, while at the same time remaining distinct. We present the possible relations between these functions in the system as presented in the tetrahedron in Figure 1.

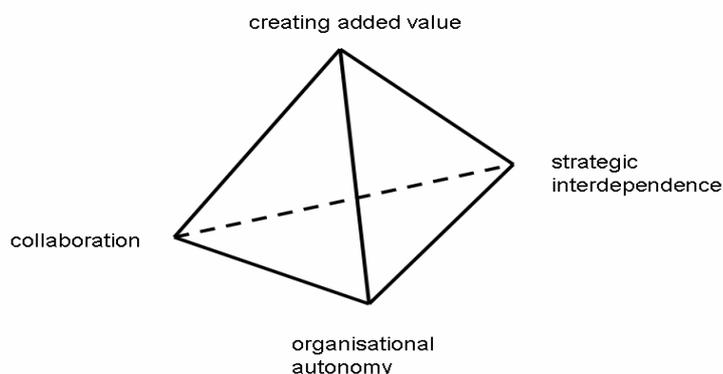


Fig. 1 The strategic relationship of the researcher in the societal environment

The relations between the functions result in a number of combinations of modes of strategic positioning. We assume that only if strategic interdependence is aligned with collaboration, then research activities performed by the research enterprise will lead to added value. A position of high collaboration is aligned with a position of high strategic interdependence, and vice versa. Thus, a position of low strategic interdependence together with a position of high collaboration or vice versa is not possible, because if there is no exchange of strategic resources there is no need for managing them.

From all possible combinations of relations between the functions, four combinations meet the above conditions. These combinations lead then to four possible modes of strategic positioning and can be formalised as:

- $\uparrow AV = AV (C \downarrow + OA \downarrow + SI \downarrow)$  mode0
- $\uparrow AV = AV (C \downarrow + OA \uparrow + SI \downarrow)$  mode1
- $\uparrow AV = AV (C \uparrow + OA \downarrow + SI \uparrow)$  mode2
- $\uparrow AV = AV (C \uparrow + OA \uparrow + SI \uparrow)$  mode3

The model of strategic positioning analysing and justifying these modes of strategic positioning was presented in an earlier version of this paper [Kurek, Geurts, Roosendaal, 2006].

Given these possible combinations of relations between the functions and degrees of these functions resulting in modes of strategic positioning we can order these modes due to the energy the researcher requires for the effort of creating added value efficiently. To analyse energy differences in a system consisted of the researcher and the societal environment we apply the term of the ‘ground state’ as used in atomic physics.

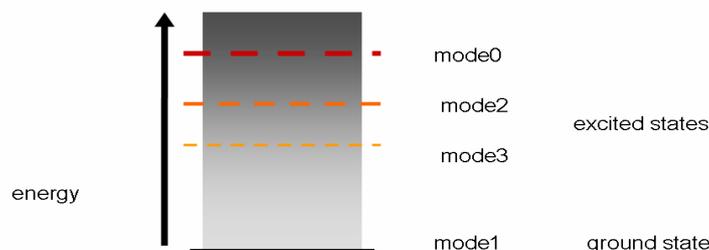


Fig2. Ground state of strategic positioning

The ground state is defined from the view of the researcher. The ground state requires the least energy from the researcher to create added value. This lowest state means that the researcher possesses a position of low collaboration and of low strategic interdependence and a position of high organisational autonomy. Hence, the researcher does not establish a relationship with the societal environment, which is not involved in creating added value. The ground state fits then the characteristics of mode1.

Any other position that requires more energy for creating added value is defined as an excited state. This means that the creation of added value in collaboration with the societal environment requires additional energy from the system of the two partners of collaboration. The acquisition of strategic resources has an impact on knowledge production by “consuming applicants’ and reviewers’ time and money, which would otherwise be available for research” [Knorr-Cetina, 1981; Chubin and Hackett, 1990; Lederman, 1993; Horrobin, 1996; Wessely, 1998; Laudel, 2006]. This acquisition requires also extra energy as the researcher has to make an “effort in gathering information about the rules of the funding agency and ‘learning the game’” [Laudel, 2006]. Another example of extra energy required from the researcher is from the Framework Programmes of the European Union. The EU requires collaborative research projects only. The researcher therefore has to find research partners and manage such a collaborative research organisation [Eichinger, 2007]. Furthermore, joint research projects require “negotiation, coordination and integration of heterogeneous types of knowledge, values and interests” [Maasen & Lieven, 2006]. This additional energy results from external restrictions on organisational autonomy that the researcher has to accept in the strategic relationship. The researcher will only invest in collaboration with the societal environment, will accept strategic interdependence to a certain degree, and will give up organisational autonomy to a certain degree, if this collaboration will result in added value. The societal environment is willing to invest in scientific research if this research creates added value for the environment. This added value is an objective for the environment and leads to external restrictions on research. Such an added value is then organised and commanded, and therefore requires extra energy from the researcher. The environment can also invest in research without this objective of added value. The added value is then used by others for further scrutiny and for adjusting to possible application. An example of such a situation is cosmology that is curiosity driven and has spin offs in application driven domains, e.g. nuclear instrumentation for medical applications.

In the research reported here, the assumption is made that in any relationship the partners each strive in principle to maximise their organisational autonomy and to minimise their strategic interdependence. This means that any external restrictions from the societal environment on these dimensions, and finally on the added value are not desired. The long-term strategic goals of the researcher may, however, lead to a collaboration with the societal environment and allow the environment to limit his organisational autonomy leading to restrictions on added value.

As said, the ground state model is characterised by a position of low strategic interdependence and high organisational autonomy. This means that the researcher does not establish a relationship with the environment and therefore there are no restrictions on organisational autonomy. Therefore, the researcher does not need to take into account societal needs and demands when setting his research goals. He is independent and autonomous in taking strategic directions in research. In model the added value is a curiosity driven scientific product, reliable knowledge [Ziman, 1991] as research goals are set by the researcher himself [Wilts, 2000] and it is being certified and accepted or rejected by the research environment. This, however, does not say anything about the quality of a scientific product. It means that such a product complies with scientific standards of the research environment and results of research are not necessarily meant to be of societal relevance. This type of strategic positioning is well-known as ‘ivory tower’ or ‘free research’ [Gibbons et al., 1994].

By allowing the societal environment making restrictions, a scientific product is application driven [Wilts, 2000] as the environment has its own intentions concerning this product and the researcher allows the environment to persuade its intentions. Therefore, in mode0, mode2 and mode3 scientific products are more application driven, and socially robust [Novotny et al. 2001].

The next mode that requires extra energy to create added value is mode3. Mode3 is characterised by a position of high strategic interdependence and of high organisational autonomy. We call this mode the research entrepreneur. In this mode the researcher allows the societal environment to make some restrictions on added value to an acceptable degree as the organisational autonomy remains high. The research entrepreneur has the opportunity to autonomously determine the strategic directions of research. He retains his own responsibilities for directing a project. The research entrepreneur is an answer to the need for a social contract rewarding all the parties, as proposed by Gibbons [1999]: the research entrepreneur interacts with the societal environment in such a way that “he speaks to the environment and the environment speaks back to him”. The two parties, the researcher and the societal environment are keen on establishing this strategic relationship. The researcher because his research will be funded, the societal environment because scientific results will be applied. The research entrepreneur, like a business entrepreneur, influences the societal environment by creating demand for his scientific products. The researcher entrepreneur influences added value by setting goals that determine scientific information acquired and used, and methodology used.

The second excited state of strategic positioning is a position of low organisational autonomy and high strategic interdependence. In this mode2, the societal environment directs the researcher. It influences research directions taken by the researcher and ipso facto influences the added value the researcher creates. This means that the researcher matches his own research problems to existing research programmes based on the demand of the societal environment. Examples of this mode are consultancy and research outsourced by a financial partner if this partner demands particular studies to be carried out and the researcher complies. In this case, the researcher does not influence his societal environment in creating demand for his scientific products but supplies in reaction to the demand by the societal environment. The researcher listens to the environment and fulfils societal needs. By the societal need we mean a need, which is explicitly expressed by the strategic partner of the researcher, as a representative of the societal environment, in the strategic relationship. The properties of this mode show that this mode is comparable with Gibbons’ mode2 or strategic research as broadly described by him, his co-authors, and Ziman [Gibbons et al, 1994, Ziman, 1994].

In mode0 there is no strategic relationship between the researcher and the societal environment but a position in low organisational autonomy indicates restrictions on organisational autonomy. An example of such a mode is a researcher in the Middle Ages supported by a maecenas. This mode requires most energy to create added value. Nowadays researchers don’t accept this kind of positioning, therefore mode0 is rather irrelevant for this discussion.

The researcher positions himself in a continuum of positions in between these four ideal types of modes of strategic positioning [Kurek, Geurts, Roosendaal, 2006].

### ***How to observe strategic positioning?***

To observe the strategic positions we look at the exchange between the partners, the researcher and the societal environment, in the strategic relationship. The researcher making strategic choices is being influenced by other actors: the research environment and the societal environment<sup>3</sup>. By analysing the strategic relationship between the researcher and the environment we can actually measure how the strategic choices of the researcher are influenced by this environment.

The researcher starts establishing a relationship with a strategic goal in mind that he strives to achieve. This goal is expressed in his intentions and situation. The researcher confronts then his intentions and situation with intentions and situation of the environment. The intentions, but not the strategic goal, are negotiable. The negotiation process ends with an agreement that is an expression of intentions and situations of the partners including potential positive and negative sanctions that could be used in case the partners deviate from situations and intentions they agreed upon. The agreement is then the enactment of the negotiation. The strategic choices the partners make afterwards are executed in terms of positive or negative sanctions included in such an agreement. The strategic choices of the researcher result in a position in organisational autonomy and strategic interdependence that he accepts in a specific relationship. We can then observe positions in organisational autonomy and strategic interdependence in potential sanctions on which the partners agreed. An analysis of contracts between research and environment will then result in a partial reconstruction of this negotiation process.

Intentions of the researcher and the societal environment refer to scientific aspects of the research enterprise including strategic directions of research and management of research, the acquisition of scientific information, exchange of scientific information between the partners, and the dissemination of scientific information to the societal environment. The situation of the partner (the researcher or the societal environment) refers to all organisational aspects of a research project (mainly possession of strategic resources or lack of such resources).

A strategic relationship between the researcher and his environment is in this research analysed in terms of four types of behaviour as proposed by Parsons [1963]. These types of behaviour are used by the partners to get the other to comply with their demands.

	<b>intention</b>	<b>situation</b>
<b>positive sanction</b>	persuasion (influence)	inducement (money)
<b>negative sanction</b>	activation of commitments (commitment)	deterrence (power)

Table 1 Types of actor's behaviour towards another actor and currencies of exchange [Parsons, 1963, p.44]

Table1 presents the types of behaviour and concomitant currencies of exchange<sup>4</sup> (in brackets). To be able to compare different strategic relationships

<sup>3</sup> The societal environment is understood as users and potential users of scientific products and services who are interested in the development of scientific knowledge and relations between these users. In a strategic relationship that the researcher is involved in the societal environment consists of scientific communities financing research e.g. research group or institute, government and industry.

<sup>4</sup> Parsons used to term "generalised media of exchange". For reasons of consistency with the business literature we have chosen to use the term "currencies of exchange" consistently throughout this article.

established between the researcher and his societal environment we translate the types of behaviour of these partners to these currencies. A currency of deterrence is power. In a strategic relationship between the researcher and the environment, the environment has power to e.g. terminate a research contract (negative sanction) and therefore to affect the situation of the researcher. A currency for persuasion is influence. To influence others, actor uses his prestige, his reputation. The higher the reputation of the person, the easier to persuade others.

The researcher influences the societal environment when he offers (positive sanction) to create a new scientific product, e.g. a new theory that will supersede an existing one (effecting intentions of the users). When the partner in a relationship wants to induce the other he uses money. Money is not always 'money' in the literal sense; it can for instance be information or a physical product, which is being exchanged. It can be any scalable added value. Another way to get one partner to comply with demand is to commit him to the system of values and norms of the other partner. The researcher being a part of the research environment is committed to comply his research with high scientific standards, as discussed by Merton in his normative structure of science [Merton, 1973]. In a relationship with the environment, the researcher engages the environment to values and norms of the research environment, to a different extent in different relationships.

As the situation of the societal environment refers to organisational aspects of research including the control over strategic resources the researcher can hardly affect the situation of the general societal environment. The researcher can affect the situation of the societal environment differently at different levels of aggregation of this environment. One level is the level of industry. The researcher can affect a company e.g. by producing a scientific product from which the environment will financially benefit. The researcher can affect the situation of a company relatively more than the situation of another level of aggregation such as government funding agencies or the entire European community. The funding agencies or the EU can be affected only in the long term. This is because for a small-medium enterprise financing a research project is usually a bigger investment than for the European Union having larger research budget. Having invested in research, the situation of such an enterprise can depend on scientific product more than the situation of the EU. The next level of aggregation of the societal environment (the general level) considered in this research consists of potential buyers/users of scientific products. These potential users do not enter the strategic relationship and do not finance research. They can purchase scientific products. Such products will not affect their situation but can affect their intentions though.

The societal environment using negative sanctions can change the situation of the researcher in a sense that he will have to look for another financial source. By a positive sanction the environment encourages the researcher to conduct certain research by means of rewards or strategic resources.

We will expand on the use of these currencies of exchange in the following paragraph. Observed examples of the use of currencies of exchange will be presented later when presenting empirical results.

Some intentions of the partners are presented in the table1. This list is not definitive and will be expanded in the future.

	<b>researcher</b>	<b>societal environment</b>
<b>added value</b>	<ul style="list-style-type: none"> <li>• to deliver research results that will be reported and justified</li> <li>• to add to existing theories</li> <li>• to disseminate research results in <ul style="list-style-type: none"> <li>○ scientific publication</li> <li>○ presentation</li> <li>○ internal research reports</li> </ul> </li> <li>• to independently choose a medium for dissemination of research results</li> <li>• to create a theory driven scientific product</li> <li>• to be recognised as an author of research results</li> </ul>	<ul style="list-style-type: none"> <li>• to get research results delivered</li> <li>• to obtain new solutions (more cost effective, more efficient) to existing applications</li> <li>• to disseminate research results in <ul style="list-style-type: none"> <li>○ research reports</li> <li>○ patents</li> <li>○ business units</li> </ul> </li> <li>• to direct a choice of medium in which results will be disseminated</li> <li>• to get an applicable scientific product created</li> <li>• to be recognised as a contributor to research</li> </ul>
<b>strategic interdependence</b>	<ul style="list-style-type: none"> <li>• to acquire strategic resources (financial, knowledge from the societal environment, research facilities, to acquire human resources without an involvement of the environment)</li> </ul>	<ul style="list-style-type: none"> <li>• to share strategic resources (financial, knowledge with the researcher, research facilities if available, to be involved in acquisition of human resources)</li> </ul>
organisational autonomy	<ul style="list-style-type: none"> <li>• to set research goals</li> <li>• to direct research</li> <li>• to be accountable to the research environment only</li> <li>• to communicate research results primarily to the research environment</li> <li>• to govern scientific information use and acquisition</li> <li>• to govern methodology applied</li> </ul>	<ul style="list-style-type: none"> <li>• to set research goals</li> <li>• to direct research</li> <li>• to ask the researcher to deliver on demand</li> <li>• to be informed on research results</li> <li>• to govern scientific information use</li> <li>• to govern methodology applied</li> </ul>
collaboration	<ul style="list-style-type: none"> <li>• to organise research</li> <li>• to manage available human resources</li> <li>• to manage possessed financial resources</li> <li>• to manage research facilities</li> <li>• to manage exchange of scientific knowledge with the societal environment</li> </ul>	<ul style="list-style-type: none"> <li>• to direct the organisation of research</li> <li>• to direct managing human resources</li> <li>• to direct managing financial resources</li> <li>• to direct managing research facilities</li> <li>• to direct managing exchange of scientific knowledge with the researcher</li> </ul>

Tab.2 Intentions of the researcher and the societal environment

The potential sanctions that the partners may use in the strategic relationship are specified in table3.

	researcher	societal environment
Positive sanctions	<ul style="list-style-type: none"> <li>• offering added value               <ul style="list-style-type: none"> <li>○ scientific product</li> <li>○ scientific services</li> <li>○ commercial product</li> </ul> </li> <li>• offering strategic resources (human, knowledge, research facilities)</li> <li>• contribution of the societal environment will be mentioned in agreed media</li> </ul>	<ul style="list-style-type: none"> <li>• offering added value               <ul style="list-style-type: none"> <li>○ recognition</li> <li>○ rewards</li> <li>○ patents</li> </ul> </li> <li>• offering strategic resources (human, financial, knowledge internalised by the societal environment, research facilities)</li> <li>• encouraging certain behaviour, e.g. dissemination of research results</li> </ul>
Negative sanctions	<ul style="list-style-type: none"> <li>• refuse to conduct specific research</li> <li>• refuse to produce demanded added value</li> <li>• refuse to disseminate research results</li> <li>• refuse to disseminate research results in a manner proposed/ medium chosen by the societal environment</li> <li>• disseminate research results without acceptance of the societal environment</li> <li>• terminate contract</li> <li>• refuse to conduct research if not universal</li> <li>• the researcher may acquire strategic resources from another representative of the societal environment in next research</li> <li>• disagreement</li> </ul>	<ul style="list-style-type: none"> <li>• refuse to finance specific research</li> <li>• control of research and management activities</li> <li>• obstruction on disseminating research results</li> <li>• omit dissemination of research results</li> <li>• ask to delete certain information from a publication</li> <li>• terminate a contract</li> <li>• ask to conduct research compatible with ethical and political correctness</li> <li>• stop financing in future (if reputation is lost)</li> <li>• disagreement</li> </ul>

Tab.3 Potential sanctions by the researcher and the societal environment

The observable difference between the modes of strategic positioning is in the balance of the sanctioning of intentions and situations. In balance, the partner sanctioning the other has a stronger flow of currency than the dependent partner. This asymmetry in the balance in the exchange of currencies is well visible in the excited states of strategic positioning.

In the ground state (mode1) the researcher has a position of low strategic interdependence therefore there is no external exchange between the researcher and the societal environment. There is no direct flow of currencies of exchange between

these two partners; therefore there is no sanctioning from the environment. There is a symmetrical balance in exchange. The researcher has a position of high autonomy and there are no restrictions on organisational autonomy. This results in a theory driven scientific product as discussed before. In mode1 the research institute of the researcher and external institutions exchange money. These institutions do not directly connect money with research tasks and do not influence research directions (e.g. lump sum financing of universities). In such a situation, the researcher is accountable not to his societal environment but only to his research environment, meaning that he has to comply with the norms of the research environment. He has to create added value according to agreed standards without being constrained to specific, externally set research goals. Furthermore, it isn't the intention of the researcher in mode1 to produce knowledge that can be applied directly and influence the societal environment. The researcher makes use of power and influence only within his research environment. In the mode1 situation, the researcher does not sanction the societal environment but only the research environment and vice versa.

To get to the excited state the researcher allows the societal environment to sanction intentions (presented in table2) and situations having in mind the goal to create added value that he cannot create without strategic resources provided by the environment. The incentive for the researcher to move from the ground state is a long term strategic goal that he wants to achieve.

In Mode3 the researcher is strong enough to sanction the societal environment. The most important characteristic of the research entrepreneur is that he influences research management and directions including research goals in such a way that he creates demand for scientific results he wants to deliver. The research entrepreneur influences the environment by creating demand for the scientific products he produces. Even being an equal partner in the collaboration the research entrepreneur is still accountable to the societal environment, but to a certain, negotiated degree. This degree depends on the degree of autonomy he accepts to give up reaching his strategic goals. Moreover, the exchanged commitment in the mode3 relationship is more general than in the mode2 relationship as it deals with more general issues such as e.g. ethical issues [van Steendam, et al. 2006] as will be seen below. Commitment is then not connected to specific research tasks and the researcher himself directs deliverables. This means that added value created by the researcher is negotiated by both partners but the societal environment does not govern this value.

In mode2 added value creation is being restricted by the societal environment as the researcher possesses a position of low organisational autonomy and of high strategic interdependence. There is an exchange of currencies between the societal environment and the researcher. In such a relationship the environment sanctions the researcher. The researcher is accountable to the environment which is able to set specific research goals for the researcher. The societal environment will ask the researcher to deliver a specific commitment dedicated to a specific research task. This does not necessarily have to comply with high scientific standards, but must comply with the demand of the environment. Furthermore, next to setting research goals the environment influences the researcher and his research. The environment has also power in the mode2 relationship.

### ***Empirical study***

An analysis of the exchange between the researcher and his societal environment is being conducted at the MESA+ Institute for Nanotechnology being

part of the University of Twente (The Netherlands). MESA+ employs over 475 people including 375 researchers. MESA+ is a multidisciplinary institute collaborating at the national and international level. Internationally MESA+ collaborates with e.g. IMEC (Belgium), Max Planck Institutes (Germany), Forschungszentrum Karlsruhe (Germany).

The societal environment of MESA+ is represented by NWO (Dutch National Science Foundation), STW (Technology Foundation), Senter (an agency of the Dutch Ministry of Economic Affairs for implementing policies on: innovation, energy and climate and environment and spatial planning), FOM (Research foundation related to NWO), the European Commission (framework programmes), and industry.

As mentioned before a strategic relationship is defined as a deliberate and established collaboration in which partners sanction each other, both positively and negatively, and are dependent on each other. These sanctions can be observed in formal documents such as contracts. Contracts are seen as expressions of desired intentions and desired situations. They in fact show the positions the involved partners want to establish with respect to each other and the needs of the partners that had to be resolved explicitly to establish the relationship. According to the model of strategic positioning, the observation of sanctions allows assessing the use of currencies of exchange and determining the mode of a strategic position. Therefore, a content analysis of contracts of research projects at MESA+ is carried out in this empirical study. Contracts are usually dealing in approximately 80% of their content with standard issues, but focusing on those non-standard 20% gives insight to what has been the core of the negotiation and therefore indicates the strategic positioning of the researcher in a strategic relationship.

Studying research projects in this specific research environment consists of two steps: one step is contract analysis to be followed by the second step of interviewing researchers (not reported in this paper).

The contracts were studied to analyse clauses indicating the presence of observables for added value creation, strategic interdependence, organisational autonomy, and collaboration. Each of these functions is operationalised in terms of intentions of the researcher and his societal environment as listed in table2. Each of these intentions (as well as the situation of the partners) is being matched with potential sanctions: positive and negative as proposed by one of the partners.

To illustrate the model and the measurement some interesting aspects of content analysis of the contracts are presented underneath on one example of a strategic relationship of MESA+ and the European Union under the 6<sup>th</sup> Framework Programme.

As expected, not all of the intentions from the list (table2) can be found in the contracts of MESA+. Nonetheless, in each contract there are at least a few, and this is sufficient to test the feasibility of the model in creating observables.

Each mode of strategic positioning has a specific combination of strategic interdependence, organisational autonomy and collaboration being variables determining the added value creation (being in this model a dependent variable). In the different modes the researcher has to accept different restrictions from his societal environment on these variables in order to create added value. This being the case, each of these four variables will be analysed closely and separately to distinguish between these restrictions.

In the exemplary contract between MESA+ and the EU it is expressed that MESA+ responds to a call for proposals with a new solution to existing applications, which up till now are not sufficient in terms of cost effectiveness and efficiency. This

agreement is interpreted as a positive sanction affecting the intentions of the environment. Therefore it indicates the use of influence by the researcher. This statement also indicates that added value will be created in this relationship. Furthermore, the researcher offers the environment *“to maintain such higher level competitiveness”* (positive sanction) of European research and this will affect the intention of the societal environment who wants to be competitive.

MESA+ affects intentions of the societal environment by proposing this specific solution, and can sanction negatively the environment (can refuse doing specific research) if the environment does not agree and tries to affect and change this solution. This indicates the exchange of commitment by the researcher for money that the EU agrees to invest in the proposed solution (positive sanction affecting the situation of MESA+). The commitment is more general as it is MESA+ who decides what solution to produce and the environment agrees on what the researcher proposes. MESA+ offers to *“bridge the gap from ‘knowledge production’ to ‘knowledge use’”* (positive sanction) affecting intentions of the societal environment (indicating an exchange of influence by the researcher). This argument also indicates that the environment affects the intention of the researcher. The researcher has to comply with the restriction of the environment and deliver added value that can be applied otherwise the environment will not grant the project (potential negative sanction affecting the intention of the researcher indicating an exchange of commitment by the EU).

Research results will be disseminated via scientific publications as well as via the web site, the popular scientific press, and via invited European companies *“to lay the foundations of a European network of companies and research institutes that develop, fabricate or apply ... (scientific product at hand)”* (positive sanction affecting the intentions of the societal environment indicate exchange of influence by the researcher). Furthermore, the environment requires that *“any notice or publication by the contractors about the project, including at a conference or seminar, must specify that the project has received research funding from the Community’s Sixth Framework Programme”* otherwise the research project will not be funded (potential negative sanction affecting the situation of the researcher indicating use of power by the EU). The researcher will be recognised as an author as he can use his research results *“the contractors shall use or cause to be used the knowledge arising from the project, which they own, in accordance with their interests”* (negative sanction that can be used if the environment would not agree, affecting the environment’s intention). However, *“the contractors shall set out the terms of use in a detailed and verifiable manner, notably in the plan for using and disseminating the knowledge, and in accordance with the provisions of this contract and the Rules for Participation”* (potential negative sanction affecting the intention of the researcher).

The next variable determining the added value creation is strategic interdependence. As expressed in the contract, both partners share strategic resources with each other. MESA+ shares *“experience, infrastructure and know-how”* and *“the consortium partners possess between them the wide range of skills and relevant infrastructure”* (positive sanction affecting the intentions of the societal environment) whereas his environment shares financial resources (positive sanction affecting the situation of the researcher). Another indicator of strategic interdependence is the acquisition of human resources by the researcher (positive sanction affecting the intention of the societal environment).

As we assume in the model, the researcher strives to maximise his organisational autonomy. The researcher is accountable to his societal environment,

like in this case, has always to provide arguments for his choices in setting research goals and in a choice of research methods.

A deficiency in this method is that we cannot observe the research interests of the researcher and to what extent he has to fit his research interests to research topics proposed by the societal environment. This deficiency will be solved by expanding this study to include interviews and scientific publications analysis (publication records will help to define research interests of researchers involved in analysed research projects). As this is a large project requiring extra energy to create added value we assume in this example that, the researcher looks for a call for proposal that will fit his research interests as close as possible. Hence, he sets a research goal more autonomously.

MESA+ in this relationship defines the methodology that will be applied: *“the overall methodology has the advantage of inherently minimising the risk of project failure”* (positive sanction affecting the intention of the societal environment). The EU sets some restrictions on the methodology in the sense that the researcher tries to prevent a project failure (negative sanction; intentions). But after all, it is the researcher who directs methodology and the direction of research (potential negative sanction potentially affecting the intentions of the EU and indicating the use of commitment by MESA+).

As mentioned, MESA+ is accountable to the EU as the EU requires reports on the progress of the research otherwise the researcher can lose his reputation and this can change the organisational aspects of research (potential negative sanction affecting the situation of the researcher and indicating the use of power by the EU): *“the project co-ordinator MESA+ will organise an annual assessment meeting (...) with all parties and the Commission’s representative(s)”*, and *“final versions will be proved before the end of each year for the assessment review by the European Commission”*.

The last, but not the least, function of strategic positioning is collaboration. Activities that the partners perform focus on the organisation and management of the research. According to the contract, the researcher manages and organises the research activities (positive sanction affecting the intentions of the societal environment; and potentially a negative sanction if the researcher refuses to conduct this research thereby affecting the intentions of the societal environment). The project coordinator is chosen by the researcher and named in the contract (potential negative sanction, as mentioned above, affecting the intentions) but the EU has to agree to this coordinator (negative sanction potentially changing the situation of the researcher). The EU requires a specific project management that is standard for all the applicants (negative sanction potentially affecting the situation of MESA+). The researcher has to establish an international collaboration before applying for the resources. Project proposals without other research partners are not taken into account by the EU (potential negative sanction affecting the intentions of the researcher as well as his situation). This somewhat limits the researcher striving for independence in research.

This presented analysis shows that the contract covers almost all of the intentions of both partners. Some of the intentions are not included in the contract indicating that the exchange of currencies has not reached the equilibrium for each of the variables (table3). This needs further exploration in future research.

	researcher	societal environment
added value	<ul style="list-style-type: none"> <li>• influence</li> <li>• general commitment</li> <li>• commitment</li> </ul>	<ul style="list-style-type: none"> <li>• power</li> <li>• money</li> <li>• commitment</li> </ul>
strategic interdependence	<ul style="list-style-type: none"> <li>• influence</li> </ul>	<ul style="list-style-type: none"> <li>• money</li> </ul>
organisational autonomy	<ul style="list-style-type: none"> <li>• influence</li> <li>• commitment</li> </ul>	<ul style="list-style-type: none"> <li>• power</li> <li>• commitment</li> </ul>
collaboration	<ul style="list-style-type: none"> <li>• influence</li> <li>• commitment</li> </ul>	<ul style="list-style-type: none"> <li>• power</li> <li>• influence</li> </ul>

Tab.4 The strategic positioning of the researcher as expressed in the exchange of currencies<sup>∞</sup>

The balance in exchange of currencies in this contract is asymmetrical as presented in table4. This means that this project requires from MESA+ extra effort to create added value. The balance shows that there is a stronger flow of influence and commitment (general commitment for added value) for MESA+. The flow of power and money is stronger for the EU. A flow of influence in collaboration from and to both partners indicates a relationship of two strong partners and the engagement of the EU in the organisation and management of this research project.

As the model of strategic positioning is a continuum, the researcher can be more a research entrepreneur in some aspects of strategic positioning e.g. in added value creation whereas in the other aspects e.g. in organisational autonomy, collaboration he can be less entrepreneurial.

As said, the modes of strategic positioning have specific combinations as results of the model of strategic positioning. Having elaborated the functions of the model it can be concluded that MESA+ has a position of high strategic interdependence (observed stronger flow of influence by the researcher) and high collaboration (observed flow of influence on both parties), and a position of quite high organisational autonomy (not as in the ideal type) in the strategic relationship with the EU. This combination is therefore close to the ideal combination indicating the mode3 of strategic positioning.

$$\uparrow AV = AV (C \uparrow + OA \uparrow + SI \uparrow) \text{ mode3}$$

In this particular contract MESA+ is positioned slightly above mode3 (see Figure 3) on the scheme of energy required from the researcher to create added value. The energy required from the researcher is much lower than in mode2 but somewhat higher than in mode3.

<sup>∞</sup> The exchange between MESA+ and the EU (STRP 01303)

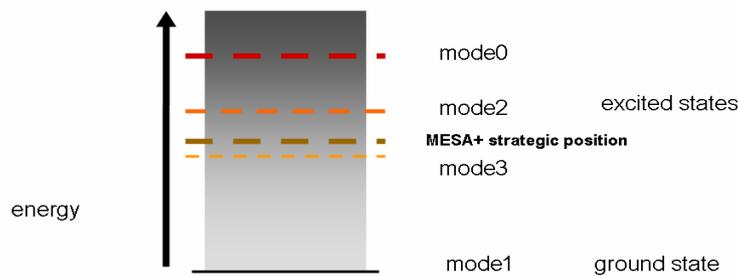


Fig.3 A particular strategic position of MESA+ in its relation with the EU

A similar analysis was done for other contracts of MESA+. An example of a strategic relationship with a company shows that there is also an asymmetrical balance of power, money and commitment for the company. The position of MESA+ is not very high in organisational autonomy and collaboration. We can conclude that this particular relationship is more mode2 than mode3.

### *Outlook and conclusions*

In this paper, the concept of strategic positioning is being applied to the relationship between researcher and environment. Based on this concept, a new, analytical model of this relationship of the researcher is developed. The model is built on the assumption that the researcher has long-term goals and in order to achieve these goals he strategically positions himself and his research in his societal environment. The second assumption is that he establishes a relationship with this environment, with the goal to create added value, when positioning, and such a relationship is comparable to relationships as strategic alliances, joint ventures, mergers and acquisitions. This model then results in different modes of strategic positioning. These modes depend on the researcher's strategic choices and on his long-term strategic goals. The model is able to deal with the researcher at different levels of aggregation ranging from the individual researcher to the research institute or research at large.

With this model the modes well known from the literature, mode1 – ivory tower and mode2 – strategic research, and a new mode3 – the researcher entrepreneur can be measured. The research entrepreneur, as distinct from the other modes, is highly autonomous and at the same time fully intertwined with his environment.

The model is able to measure the positions in organisational autonomy and strategic interdependence that the researcher most probably is likely to accept given his strategic goals. Therefore, it is able to measure the mode of strategic positioning the researcher decides to establish, under the assumption that the researcher behaves like a rational actor and given ceteris paribus conditions.

These modes of strategic positioning are being analysed in terms of energy that is required from the researcher to create added value. The term “ground state” is used here to analyse the creation of added value that requires different degrees of energy from the researcher for different modes. Creation of added value in

collaboration with the societal environment requires always more effort because the environment wants to influence research with his own intentions.

Energy differences have consequences for scientific products. More curiosity driven scientific products (reliable knowledge, as defined by Ziman, [1991]) require less energy to create and tend to be like in mode1. Scientific products in mode2 require more energy to create. This is because in mode2 (more than in mode3) the researcher is accountable to the societal environment, is driven by the intentions of this environment in this way accepting restrictions on research. The mode2 scientific products are mostly intended to be application driven (socially robust as defined Novotny et al., [2000]). The mode3 researcher, as he influences his societal environment, accepts fewer restrictions from the environment and therefore fewer intentions of this environment. The mode3 scientific product can be application driven as well, if agreed.

Different research organisations and scientific domains are characterised by different distributions of modes of strategic positioning, and are necessarily commensurate with the added value intended by these organisations and domains. For example, theoretical physics, mathematics and cosmology will position themselves more like the mode1 researcher whereas nanotechnology, applied mathematics etc. more like the mode2 or mode3 researcher.

The research entrepreneur is claimed to be the answer to the need, as articulated by Gibbons, for a new social contract between research and the societal environment requiring research to “enter the agora and participate fully in the production of socially robust knowledge” [1999]. To paraphrase Gibbons [1999], the research entrepreneur speaks to the societal environment and this environment not only speaks back but also listens to the researcher as he directs the environment.

The results from this preliminary study conducted at the MESA+ Institute for Nanotechnology show that the researcher establishes in his negotiations different strategic positions in different relationships with different partners. The position depends on the strategic long-term goals of the partners that make the researcher to give up the governance of research and to accept sharing strategic resources. In its relationship with the EU MESA+ positions itself more as the research entrepreneur. This is an example of a relationship of two strong partners who are strategically interdependent on each other resulting in a joint goal and an exchange of resources to attain this goal, and at the same time, the researcher is autonomous enough to influence the societal environment and the EU as its representative. This relationship is typical mode3. In its relationship with a company MESA+ positions itself more as the strategic researcher. MESA+ can thus be dependent on a partner such as a company who wants the researcher to deliver a solution to a set of certain research goals only. This relationship is a typical mode2 relationship.

The empirical findings confirm the feasibility of the proposed analytical model; the model is feasible as it is able to create observables for the different modes of strategic positioning of the researcher. Further research focused on predicting the performance of research tasks e.g. acquisition of scientific information by the researcher as determined by strategic positioning will be reported in the future.

The researcher will in the long term strive to achieve a position of highest possible organisational autonomy and lowest possible strategic interdependence. Along the path to achieve this desired strategic position, the researcher may encounter the need to compromise on strategic positioning in mode2 or in mode3. Nevertheless, at the end of the day mode2 and mode3 will only be intermediate positions necessary

to attain the desired model strategic position. This is the position of the least energy required for added value creation, the “ground state”.

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