

Drivers of innovation between globalisation and localisation¹

Elisabeth Baier² and Jannika Mattes³

(unpublished draft, spring 2008, not to be quoted)

1. Introduction

Innovative activities in general and innovations in particular are influenced by a variety of internal and external factors. Thereby, the sources of innovative activities are manifold. Contextual factors, shaped by regional, national and international policies, the general business climate as well as inter- and intra-firm conditions contribute to the innovative performance of enterprises. The propensity to innovate is partly intrinsic and additionally spurred by external factors. Factors which enable and foster the propensity to innovate are called “drivers of innovation”. They do not necessarily evolve from the innovation process intrinsically, but can also be found on an aggregate level.

The notion of drivers of innovation is not new. However, it currently experiences a renaissance (Cooke/Schwartz 2007). The contextual character of innovations was noticed decades ago, causing a debate on external and internal framework conditions which enable enterprises to innovate and to find new solutions to existing problems. Despite the tradition of this notion, a structured analysis is still missing. This article looks at the issue of drivers in innovation processes in MNEs (multinational enterprises) asking for their geographical origin. MNEs source technological knowledge internationally (Cantwell et al. 2001) and incorporate it in their innovation process. In order to investigate the geographical origin of innovation drivers, we consider innovation projects in MNEs as an appropriate object to study, as they host complex innovation projects involving various partners. We will proceed in the following way: We first shed some light onto the various notions on innovation drivers which emerge from various strands of literature (ch. 2). This analysis will show that innovation drivers can be found at several levels (macro-economic framework conditions, the meso level consisting of competitive

¹ This article draws upon research undertaken in the project “Regional learning in multinational companies”, financed by the Volkswagen Foundation. We would like to thank our interview partners for their openness, patience and the disposition to explain the characteristics of innovation processes to us as non-technicians. All the interviews were conducted by the authors.

² Elisabeth Baier, Fraunhofer Institute ISI, Karlsruhe, elisabeth.baier@isi.fraunhofer.de.

³ Jannika Mattes, University Oldenburg, jannika.mattes@uni-oldenburg.de.

and cooperative forces, and enterprise-internal drivers at the micro level). Although these levels do not allow to draw conclusions regarding the geographic origin of the drivers, they provide a useful starting point. We propose to take a knowledge-oriented approach to root innovation drivers in the innovation processes (ch. 3). Therefore, we subdivide the innovation process into functional arenas of innovation and characterise them regarding the importance of explicit and tacit knowledge. This leads us to three hypotheses which link geographical origins of innovation drivers to knowledge characteristics of the arenas. After some methodological considerations (ch. 4), we move to the empirical analysis of selected innovation projects (ch. 5), which allow us to test and discuss the hypotheses (ch. 6). The article finishes with a brief conclusion (ch. 7).

2. State of the art

Without explicitly addressing innovation drivers, the topic is present in various scientific debates. The already existing literature concentrating on drivers of innovation can be structured in a threefold way. Firstly, it deals with driving forces that belong to the general macro-economic framework which represents the scope of action for MNEs. Secondly, it addresses drivers of innovation on a meso-level, targeting the interaction between MNEs and other actors. Finally, a third thread of literature concentrates on enterprise-internal drivers of innovation. We will now briefly summarize the contributions of these different debates in order to allow an enhanced understanding of what innovation drivers are and where they originate.

2.1 Macro level

Drivers of innovation that come from a macro- level are enterprise-externally determined and even MNEs have none or only limited means of influencing them.

At this level, we can identify three relevant innovation-economic approaches which provide a suitable framework for the classification of drivers of innovation (Meyer-Krahmer 1999). The first theoretical concept is provided by evolutionary approaches in innovation economics. Path-dependency and technological development depend strongly on learning processes and interaction between the different actors involved in innovation processes. A second theoretical basis can be found in the lead-user concept (von Hippel 1988) that states that the integration of lead-users in technological development may improve the process of technology development. The third relevant thread of literature is the theory of innovation systems, which seizes user-producer-relationships, knowledge as fundamental resource for innovation and learning, the role

of the public sector, including its responsibility for education and R&D as enterprise-external sources of innovation (Lundvall 1992). The important role of the public sector in the innovation process, especially its direct support of the R&D, system has implications on the conduction of innovation policy.

From a policy perspective, innovation drivers are new forms of innovation governance. This includes the management of interfaces, the building and organisation of (innovation) systems, the provision of platforms for learning and experimenting, the establishment of an infrastructure for strategic intelligence, the stimulation of demand and the development of a clear vision (Smits/Kuhlmann 2004). Further (innovation) policy instruments target the macro-economic framework and in this manner foster MNE-internal innovation processes through external stimuli. The creation of favourable conditions for welfare and social peace, security of markets by regulative guarantees, overcoming global effects of locally caused disturbances and, finally, facilitating regional, national or sectoral innovation systems (Blind 2004; Kuhlmann 2001) clearly belong to the instruments targeting general framework conditions. As innovation policy instruments fulfil functions on regional, national and supra-local levels, an integration of different spatial levels is called for (Fromhold-Eisebith 2007). Since MNEs are entangled in actions on different levels, they are most likely to profit from an improved effectiveness by a coherent innovation policy which is characterised by a clear division of competences and functions among multi-level actors.

Regional systems of innovation perceive the economic position of a region as the result of path-dependent developments and institutionally anchored governance structures. The generation of synergy effects between institutional and technological development paths is very promising for increasing regional innovative capacity and for creating a new regional identity (Braczyk/Heidenreich 1998). Besides regional institutions and local organisations, collaborative networks are likewise important and influence firms' innovation activities significantly. Within this context, different forms of regional systems of innovation can be identified, which are in turn characterised by different geographical origins of the knowledge sources that spur innovation and is achieved through cooperation (Asheim/Isaksen 2002). Further, spatial proximity is important, due to the fact that the transfer of tacit knowledge requires a higher degree of mutual trust and understanding which can be gained through shared values and culture (Maskell/Malmberg 1999). MNEs may benefit from their regional embeddedness as they have access to the local knowledge base, to the institutional infrastructure and to local cooperation partners. Regional innovation system and clusters therefore act as drivers of innovation on a regional scale.

All in all, general framework conditions act as driving forces for organisational innovation processes. These can be political innovation policies as well as path-dependent developments which create an environment favouring or hampering innovation. The geographic origin of these drivers varies, although those in force in the direct regional surroundings are most decisive.

2.2 Meso level

MNEs need to incorporate a variety of resources that are not necessarily available internally. This is why contributions at the meso level focus on inter-firm cooperations. The drivers identified here are not general framework conditions as at the macro level, but result from direct interaction with partners. This interaction gives way to the integration of knowledge from different social entities, whereby additional competences can be obtained either individually, through communities of practice or via networks.

An internal lack of specific resources incites companies to cooperate and thereby include external drivers in the process of innovation. Reasons for and consequences of cooperation are manifold. First of all, MNEs cooperate in a search for heterogeneity, which is often regarded as a source of innovation (Powell/Grodal 2005). Cooperation thereby serves to break up rigid structures (Grabher 1993). Through external cooperation, MNEs have access to knowledge which is not available internally (Zhang et al. 2007). Thus, cooperation carries enormous potential for MNEs and acts as an enabler in the combination of heterogeneous knowledge (Fagerberg 2004; Teece 2000; Gerybadze 2005). In this resource-based view, externally obtained resources such as knowledge, but also material impact factors, drive innovation projects forward and are crucial enough to make MNEs cooperate with external partners.

Besides cooperation, vigorous competition in geographic concentration of interconnected enterprises is stressed in the literature of clusters (Porter 1998; Porter 1990). The competition with other firms can increase the urgency upon MNEs to launch new products and therefore act as a driving force: It incites new innovation processes.

On the meso level, innovation drivers result from direct cooperation or competition with organisational and institutional partners. Such partners can come from various backgrounds in the region and worldwide.

2.3 Micro level

Another thread of literature, which is occupied in a more implicit manner with innovation drivers, is settled at the micro level. Hereby, the focus lies on knowledge and project-internal characteristics. More than the other two levels, it has a management dimension and is rooted within the enterprise.

Although the external driving forces determined on macro and meso levels do matter, Beugelsdijk (Beugelsdijk 2007) concludes that firm specific drivers of innovation are more important than a firm's regional environment. This points to the significance of such internal drivers and explains why local knowledge spillovers as drivers of regional innovative activity have to be complemented by insights from learning and the change of routines in firms (Caniels/Romijn 2005). In addition to the considerations on competition and concentration in space as potentially driving forces in the innovation process, the enterprise strategy sets the framework for company-internally driven factors that have an influence on innovation (Porter 1998).

Key drivers of innovation in large enterprises are the internal technological environment, especially the technology strategy, idea generation and idea quality, and, partly externally driven, technology acquisition and exploitation (Koc/Ceylan 2007). Since the development of a technology strategy and the idea generation are primarily shaped enterprise-internally, however, not individually, this points towards the significance of internal cooperation and knowledge management.

Due to their size, their dispersed nature and the structure as "Betriebe von Betrieben" ("company of companies") (Pries 2000), MNEs possess a larger pool of resources and a more diversified knowledge base. Thus, similar factors to those which can be obtained through external cooperation are also available internally. This explains why MNEs do not necessarily need to draw upon external resources in order to incorporate diversity. Their first option is rather an internal collaboration, i. e. with another subsidiary or with the headquarters, often in different countries (Hislop 2003). This propensity to collaborate internally leads to a rising internationalisation of R&D, although not necessarily to a dispersion of projects (Gerybadze et al. 1997). MNEs transform into polycentric networks of knowledge production and knowledge dispersion, maximising both globalisation and localisation advantages (Pries 2000; Bartlett/Ghoshal 1989).

As MNEs evolve into dispersed heterarchies of learning (Hedlund 1994), knowledge management becomes the key driving force in innovation processes. The successful implementation of knowledge leads to a higher propensity to innovate. Tacit and codified, local and global knowledge and the understanding of the different channels and mechanisms of how to exploit these sources contribute to innovation (Bathelt et al. 2004).

Innovation is, per definition, a process of knowledge handling and knowledge combination. This is why knowledge serves as an important, if not the most important, source in innovation processes (Teece 2000). Thus, the exploitation of internal resources and the therefore required enabling management structures are core issues in MNE knowledge management. The generation of knowledge in enterprises targets the handling of implicit and explicit knowledge which is present in an enterprise. Necessary preconditions for a successful knowledge management are an open communication structure, autonomy of employees, fluctuation and creative chaos, redundancy of information, diversity and multidisciplinary (Nonaka/Takeuchi 1997).

Further enterprise-internal determinants of innovation can be found in the motivation of employees. Motivation is crucial for decision making and depends on the benefit which an employee can achieve through the respective action (Heckhausen et al. 1987; Nonaka/Takeuchi 1997). Pecuniary, material and non-material incentives are able to increase the motivation of the individual employee and can be used as management tools in this context (Heckhausen et al. 1987; North 2005), thereby facilitating the progress in innovation projects. At the same time, MNEs can draw upon more established processes for settling conflicts and coordinating various activities (Gopalakrishnan/Bierly 2001).

In conclusion, the most specific drivers of innovation reside at the company-internal micro level, both in the subsidiary itself and in the company group. These drivers are based upon strategic considerations, knowledge and the motivation of the employees to trigger innovation processes themselves.

2.4 Summary

Factors that spur innovation are found at different economic levels and can be extracted from various debates. As a synopsis to our research we propose the following structure for a compound and coherent presentation.

Table 1: Drivers of innovation structured according to their origin

General framework conditions (macro- level)	Collaboration and cooperation (meso-level)	Enterprise internal (micro-economic level)
<ul style="list-style-type: none"> · technological development due to learning processes and interaction and integration of lead-users · user-producer relationships · adoption of new innovation policy instruments, new forms of governance such as management of interfaces, strategic intelligence, regulative guarantees, facilitation of regional, national and sectoral innovation systems · integration of different spatial levels in innovation policy · institutionally anchored governance structures in regions and the creation of regional identity · local networks to draw upon unique regional resources · local knowledge spillovers · geographically concentrated competition 	<ul style="list-style-type: none"> · search for heterogeneity · break-up of rigid structures · access to knowledge which is not available internally · access to further material impact factors · technology acquisition · competitive pressure to innovate 	<ul style="list-style-type: none"> · technology strategy · management strategy · idea generation · internal incorporation of diversity, internal cooperation, leading to internationalisation of R&D · exploitation of the advantages tacit and explicit knowledge · conflict management and coordination of activities · open communication structure · autonomy of employees · fluctuation and creative chaos · redundancy of information and diversity · motivation management · financial resources

Source: own representation.

Although a multitude of drivers has been identified and presented, a coherent analysis, especially with regard to their regional origin, is still missing. We could observe that drivers from all levels are regionally concentrated or more dispersed. The multitude of drivers we have identified shows that there is no universal driving force which can trigger innovation in a sufficient way. Innovation projects are rather driven by a set of influences, especially if MNEs are the object of interest. We will thus now turn to a closer analysis of how the nature and thus the geographic origin of innovation drivers varies in the course of an innovation project.

3. Model of innovation drivers

In order to develop a model of innovation drivers, we proceed in the following way: Starting with definitions of MNE and innovation projects, in a second step, we investigate the character of innovation processes regarding their different functions, so-called “arenas” of innovation. Finally, by analysing the significance of different modes of knowledge in these arenas, we derive our hypotheses which will then be tested empirically.

MNEs are commonly defined as firms that control and manage production located in two or more countries (Caves 1996; Dunning 1993). Furthermore, MNEs produce for markets throughout the world (Root 1990), engage in substantial foreign direct investment, and actively manage their foreign-based assets (Krug/Daniels 2008). MNEs are thus “companies of companies” (Pries 2000), constituted by a headquarters and subsidiaries in several countries.

Innovation projects are defined as strategically significant product or process innovations which are rooted in different organisational units across all organisational levels. Related activities include not only research and development, but also the market launch. The resulting interaction of multiple levels within the enterprise and the inclusion of external partners leads to a complex structure of potential drivers of innovation, encompassing a multitude of the factors proposed in the literature analysis.

Such processes of innovation have traditionally been analysed as a linear flow of activities, including different stages of innovation that are followed through sequentially. A prominent example from IT, hereby, is the waterfall model. This model has been regarded as outdated for a long time. Successive models such as the chain-linked model (Kline/Rosenberg 1986) respect the higher degree of reflexivity and the possibility of feedback-loops in a process of innovation. The most current versions of innovation models describe the process as circular (Schoen et al. 2005) or model it in a fluent way, leaving both the incorporation of functions and the timing of their inclusion open (Hage/Hollingsworth 2000). Hage and Hollingsworth thereby propose to regard innovation projects in terms of arenas, where each arena describes all activities related to innovation-specific functions. Altogether six arenas were identified: basic research, applied research, development, production, quality control and marketing. Each arena transcends both departmental and organisational boundaries and can include actors from any part of the company as well as external partners.

This arena model of innovation has several positive implications for our analysis. By not limiting arenas to particular departments or companies, each arena includes all relevant innovation drivers for a particular function of innovation. Furthermore, it con-

siders all the important “steps” of innovation, without implying their linear succession. In order to simplify where possible, we adapt the model slightly: We do not differentiate between basic research and applied research, but merge them into one arena of “research”.

We will now move on to an analysis of the drivers of innovation as a function of these arenas. The underlying idea is that the origin of the dominant drivers of innovation depends on the importance of implicit and explicit knowledge in each of these arenas.

Jensen et al. (2007) state that the production and use of codified knowledge as well as informal processes of learning and experience-based know-how have positive impacts on innovation. Especially the combination of both leads to a higher propensity to innovate (Jensen et al. 2007). The connection between transferring knowledge and geographic proximity has frequently been observed (Malmberg/Maskell 1997). In order to describe the origin of the drivers of innovation in different innovation arenas, we draw upon the debate on knowledge and the ubiquitous distinction between explicit and tacit knowledge (Polanyi 1978; Lundvall/Johnson 1994). While explicit knowledge can be transferred more easily and communicated between various project partners in form of written documents and data, tacit knowledge depends for its communication upon personal, face-to-face interaction (Nelson/Winter 1982; Lundvall/Johnson 2000; Teece 2000), which is easier achieved in geographic proximity (Bathelt et al. 2004; Sölvell/Zander 1995). Based on the characteristics of explicit and tacit knowledge and the possibilities to convey these types of knowledge, different types of knowledge require different types of regional and enterprise-internal settings. We thus conclude that explicit knowledge can be transferred more easily across bigger distances, whereas tacit knowledge needs spatial concentration in order to be combined or interchanged. We will now link this conclusion to the specific arenas.

The functional arenas differ in regard of the knowledge which they mainly depend on. Although this has not been analysed explicitly for the arenas we have defined, some authors come to conclusions adaptable to our analysis. General hints can be derived from March (1991), who distinguishes exploration and exploitation in innovation projects and concludes that tacit knowledge is more important in the very uncertain tasks referring to exploration (March 1991: 85). Closer to our own analysis, Koskinen and Vanharanta (2002) define six phases of innovations for small technology firms, whereby their steps of invention and the decision to develop correspond to our arena of research, the development and decision to produce phases mirror the development

arena, and production and marketing are acknowledged as separate functions.⁴ Transferring their findings to our categories, one can conclude that tacit knowledge is especially important for the arenas of research and development, and, less significantly, for marketing. Production relies stronger on explicit knowledge (cf. Koskinen/Vanharanta 2002: 63).

This differentiation is consistent with the fact that research – especially basic research – is a comparably undirected activity which therefore relies highly upon tacit knowledge (Lawrence/Lorsch 1967: 30). The same is true for development: The tasks performed are still rather unstandardised and therefore rely upon implicit knowledge. In contrast to these arenas based on tacit aspects, the process of production is a lot more formalised (Lawrence/Lorsch 1967: 32). Here, pre-defined procedures are put into practice. Similarly, quality control is mainly about conforming to laws, rules and regulations and therefore carries important explicit elements. It simultaneously limits the diversity of products and excludes individual wishes (Blind 2004). Finally, marketing is again rooted in creative ideas. It relies upon a high level of tacit knowledge which complements explicit data derived from market research.

These considerations help us to formulate hypotheses on the spatial arrangement of innovation drivers for the functional arenas.

In production and quality management, as the dominant type of knowledge is explicit, geographical concentration is not necessary. Difficulties which occur in the process of putting an innovation into production or controlling its quality can be estimated (comparably) easily: the required information is available in form of handbooks, manuals and legal documents. Thus, these arenas work across big distances.

Hypothesis 1: In quality management and production, explicit knowledge is dominant; therefore, innovation drivers are not regionally concentrated.

On the other hand, in research and development, implicit knowledge is prevailing. The relevant knowledge concerns, above all, technological facts. Creativity and ideas are likewise important, and trial-and-error processes shape the process of innovation. Thus, project teams are rather small at this stage, cooperation among the participants is very intensive, and – in order to be able to transfer all this relevant knowledge -, geographical concentration is helpful but not ultimately necessary. This leads to the second hypothesis:

⁴ Their analysis does thus not allow to draw any conclusions regarding quality management, which is a function Koskinen and Vanharanta (2002) do not look at.

Hypothesis 2: In research and development, implicit technological knowledge is decisive; this is why innovation drivers are geographically concentrated.

For marketing, implicit knowledge is also important, but the type of knowledge implied is different. This time, technological issues are secondary, whereas selling and thus knowledge about customers and about markets are crucial. Due to the fact that MNCs usually aim at a global market, very diverse knowledge is needed here. Relying on the access to all the relevant market knowledge, innovation drivers for this arena are highly dispersed and internationalised.

Hypothesis 3: For successful marketing, implicit market knowledge is crucial; thus, innovation drivers are geographically dispersed.

4. Methodology

In order to test the three hypotheses, we choose a qualitative, case study based research design that allows the examination of innovation projects in multinational enterprises. The choice of a case study research design seemed to be the most appropriate measure for this kind of task. Due to their individual character, case studies are able to mirror the complexity of innovation processes in MNEs on the one hand and, on the other hand, allow for a comparative perspective without being too exclusive. Data collection included the conduction of personal, unstandardised interviews which target the topic of each case study exactly (Yin 2003). This material was complemented by written sources of evidence such as records, report and websites.

The objects of analysis were strategically significant innovation projects in six large German MNEs from four sectors, covering a mix of enterprises from traditional as well as future-oriented industries based on high and medium-high technology. We chose a cross-sectoral approach to avoid a bias in our investigation due to sector specificities.

In each of the enterprises, we conducted five to fifteen expert interviews, 50 altogether. All interviews were carried out on site and in person. Since innovation projects are among sensitive issues in enterprises, we guaranteed anonymity to our interviewees. This is why enterprise names are replaced later in the text.

We organised the structure of the conversation as open as possible to ensure that the experts were able to address all the aspects they considered as relevant for the innovation project. Core topics that had to be covered during the interviews were fixed in an open interview guideline. They included the organisation of innovation processes in the MNE, the course of action during the innovation project, organisational features, inter-

action of different actors and in different arenas, trust, internal and external communication structures with regional actors and collaboration partners and the incorporation of external knowledge in the innovation process. Additionally, hard facts on the selected innovation project such as the financial volume, duration, number of people, departments and sites involved were briefly addressed. To include the degree of regional embeddedness in our research design, these enterprise-internal interviews were complemented by almost 60 interviews with regional actors that were likewise involved in the innovation project or engaged in regional innovation networks.

The contact to the interview partners was established either via e-mail or telephone, making sometimes use of previously established contacts with the MNE. Almost all interview partners consented to a recording of the interview. During the interviews, notes were taken, which were afterwards completed on the basis of fresh memories of the interview and with the help of the audio material collected during the interview process. All interviews were transcribed in order to extract all the relevant information.

Based on the extensive interviews and the resulting case studies of innovation projects in six large German MNEs, we now proceed in two steps. In a first step, we identify the most important innovation drivers for each arena in the innovation process. In a second step, we analyse these drivers of innovation according to their geographical origin and their concentration in space.

5. Empirical results

The data we analyse results from case studies in six large German MNEs from four different sectors: IT (IT-A and IT-B), pharmaceuticals (Pharma-A), automotive (Auto-A and Auto-B) and electronics (Electro-A). Except for one process innovation (Auto-B), we analysed product innovations in all other projects. In general, we looked at large, financially and strategically significant projects which are of superior importance for the MNE; merely the project in IT-A is a small innovation carried through only by about 20 people.

Technologically, the IT-A project results in a new software device, whereas IT-B aims at developing a new cinema technology. The project in Pharma-A refers to the development of a new drug combined with a new pharmaceutical form. Auto-A develops an alternative impetus system and Electro-A devices an innovative train engine. Finally, the process innovation in Auto-B is based on a restructuring of development activities.

We will now analyse what drives forward the innovation projects in each arena and thus identify the geographic origin of the most decisive drivers of innovation.

Research:

In the arena of research, the crucial aim is to achieve that the project will in fact be implemented and carried through. In most cases, general conditions of the innovation project such as financing, duration, participating actors, etc. are not yet clear. Before the project is formally set up, it relies upon the motivation of individuals pushing it forward, who truly and properly believe in its success. Thereby, the projects of Pharma-A, Electro-A and IT-A are characterised by a strong personal interest of the participants in the projects, who are initiators and drivers at once. However, driving individuals are not necessarily those who participate actively in the project themselves: In both Auto-A and Auto-B, the CEOs promote the initiation of the projects by granting funds and manpower, and, subtly, thereby influence which direction the innovation process will take. The IT-A project is sheltered through the personal ambitions of a sponsor in the far-away headquarters, who acts as an intermediary between the small project and the board level. In the cases of Pharma-A, IT-A and IT-B, creative experimentalism is an institutionalised company innovation strategy, which leads to a generalised company-internal driving force of innovation.

Furthermore, in the arena of research, the impact of individual effort is still enormous: In the Pharma-A project, the personal engagement of one researcher initiates that, for a period of time, the project is sub-divided into two groups (one consists of a single researcher, the other is a group of researchers), doing research in parallel, whereby nobody believes in the success of the other strategy. Only at the moment when the single researcher succeeds, the whole group shifts its focus and re-joins him. This shift of the focus, which results from the personal initiative of one of the researchers, is later regarded as the crucial factor for being able to uphold the project at all.

In conclusion, the work in research relies upon two main group of drivers: Personally motivated, intrinsic engagement of project team members themselves, which only partly relies upon the institutionalisation of freedom for searching and exploring in general, and their backing through hierarchically superior sponsors from the own and foreign subsidiaries as well as from the headquarters.

Development:

When shifting the focus towards more concrete development activities, many of the factors which are still open in the arena of research are officially clarified, fixed and determined. The process of innovation evolves from an open, explorative activity to-

wards a more structured one. Many of the crucial drivers still come from within the projects themselves. This is particularly the case for IT-A, where individual engagement of the participants facilitates the access towards decisive project-external factors: finance, manpower, knowledge and ideological support. These factors seem to be dominant in this arena for all of the projects we looked at, and they largely remain within company borders, although especially relevant knowledge and ideological support are often obtained in other subsidiaries or the headquarters. Furthermore, the project is now, for the first time, also subject to company-external factors. In order to fulfil legal requirements for the introduction of a new drug, Pharma-A takes a whole variety of external partners into the project. In the Electro-A project, we observe the same phenomenon, although the underlying reason is different: here, the external drivers are mainly financiers. Auto-A and IT-B actively seek and draw upon external expertise in order to speed up the introduction of the to-be products: Both companies anticipate potential market entry barriers and try to fight them through strategic partnering and by including crucial decision makers in the development.

Thus, the development arena is still characterised by personal and concentrated innovation drivers. Our empirical examples show that individual engagement and the backbone achieved through sponsors are core factors for the project advancement. However, external and more spread drivers also gain importance. They can be identified as access to additional knowledge and financial resources and as taking first steps towards fulfilling legal obligations.

Production:

In contrast to both research and development, the interview partners do not describe production as a creative activity. Serial production is mainly regarded as a standardised routine procedure. Although there certainly are drivers for this process, their influence is limited due to many pre-defined facts. In this way, the most important driving factor is a successfully accomplished development. Additional drivers are diverse. For Electro-A, a strong involvement of the project leader is decisive, as the project brings along new production procedures. The project leader helps by being physically present at the production site, which enables the transfer of knowledge from the formerly passed arenas to this one. The success of the project of Auto-B relies upon its conformation with existing production procedures and routines. Finally, both Auto-A and IT-B rely upon the technological know-how of external partners who take part in the production process.

In comparison to both research and development, the key driving forces in the arena of production are by far more dispersed. They range from a dominant role of the project leader to access to partners and, especially, to fulfilling the standards established by the company and based on external requirements.

Quality control:

Quality control is often not easy to characterise as an own empirically observable arena. Especially in Pharma-A, where the whole development of the drug takes place while it is tested clinically, development and quality control are congruent arenas. However, as the functions do clearly differ, it seems to make sense to treat quality control as a separate arena. Its main function is to make sure that the developed product is truly fit for market introduction. This implies practical tests to ensure that it works correctly as well as fulfilling all legal and regulatory obligations. In Electro-A and IT-A, the necessary knowledge is internalised, and the project team draws upon the expertise of colleagues from other departments. Electro-A even has its own test site and thus does not need to involve external parties. Their own quality control centre ensures the quality of the new engine and is at the same time allowed to grant the legal permission of market access. In contrast, to make sure that exactly these legal requirements are met, and especially to be granted market admission, all the other companies undergo a variety of procedures and select external partners which help to fulfil the legal obligations or standards. Pharma-A and Auto-A thereby let partners from all over the world participate in the projects, which results in a globally dispersed fleet of test cars for Auto A and in world-wide spread clinical trials for Pharma-A. Both companies aim at changing existing laws in order to be allowed to launch the product. On the other hand, as they do not enter completely new technological fields with the projects, Auto-B and IT-B act within prevailing rules. Although they do need sufficient knowledge about these standards, they are not reliant upon new technological partners to be able to comply with these rules.

The extent to which innovation drivers are spread in quality control, thus, depends largely upon the degree to which rules are modified or simply adopted. If crucial alterations are necessary, MNCs rely upon extensive external partnering in order to obtain the external approval. Internal drivers, in turn, matter if the product ex ante complies with external rules and mainly has to fit internal standards and routines.

Marketing:

Finally, when launching the new product and at the hour of preparing this launch, the MNEs need detailed knowledge about the market. Additionally, they aim at a strong position in the market, which can only be guaranteed if they are known by their target group. Only in the case of Auto-A, where the high production costs inhibit a successful marketing strategy, are the determining factors within the project itself. For IT-A and Auto-B, the crucial drivers come from other parts of the company: In order to guarantee the smooth implementation of the new software and the new process in standard products and procedures, they draw upon company-internal knowledge. In the other cases, namely for Pharma-A, Auto-A and IT-B, the crucial focus is external: a successful marketing strategy relies upon obtaining knowledge of the market via qualified expert partners. In order to achieve this, Pharma-A chooses to step into a cooperation which aims primarily at marketing, and Auto-A cooperates with various partners who all aim at creating a market for this new technology. IT-B uses the advice by external experts and then presents its technology at an international event taking place in the region. The project of Electro-A has not yet reached the stage of commercialisation and can thus not be included in the analysis.

Marketing is, therefore, largely driven by forces from the target markets, which are usually internationally spread. Only if MNEs follow a highly ethnocentric approach (and thus centralise market knowledge in the headquarters) or if the target market is regionally confined can it be managed locally.

In conclusion, it can be observed that the origin of the drivers of innovation varies significantly among the arenas of innovation. Table 2 gives a detailed overview of the different drivers in each arena for the empirical cases on hand and thereby summarises again our findings regarding their geographic origin. We will then use the results of our analysis to test the three hypotheses.

Table 2: Drivers of innovation – factors which are crucial in the advancement of the project

	Research	Development	Production	Quality management	Marketing
Pharma-A	<p><i>Personal interest in the project</i></p> <p><i>Institutionalisation of unorthodox thinking</i></p> <p><i>scientific curiosity</i></p>	<p><i>Access to knowledge in the company group</i></p> <p><i>Financial security</i></p> <p>Access to external partners to fulfil legal requirements</p>	-	<p><i>Access to knowledge in the company group</i></p> <p><i>Financial security</i></p> <p>Access to external partners to fulfil legal requirements</p> <p>Conformity with norms, rules, legislation</p>	<p>Access to external knowledge about the market</p> <p>Access to additional finances and expertise</p>
Electro-A	<p><i>Personal and scientific curiosity</i></p>	<p><i>Financial resources</i></p> <p><i>Conformity with internal organisation standards</i></p> <p><i>Regional funding</i></p> <p><i>Administrative support in obtaining external funding through city council</i></p>	<p><i>Strong involvement of the project leader</i></p>	<p><i>Access to knowledge about legal conformity</i></p>	-
Auto-A	<p><i>Backbone of CEO</i></p>	<p>Introduction of new standards through cooperation with external partners</p> <p><i>Time and resources through CEO backing</i></p>	<p>Access to partners with relevant knowledge and technological advices</p>	<p><i>External funding</i></p> <p>Partners in different countries to fulfil different legal requirements</p> <p><i>Vast amount of partners to save time</i></p>	<p>Acceptance of the new product</p> <p><i>Cost reduction</i></p>

Auto-B	<i>Backbone of CEO</i>	<i>Financial and ideological support through CEO</i>	<i>Conformity with existing rules on design of belt conveyor</i>	Conformity with legal requirements	Knowledge of the different markets
IT-A	<i>Internal sponsor as a backbone</i> <i>Access to know-how (internally)</i> <i>Personal interest in the project</i>	<i>Personal engagement of project members</i> <i>Sponsor as enabling mechanism</i>	-	<i>Conformity with product portfolio</i>	<i>Application in other products (mother products)</i>
IT-B	<i>enterprise intrinsic interest in research activities (basic and applied)</i> <i>technological and market research activities (hybrid approach)</i>	<i>ideological support of the project in one of the enterprise divisions</i> <i>as a result availability of financial resources</i> <i>attraction of external financial sources</i> <i>access to external knowledge about technological developments and standardisation and important players in the market</i>	amalgamation of technological knowledge from all partners	conformity with international standards, approving of technology by market leaders	<i>Access to external knowledge about the market</i> utilisation of spectacular international events to generate publicity (external events as marketing platform)

Regional Micro**Dispersed Micro****Regional Meso****Dispersed Meso****Regional Macro****Dispersed Macro**

6. Discussion

The representation of empirically identified drivers of innovation has clearly displayed that they vary among the arenas of innovation. Although we draw upon a rather small sample and can certainly not derive any general results, there are patterns to be observed which seem to be characteristic. We will now discuss these patterns in more detail as we test our hypotheses.

Hypothesis 1 predicts a spread of the activities in production and quality management, as both rely upon highly codified knowledge. Referring to production, this seems to be true. Although not all drivers are to be found in geographically dispersed settings, their origin seems to be largely arbitrary and not decisive. The contribution of driving forces here lies in the integration of a new product into standard routines, and it is mainly about putting in practice the proposals worked out by development. Although this is certainly not always trivial, the drivers largely reside in explicit factors and can thus bridge distances without major problems. Explicit factors in the production phase are an important part of the knowledge management process in MNEs which were identified as innovation drivers earlier.

Whereas the conclusion regarding quality management is very similar and a dispersion of activities can also be observed here, the underlying reasoning is rather different. Partly, as had been expected, the relevant knowledge is codified and documentation on legal requirements that have to be fulfilled is readily available independent of time and space. However, if these standards need to be changed and modified for a new technology, the arena of quality management evolves into a process of political negotiation and relies upon tacit and explicit knowledge. Additionally, it requires involvement of different regional levels (Blind 2004), which favours the impact of dispersed innovation drivers.

This can lead to a concentration of the decisive partners in one region and thus to a localisation of innovation drivers. Nonetheless, even in this case a dispersion of the drivers can be observed, which is then related to legal obligations and requirements.

Hypothesis 1 can thus not be rejected. It needs to be noted, though, that the here observed dispersion of driving forces is not constitutional, but rather results from a lack of locally available alternatives.

The picture is completely different for research and development. Hypothesis 2 predicts the concentration of all the relevant drivers. This prediction can easily hold for the arena of research. Except for some sponsors from other subsidiaries, driving forces here remain within the region, and, in all cases, within the company. This creates a

very sheltered atmosphere which seems to be necessary to protect upraising and emergent ideas. Autonomy of employees and freedom to ensure creativity is part of the knowledge management process (Nonaka/Takeuchi 1997) and necessary in this phase. The motivation of individual researchers or research group is another important determinant. Although many of the drivers in development are again internal and regional, hypothesis 2 does not hold for this arena. First of all, we observe an aperture of the project towards external drivers, whereby it moves away from the isolated and protected state. In the same way, the concentration of activities decreases, and important internal and concentrated drivers are complemented through more dispersed forces and partners. The project in development is dependent upon these additional sources of knowledge, expertise, financial resources and even innovation policy instruments.

In summary, hypothesis 2 must be partly rejected. Although a strong concentration can be observed in research, these concentrated forces are complemented through more dispersed drivers in the arena of development.

Finally, hypothesis 3 claims that marketing relies upon dispersed drivers which enable the MNC to meet the needs of the worldwide markets. For those projects which are in a stage of market introduction, this expectation is congruent with our empirical observations. Nonetheless, a more differentiated perspective is necessary. There are several situations which cause a rather high degree of concentration of drivers. One results directly from an ethnocentric strategy and the logical consequence of maintaining marketing activities centralised. The other concentration of drivers does explicitly not result in a concentration of activities: if cost and quality considerations hamper the product's market entrance, the actual activities (and drivers) referring to marketing become marginal and of less importance. However, as this does not refer to the function of marketing as such, but rather collides with it in timing, these observations can be neglected and hypothesis 3 does not need to be rejected.

In conclusion, we have observed the various origins of innovation drivers. As expected, the arenas of production and quality management rely highly upon codified knowledge and are thus subject to dispersed drivers of innovation. In contrast, both research and development involve implicit and explicit knowledge and take place in a more concentrated setting. Nonetheless, the arena of development is frequently subject to external driving forces from meso and macro level as well as to internally dispersed partners at a micro level. Finally, the arena of marketing benefits from dispersed driving forces which help to prepare launching the product on the global market.

7. Conclusions and outlook

Innovation drivers are not a new object of study, although it is a recent development that they are addressed explicitly. Different strands of literature deal with aspects of innovation that can be regarded as driving forces. The richness of these contributions shows that innovation drivers are manifold and usually only have effect in combination. They come from different economic levels, whereby neither general framework conditions at the macro level, nor cooperation and competition forces at the meso level, nor company-internal aspects at the micro level may be neglected. None of the levels is intrinsically correlated to the geographical origin of the drivers.

This reflects the importance of a coherent analysis of these driving forces. We have attempted to present the relevant literature in a structured way and then have shifted the focus to a knowledge-oriented model which links the geographic origin of innovation drivers to different functional arenas. The proposed connection between the type of knowledge dominant at a particular point of an innovation project and the drivers which influence the process at this moment of time has proven true for our empirical sample. However, we have also observed that knowledge alone is not sufficient for explaining the location of innovation drivers. Their origin also varies depending on other characteristics of the tasks performed in the arena, which can lead to a considerable influence of more dispersed drivers even in arenas largely based on tacit knowledge.

It is important to note that we did not look at where the activities took place, but where the decisive drivers for each function came from. Therefore, our analysis does not reflect a full picture of the location of innovation activities, but rather of the origin of the most important influence factors in each arena.

As our findings propose, much remains to be done in order to gain a more enhanced understanding of innovation drivers and, particularly, of their geographic origin. Our analysis can only be regarded as a first step to a more encompassing and at the same time functionally differentiated view of these forces. A broader empirical study is now needed in order to test whether the results of this study also hold for a larger sample. Furthermore, we suggest to differentiate in a more detailed way between various types of drivers and to analyse the implications of the nature of these drivers for their geographic origin. All in all, innovation drivers certainly remain an interesting field of study from which we can expect new insights in future studies.

8. References

- Asheim, B.T./Isaksen, A. (2002): Regional Innovation Systems: The Integration of Local 'Sticky' and Global 'Ubiquitous' Knowledge, *Journal of Technology Transfer*, 27, 77-86.
- Bartlett, Ch. A./Ghoshal, S. (1998): *Managing across borders. The transnational solution*. 2nd edition. Boston: Harvard Business School Press.
- Bathelt, H./Malmberg, A./Maskell, P. (2004): Clusters and knowledge: local buzz, global pipelines and the process of knowledge creation, *Progress in Human Geography*, 28, 31-56.
- Beugelsdijk, S. (2007): The Regional Environment and a Firm's Innovative Performance: A plea for a Multilevel Interactionist Approach, *Economic Geography*, 83, 181-199.
- Blind, K. (2004): *The Economics of Standards: Theory, Evidence, Policy*. Cheltenham: Edward Elgar.
- Braczyk, H.-J./Heidenreich, M. (1998): Regional governance structures in a globalized world. In: Braczyk, H.-J./Cooke, P./Heidenreich, M. (eds.): *Regional Innovation Systems*, London, Bristol: UCL Press, 414-440.
- Caniels, M.C.J./Romijn, H.A. (2005): What drives innovativeness in industrial clusters? Transcending the debate, *Cambridge Journal of Economics*, 29, 497-516.
- Cooke, P./Schwartz, D. (2007): Key Drivers of Contemporary Innovation and Creativity, *European Planning Studies*, 15, 1139-1141.
- Dunning, J. H. (1993): *Multinational enterprises and the global economy*. Wokingham u. a.: Addison-Wesley Publishing Company.
- Fagerberg, J. (2004): Innovation: A guide to the literature. In: Fagerberg, J./Mowery, D./Nelson, R. (eds.): *Handbook of innovation*, Oxford: Oxford University Press, 1-26.
- Fromhold-Eisebith, M. (2007): Bridging Scales in Innovation Policies: How to Link Regional, National and International Innovation Systems, *European Planning Studies*, 15, 217-233.
- Gerybadze, A. (2005): Technologie- und Innovationsmanagement in internationalen Konzernen: Organisation und Führung länderübergreifender Wissensproduktion. In: Brandt, W./Picot, A. (eds.): *Unternehmenserfolg im internationalen Wettbewerb: Strategie, Steuerung und Struktur*, Stuttgart: Schäffer-Poeschel, 311-328.
- Gerybadze, A./Meyer-Krahmer, F./ Reger, G. (1997): *Globales Management von Forschung und Innovation*, Stuttgart: Schäffer-Poeschel.
- Gopalakrishnan, S./Bierly, P. (2001): Analyzing innovation adoption using a knowledge-based approach, *Journal of Engineering and Technology Management*, 18, 107-130.
- Grabher, G. (1993): Rediscovering the social in the economics of interfirm relations. In: Grabher, G. (ed.): *The embedded firm. On the socioeconomics of industrial networks*, London, New York: Routledge, 1-31.

- Hage, J./Hollingsworth, R. (2000): A strategy for analysis of idea innovation networks and institutions, *Organization Studies*, 21, 5, 971-1004.
- Hedlund, G. (1994): A Model of Knowledge Management and the N-Form Corporation, *Strategic Management Journal*, 15, Special Issue: Strategy: Search for New Paradigms, 73–90.
- Heckhausen, H./Gollwitzer, P./Weinert, F. (1987): *Jenseits der Rubikon - Der Wille in den Humanwissenschaften*, Berlin: Springer.
- Hislop, D. (2003): Knowledge integration processes and the appropriation of innovations, *European Journal of Innovation Management*, 6, 3, 159-172.
- Jensen, M.B./Johnson, B./Lorenz, E./Lundvall, B.A. (2007): Forms of knowledge and modes of innovation, *Research Policy*, 36, 680-693.
- Koc, T./Ceylan, C. (2007): Factors impacting the innovative capacity in large-scale companies, *Technovation*, 27, 105-114.
- Kuhlmann, S. (2001): Future governance of innovation policy in Europe - three scenarios, *Research Policy*, 30, 953-976.
- Lawrence, P. R./Lorsch, J. W. (1967): *Organizations and environment: Managing differentiation and integration*, Boston: Harvard Business School Press.
- Lundvall, B. A. (1992): User-Producer Relationships, National Systems of Innovation and Internationalisation. In: Lundvall, B. A. (ed.): *National Systems of Innovation*, London: Printer Publishers, 45-92.
- Lundvall, B. A./Johnson, B. (1994): The learning economy, *Journal of Industry Studies*, 1, 2, 23-41.
- Malmberg, A./Maskell, P. (1997): Towards an Explanation of Regional Specialization and Industry Agglomeration, *European Planning Studies*, 5, 25-41.
- March, J. G. (1991): Exploration and exploitation in organizational learning, *Organization Science*, 2, 1, 71-87.
- Maskell, P./Malmberg, A. (1999): Localised learning and industrial competitiveness, *Cambridge Journal of Economics*, 23, 167-185.
- Meyer-Krahmer, F. (1999): Anwendungskontexte: Technologie- und Innovationstreiber. In: Sauer, D./Lang, C. (eds.): *Paradoxien der Innovation. Perspektiven sozialwissenschaftlicher Innovationsforschung*, Frankfurt, New York: Campus Verlag, 119-128.
- Nonaka, I./Takeuchi, H. (1997): *Die Organisation des Wissens: wie japanische Unternehmen eine brachliegende Ressource nutzbar machen*. Frankfurt, New York: Campus Verlag.
- North, K. (2005): *Wissensorientierte Unternehmensführung - Wertschöpfung durch Wissen*. Wiesbaden: Gabler Verlag.
- Polanyi, Michael (1978): *Personal knowledge. Towards a post-critical philosophy*. Reprinted. London: Routledge & Kegan Paul.

- Porter, E.M. (1998): *On Competition*. Boston: Harvard Business School Press.
- Porter, M.E. (1990): *The competitive advantage of nations*. Basingstoke: Macmillan.
- Powell, Walter W./Grodal, S. (2005): Networks of innovators. In: Fagerberg, J./Mowery, D. C./Nelson, R.: *The Oxford Handbook of Innovation*, Oxford: Oxford University Press, 56-85.
- Pries, L. (2000): Globalisierung und Wandel internationaler Unternehmen. Konzeptionelle Überlegungen am Beispiel der deutschen Automobilkonzerne, *Kölner Zeitschrift für Soziologie und Sozialpsychologie*, 52, 4, 670-695.
- Schoen, J./Mason, T. W./Kline, W. A./Bunch, R. M. (2005): The innovation cycle: A new model and case study for the invention to innovation process, *Engineering Management Journal*, 17, 3, 3-10.
- Smits, R./Kuhlmann, S. (2004): The rise of systemic instruments in innovation policy, *International Journal of Foresight and Innovation Policy*, 1, 4-32.
- Sölvell, O./Zander, I. (1995): Organization of the dynamic multinational enterprise: The home-based and the heterarchical MNE, *International Studies of Management & Organization*, 25, 1-2, 17-38.
- Teece, D. J. (2000): *Managing intellectual capital. Organizational, strategic, and policy dimensions*, Oxford: Oxford University Press.
- von Hippel, E. (1988): *The Sources of Innovation*. New York; Oxford: Oxford University Press.
- Yin, R. K. (2003): *Case Study Research: Design and Methods*, 3. Thousand Oaks: Sage Publications.
- Zhang, J./Baden-Fuller, Ch./Mangematin, V. (2007): Technological knowledge base, R&D organization structure and alliance formation: Evidence from the biopharmaceutical industry, *Research Policy* 36, 515-528.