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REGIONAL TRAJECTORIES TO THE KNOWLEDGE ECONOMY: A DYNAMIC MODEL

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Firm-level based Knowledge Biographies as an Analytical Tool for the Biotech Industry

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1 Introduction:

The first interim report of the Munich project team (Kaiser/Liecke 2006) was mainly focused on sectoral specificities of the pharmaceutical biotechnology industry in Europe. Apart from that we were also able to identify specific pathways through which German biotech firms developed and we offered a so-called innovation biography as an analytical tool for the mapping of institutional arrangements that play a role in the acquisition, use and diffusion of knowledge during a specific R&D process. The usefulness of such a tool has been contested by some of our colleagues mainly because of its orientation towards innovations instead of knowledge. Nevertheless, even though we accept that our first attempt to sketch such an innovation biography suffered from limited empirical research, we still maintain the basic idea that under certain conditions a "biographical method" that refers to a firm's innovation processes provides this analytical value.

Therefore, our second interim report has two different aims. As outlined in the project's technical annex, we want to contribute to the establishment of a framework for the design of primary firm-level research to be done in WP 6. In this regard, we present a more elaborated biographical tool that links – at the firm level – knowledge flows and organizational innovations to corporate innovation processes. In contrast to our first attempt in which we highlighted one specific innovation process, we now capture the entirety of the company's technological development. In order to maintain continuity with our first report, we cite again the example of Munich-based biotech firm Medigene. Secondly, we relate the

main results of this single biographical firm portrait to conceptual elements that have been elaborated within this work package for sector comparison.

2 Knowledge Drivers and Trends in the Biotechnology Sector

The first interim report of the Munich project team (Kaiser/Liecke 2006) was mainly focused on sectoral specificities of the pharmaceutical biotechnology industry in Europe.

In this context we established that biotechnology innovation processes, especially those of the pharmaceutical or "red" biotechnology can often be categorized as highly standardized, and of a "linear" nature. Innovative drugs or treatments are hence often initiated at, or in cooperation with, a publicly financed research organisation. Larger pharmaceutical companies eschewed in the past and do even today, the effort to start a long, insecure and expensive process of biotechnology product development. They rather prefer to cooperate with specialised biotechs, which already brought on research efforts beforehand. Hence the specific biotechnology innovation process can be divided into three strictly distinct phases: first the basic invention followed by small-scale production of a compound and first pre-clinical tests, secondly the clinical evaluation and market authorization and thirdly production, marketing and extension to further indications. Consequently strengths or weaknesses of the national or regional infrastructure for biotechnology related basic research affect significantly the potential and performance of regional or national industries in this field.

From a theoretical point of view, in recent years the role of regional economies has been emphasized with increasing importance. Apart from external economies which were identified by economic scholars already more than a hundred years ago (Marshalls "Principles of Economics", first published in 1890), and "new industrial district-" networks as analyzed by Piore and Sabel in the mid 1980s, currently the role of so called localised knowledge spill-overs (LKS) has turned into a central subject of research. LKS can be defined as "knowledge externalities bounded in space", which create the opportunity for firms operating close to knowledge sources to innovate faster than firms located elsewhere. (Breschi, Lissoni, 2001a) Even main economic theory identified them as one externality driving regional agglomeration processes. Though Krugman (1991) dismissed the role of LKSs by claiming that they might exist in some high-tech sectors, but that they were not crucial for agglomeration in general.

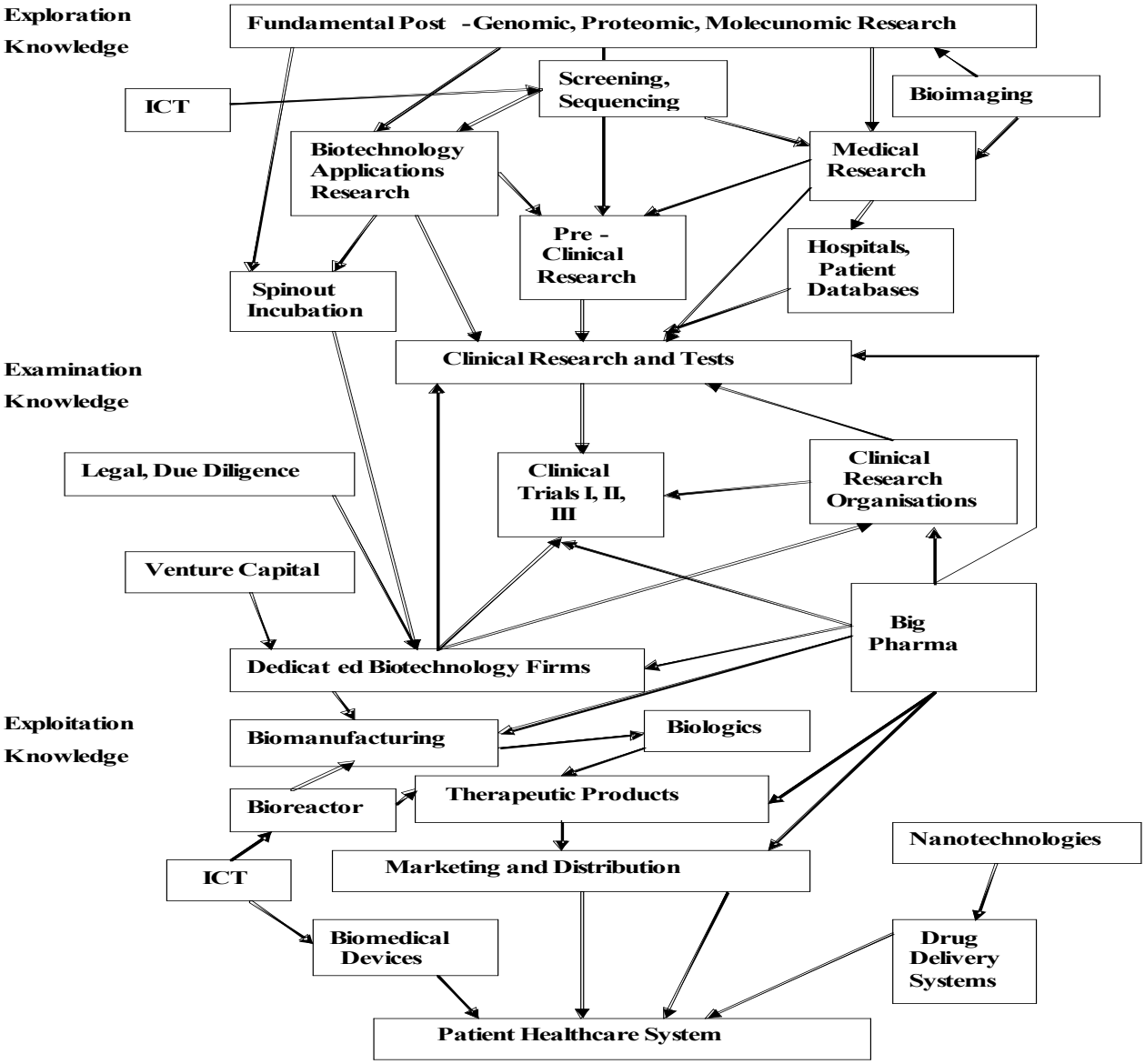
Krugman's contribution led to an intense discussion. Amongst others, Martin (1999), and in a review of empirical studies, Feldman (1999) disagreed on whether LKSs play an

important role. Cooke also considers them as a driver of the tendency of firms to cluster in specific areas (2006).

Formal spillovers may be examined at the firm level by indicating research contracts and collaborations with other firms or universities, as well as formalised institutional memberships, etc. At the individual level they may take place through industry-funded university chairs, industrial scientists having secondments or part-time placements in university laboratories etc. (Howells 2002). These activities are, as indicated, at least to a certain extent measurable. Unintended informal knowledge spillovers, however, for instance the poaching of key staff, unintended disclosure of information at conferences and workshops, positions on scientific advisory boards etc., are much harder to measure, as proven by the fact that no market mechanism for the exchange of tacit knowledge could be isolated, and is therefore largely neglected in related studies (Howells 2002). Nooteboom (2002) indicates that those informal networks might also jeopardize a firms' competitive position, as they cannot eliminate the possibility that crucial knowledge spills over to competitors. This may occur if employed scientists have more allegiance to their profession than to their firm.

More recently Feldman and Martin (2005) have emphasised the importance and significance of knowledge spillovers stemming from tacit knowledge. As Owen-Smith and Powell put it: "… formal ties among (…) organizations are important in explaining innovation primarily to the extent that they enable access to informal spillovers within a regional ecology" (2004: 9). A further tool for the examination of knowledge flows, in regional/local agglomerations or in general, is contributed through research on knowledge networks. A recent and influential study by Owen-Smith and Powell (2004) highlights the crucial role of proximate universities or other research organisations concerning the circulation of regional knowledge. As Nelson puts it: "This science base largely is the product of publicly funded research, and the knowledge produced by that research is largely open and available for potential innovators to use" (2004: 455).

In this context, the conceptual differentiation into "exploration", "examination" and "exploitation" as suggested by Cooke is well suitable to describe the relation of different kinds of knowledge in the various phases of the biotechnology innovation processes. As shown in figure 1, drawn up by Cooke, different forms of creation, use and diffusion of knowledge establish a complex, multi-actor innovation system in the biotechnology industry.



Source: The Knowledge Value Chain in the Healthcare and Medical Bioscience Value Chain (Cooke Deliverable reference number: WP2b)

Cooke et al. define these different kinds of knowledge as follows:

- **Exploration knowledge**: The aim of fundamental research, as, for example, in postgenomics, proteomics and molecunomics conducted in laboratories of universities, research institutes and DBFs in the main.
- **Examination knowledge**: The kind of ‘‘feedback’’ knowledge that comes from clinical trials of new treatments, therapies and drugs to find out if they work or work better than existing treatments.

- **Exploitation knowledge**: The mix of knowledge skills, including scientific, technological, entrepreneurial, financial and legal that enables discoveries to be transformed into commercial products with market demand (2006: 116).

In our first interim report we described how technology related path-dependencies are still of crucial importance in explaining the sectoral dominance of the United States as well as the performance of other locations in this industry. Some of the latter ones are certainly able to "catch-up". For the Munich region the authors were able to show that without the model of "in-licensing" products at a certain innovation stage, the relative performance of the cluster would have been rather weak.

Hence business models are of certain importance in explaining clusters or nations performance. In this context the Munich partners identified four dominant models for the Munich location. Those four categories were in detail:

- **Category 1:** The inventor of an active substance exploits his own invention through the foundation of a research intensive biotechnology company. Here, one can distinguish whether the invention was made in another firm or in a publicly-financed research organization.
- **Category 2:** An already existing biotech firm is in-licensing an active pharmaceutical agent, respectively a patent or patent family, as the new pile of the corporation. The active agent is still in a very early phase of development and thus the successful development as well as the potential market success can hardly be precisely estimated. This category represents a variant of category one, however, the difference is that the original inventor is not the founder of the firm which has become responsible for the product's development. Consequently one can distinguish whether the original invention was made in a public research organization (PRO) or a (larger) firm.
- **Category 3:** An existing firm in-licenses a drug compound which is already at an advanced stage in its development. The risk that the drug will not reach the market is thus significantly lower, and hence the market success can be much better estimated. In this category the provider of the license is always another firm, as PROs usually do not pursue developments to a more advanced stage. One can further differentiate if the licensee is obliged to add some proper research work or if it concerns a pure marketing partnership. The disadvantage of such a business strategy is that milestone payments and royalties have to be paid to the inventor. Consequently, the revenues for the in-licensing firm are in general smaller. In addition, the in-licensing of advanced

product candidates requires considerable financial investments which are hardly possible for start-up companies.

- **Category 4:** A firm acquires knowledge and patents about a potential drug through its merger with – or the acquisition of – another firm. Hereby the interests of venture capitalist investors, which act in the background, quite often play an important role. During the course of a drug's development this procedure might occur several times, across organizational and geographical arenas.

To further clarify the way firms develop innovation and sustain competitiveness, but also to identify drivers of knowledge related changes, we produced a first tentative innovation biography, in which we traced the geographical routes a certain compound had taken during the development process and tried to identify key transitions over space and time as well as related governance mechanisms. The results were promising, but the explanatory power for the region as a whole, was still limited.

As a consequence, we have "slightly" refocused the level of analysis from a firm's single innovation towards all the firm's innovation processes and the related organizational changes.

3 The firm-level knowledge biography of Medigene

Our approach to sketch a biotech firm's knowledge biography is based on the following principles:

1. We capture the whole lifetime of the firm which is feasible in the case of German biotech firms most of which have a corporate history of less than 15 years. We assess all of the potential corporate activities which comprise services, and the development, production and marketing of platform technologies and pharmaceutical products.
2. We start by mapping the respective innovation practices that are related to these corporate activities and further on evaluate the interrelations between these activities, We finally identify and systematize both the knowledge flows and the organizational innovations that play a crucial role for the initiation and the execution as well as the success or failure of the firm's innovation process.

Accordingly, the figure is divided into three parts. The first level indicates whether the relevant firm was actively offering services. The second level shows the platform-technology portfolio of the firm. A particularity of the biotechnology industry is, that firms are predominantly founded with a certain technology platform. Commercialisation thereof

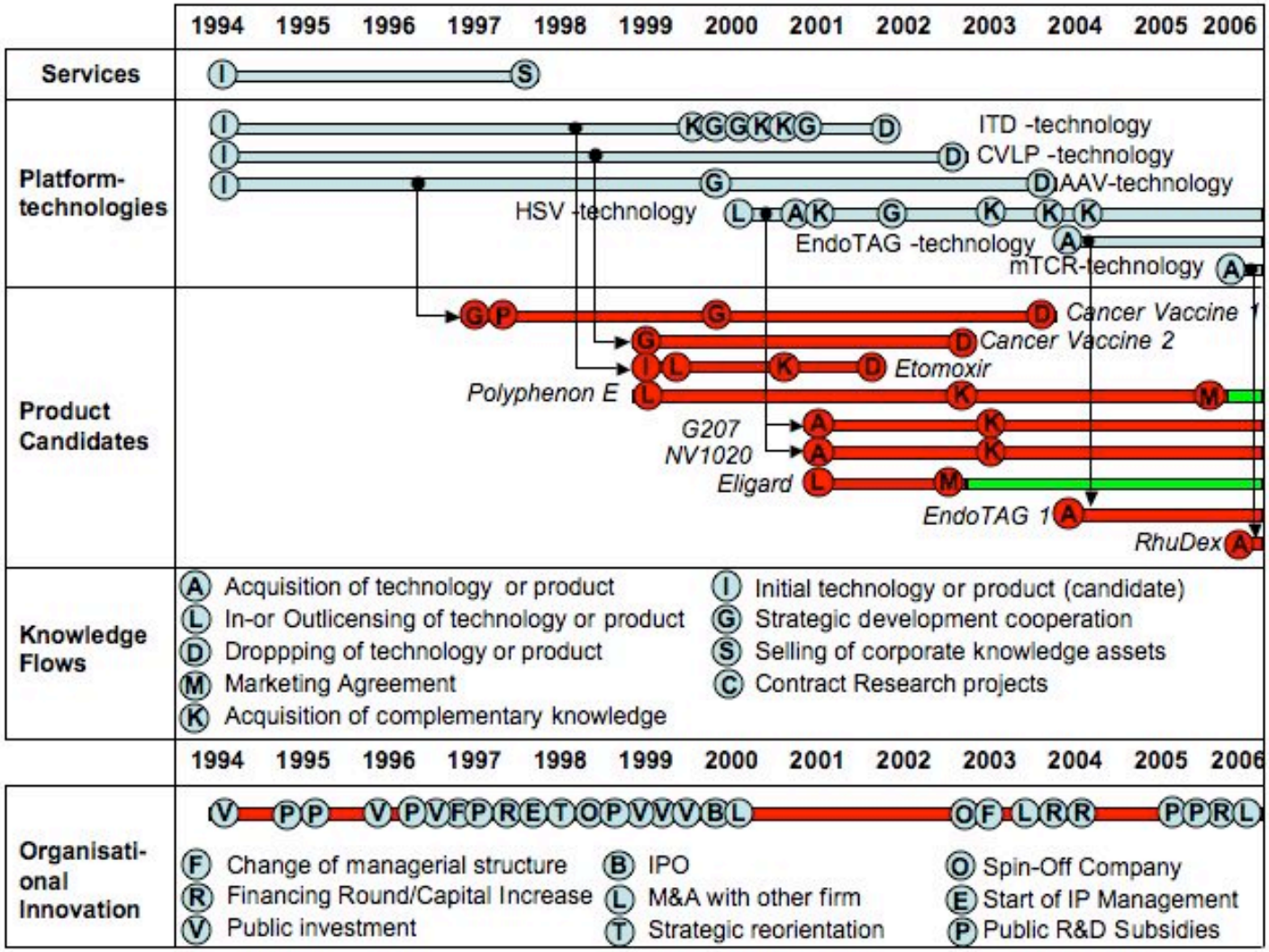
happens through two potential ways – Offering of the platform as a service to for instance other biotechnology firms or big pharma, or using the platform as a basis for a long, insecure and expensive development of new treatments or therapeutics. One merit of the suggested figure is the clear chronological location of those processes. The third level of the figure shows the origin and processing of product-candidates of the firm. They are usually triggered off by internal research activities or acquired, whether through in-licensing, collaborative efforts or acquisition of another firm. The figure is capable to show exactly how and when a firm governs those knowledge flows, and in addition if they were successful in the end or not (the green marks show whether the product reaps any revenues).

One important feature of this illustration is the relation between R&D activities and organisational innovation, which is often held responsible for a firms success, and has been project internally been identified as key driver for firms trajectories to the knowledge economy. According to the Oslo manual (OECD, 1997), organisational innovation ought to be defined as: "... the introduction of significantly changed organisational structures; the implementation of advanced management techniques; the implementation of new or substantially changed corporate strategic orientations." (p. 36/37)

We tried to comply to that by defining several organisational changes, but in addition one has to bear in mind, that the OECD sees organisational issues as partially responsible for technological change by saying that "TPP innovation activities are all those scientific, technological, organisational, financial and commercial steps, including investment in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products or processes." (p. 39)

As a result we suggest some key parameters at the organisational level, but are of course aware that additional parameters might be of conceptual use for other sectors. At least for the biotechnology sector we can say that those we have described seem to be the key responsible ones.

Firm-level Based Knowledge Biography of Medigene AG (Munich)



In the case of Munich-based biotechnology firm Medigene we were able to identify the following nine institutional arrangements that govern the company's knowledge stocks and flows:

3.1 The acquisition of technology or product:

This specific mode of technology and knowledge transfer describes the process of knowledge being acquired through the take-over of, or merger with, another firm. In the particular case of the Medigene corporation, this mode was conducted a total of three times. One striking characteristic is the isochronous acquisition of codified knowledge, e.g. patents, as well as embodied knowledge. The latter is secured through the integration of a certain number of employees who had previously been responsible for key innovation-projects in the old firm. The acquisition mode can be applied for both distinguished knowledge production modes of contemporary young biotechs: platform technologies and product development. A crucial difference to other, more mature industrial sectors, e.g. the automotive sector, is the lack of short-term aspirations concerning increasing revenues or cash flows. For Medigene this kind of knowledge acquisition was fuelled by the large amount of capital obtained through an IPO in 2000. Referring to the examination/exploration/exploitation pattern, this kind of knowledge transfer occurs in the first two phases.

One has to strictly distinguish this mode from the following, the in- or out-licensing mode, as the latter concerns predominantly the transfer of codified knowledge. Considering regional relevance it might be an interesting fact that Medigene made one of its three acquisitions inside the Munich cluster by purchasing the bankrupt Munich Biotech AG and its technological and product related assets in 2004. The other two purchases took place in the USA and UK. Further research is to be conducted particularly on how firms monitor mergers and acquisitions, and how purchased knowledge colludes with the internal knowledge stock.

3.2 In- or outlicensing of technology or product

The most common institutional arrangement for extra-mural knowledge flows in modern biotechnological and pharmaceutical industries is the in- or out-licencing of a technology or product candidate. Thereby a patent holder grants an exclusive license to a customer who is in return obliged to pay up-front milestone payments and, if the product reaches the market, royalty fees. Cooke (2006) identifies that mode as a "… major means of knowledge transfer in biotechnology and ICT through varieties of often triangular "partnership" among a large

customer, a smart technology SME and sometimes a university or institute researcher or team responsible for the discovery or invention" (p. 15). The in-or out-licensing model has also turned into a basis for specific business models. Hence firms specialise in in-licensing products, process them through pre-clinical and or clinical stages, only to out-licence them later on. The added value in the processing stage yields the potential revenues. Examples for this kind of business include the Swiss firm Speedel, and the Israeli Bioline. Economic literature had identified that specific mode as a vehicle for knowledge and technology transfer and defines three major reasons for the out-licensing: Firstly, the technology does not fit to the firms overall product/technology portfolio, secondly, an unsatisfactory expected income return, and third a lack of financial resources to further develop the product/technology independently (Ford and Ryan 1981).

This mode represents an obvious opportunity for firms to cut short development processes. One has also to take into account that this mode might occur in two knowledge phases; exploration and examination, but in each case contributes to a different organisational intention (see Kaiser/Liecke 2006). An interesting further research question might be how firms secure the transfer of embodied knowledge. In the case of Medigene one can already state that for their main product (Polyphenon E), a comprehensive transfer of related key staff occurred. Concerning the geographic nature of that mode, the global, non-regional character is well known and well researched (Kaiser 2003; Kaiser/Liecke 2006). It also raises a considerable amount of further research questions, such as: How exactly did the firm search for licensing partners? Was external professional or consultancy knowledge used or necessary? How was that new knowledge implemented? Did regional networks perhaps play an intermediate role? Following the case in question, Medigene used that instrument first in 1999 by inlicencing Polyphenon. At that time this kind of knowledge inflow was seen, according to the organisational strategy, as complementary. Later in 2002 the in-licensing became of greater importance, given that all in-house developments had failed.

3.3 Dropping of technology or product

As we empirically focus on knowledge flows, one has to bear in mind that knowledge processes can also fail completely, and thus stop without achieving any result. In such a case the invested resources have to be written off and adjustments to the firm's strategy might become necessary. The failing of knowledge processes potentially affects both pillars of a biotech's knowledge base; platform-technologies and product developments. The strategy of how to deal with such salient events is widely bounded. The firm can decide whether to write

off the current projects and sack the related staff, or try to get enough financial support and bring a spin-off on the way, which then deals with some existing achievements of the failed project, or its realisable patent value. In the particular case of Medigene one can observe both strategies. In 2003 a spin-off was founded to manage IP rights from the failed ITD technology and Etomoxir project (The spin-off went bankrupt a few months later). Some other projects and technologies were simply stopped and written off. In the template of exploration/examination and exploitation, this event most often occurs in the phase of examination, that is to say, in the clinical-testing phase. A failure is also possible in the exploration phase, namely pre-clinical research. At that stage of the innovation-process, however, trial and error is still more or less part of the normal research conduct. Interesting research questions that may arise from this knowledge category are, for instance: what regulatory parameters (in the approval process) caused the failure? Were there additional reasons apart from technical ones? How did the management (investors) react to that incidence?

3.4 Marketing agreements

Marketing agreements usually describe a knowledge flow between the inventing firm and another company, which is specialized in market structures and marketing. Smaller typical biotech firms often find themselves unable to sell their products on their own since they lack specialised distribution teams. It is a question of the particular business model whether or not biotechs strive to develop such competencies. This part of the knowledge value chain is situated explicitly in the exploitation phase since revenues are the clear objective of every marketing agreement. In this particular case marketing agreements have been acceded twice. Beforehand a long search process had taken place. In that respect it would be interesting to find out how exactly marketing partners are selected, and thus how much external knowledge is needed to conduct a comprehensive survey.

3.5 Acquisition of complementary knowledge

This kind of knowledge flow is to be seen as concomitant to acquisition of knowledge, in/out-licensing, or initial start-up knowledge stocks. It is, however, central to some of EURODITE's research questions, as it might concretely express the incremental development of firms' knowledge processes, as well as lacking resources at certain points. The most salient event in the acquisition of complementary knowledge is the acquisition of patents or licenses to secure the firms' platform technology. Medigene used that kind of knowledge transfer quite

often to process and advance its technology platforms, and also once in order to broaden the therapeutic focus of one of its product candidates. For research purposes it might make sense to differentiate between the acquisition of codified knowledge i.e. patents, licences, and the acquisition of embodied or tacit knowledge, i.e. key scientists and so on. One might estimate that in earlier phases of firm development more tacit knowledge is acquired than codified knowledge. For later firm stages one might think the opposite. An interesting research question could be how public authorities can support the searching process, for example through the constitution of network- or so-called "soft" institutions. This would also point to types of knowledge elucidated by Phil Cooke i.e. Explicit, Complicit, Implicit, by classifying network-institutions as complicit knowledge type.

3.6 Initial technology or product (candidate)

At least in the biotech sector case, this category often alludes to the knowledge flow from publicly financed research institutions to the economic sphere that is to say a firm. In the case of Medigene, the company was founded with a more or less unspecific technology that was offered for service purposes. The technology was basically invented at public research institutes in Munich. The incitement to then use the technology as a basis for the development of medical treatments was apparently made by externally consulting Venture Capital firms. As a result the service sector was closed, and outsourced into a spin-off company. The initial technology and the resulting IPR portfolio is, however, often crucial for the raising of capital, or venture capital. Concerning regional aspects, this kind of knowledge demonstrates a strong local stickiness as it is well-researched that young spin-off companies often start in proximity to their "parental" organisation. Of research interest might be how specifically the start-up team was built, if public support was necessary, or if for instance business plan competitions had some impact. Initial knowledge can clearly be subsumed into the first exploration phase of knowledge processing.

3.7 Strategic development cooperation

Strategic development collaboration often fulfils several purposes for young biotech firms. First they often get research grants from their partner, for which in return they have to assign certain parts of their intellectual property assets. Another objective for smaller biotech companies to seek partners is of course a lack of experience in certain stages of the innovation process as well as the purpose of reducing uncertainty and complexity. In fact, partnering can be described as a deliberate strategy to reduce the complexity of the innovation process. In the

case of Medigene this mode of coordination also led to launch events for products fuelled by the internal technology basis. Strategic development cooperation can refer to the technology platform as well as to the product development. It is well documented empirically that biotechs more often chose other biotechs to collaborate with on the technology side, whereas they predominantly choose big pharmaceutical corporations to cooperate with on the product-related site. This also holds true in this particular case. Concerning our knowledge pattern one can classify this kind of knowledge exchange into exploration and examination, while the emphasis lies clearly in the examination part. In the exploration phase the cooperation partners are more often of an academic nature, and the duration of these collaborations is often shorter.

3.8 Selling of corporate knowledge assets

This kind of knowledge flow is a rather scarce phenomenon and mostly related to adjustments in the business model. For instance, in the years after the burst of the new-economy bubble many firms had to restructure their (planned) product portfolios and hence focus on different market fields. In that respect a swap of therapy areas from vaccine development to cancer-related treatments took place. Due to regulation and technical issues, the latter are easier and faster to develope and thus potentially suited to shortening the phase of cash drain. The alternative to selling corporate knowledge assets might be to try to form a spin-off company.

3.9 Contract research projects

Contract research projects describe the provision of in-house platform-related knowledge by biotech firms for commercial purposes. The ordering party is often a larger pharmaceutical firm lacking the competence of biotech processes. There is a slight difference to the provision of services, as in the biotech sector contract research often leads to licence payments from future revenues of the researched product. The interesting fact considering our particular case is that Medigene did not consequently exploit its technology basis as a potential value-adding asset. In contrast to basically all other Munich-based product development companies, Medigene used its technology stock strictly for in-house product developments. This observation might tell us something about the meaning of an extra-ordinary financial pillow the firm generated through its IPO in 2000 and several increases in capital. In fact this kind of knowledge category might allude to the emerging of the so-called “open innovation” paradigm where key drivers in the new economic geography are knowledgeable SMEs.

4 The whole picture and preliminary results for sector and firm-level analysis

Roughly speaking, since its establishment in 1994 Medigene has passed through two distinct phases of corporate development in which different kinds of institutional arrangements for the governance of knowledge stocks and flows played a dominant role. A first phase lasted from 1994 to 1997/98. During these years the company was still engaged in services for external actors as it attempted to use initial platform technologies for the generation of product development programs. However, all these attempts failed. It is remarkable that during this phase of corporate development, public intervention was predominant either in form of direct financial investments or in form of specific R&D support.

Nevertheless, both revenues from services as well as the existence of initial platform technologies seemed to be promising assets that guaranteed capital inflows both from public and private investors. However, in 1998 it became obvious that neither the technological basis nor the service contracts with external actors would suffice as a basis for further corporate development. Consequently, the second phase (1998-2003/04) started with a strategic re-orientation, which led to the dropping of all of the platform technologies and product development projects, which had been within the initial portfolio or were initiated through strategic development co-operations with external partners. The companies "new strategy" largely consisted of the use of external knowledge through acquisition, in-licensing, or mergers. For all these activities the company's IPO as well as the establishment of an in-house licensing department were crucial preconditions. At least some of the innovation processes initiated in this second phase proved to be successful.

With two products on or close to the market there is reason to assume that Medigene is likely to enter a third phase of corporate development in which the firm should be able to finance further product development programs from revenues generated through the marketing of its pharmaceutical products. As an additional result it states clearly that the widely discussed role of producer – user feedback roles can hardly be assessed for the young German clusters and the sector as a whole, as there is only a considerably number of drugs already on the market.

Our major concern for this second interim report has been to present and to propose firm-based knowledge biographies as a tool for micro-level research on regional dynamics of knowledge in different industrial sectors. In order to provide further support for this proposal we will now turn our attention to the concept's capability for generalized conclusions on sector specificities in the generation, use and distribution of knowledge.

In a first step we relate the different kinds of knowledge flows to Cooke's differentiation in exploration, examination and exploitation knowledge.

Knowledge flows in different knowledge phases			
	Exploration	**Examination**	**Exploitation**
Categories of knowledge flows			
Acquisition of technology or product	•	●	
In-or outlicensing of technology or product	•	●	•
Dropping of technology or product		●	•
Marketing agreement		•	●
Acquisition of complementary knowledge	●	●	•
Initial technology or product (candidate)	●		
Strategic development cooperation	•	●	
Selling of corporate knowledge asset	•	●	●
Contract research projects	•	●	•

** The different size of the bullet points indicate varying importance in different knowledge phases*

From this exercise we assume that extramural knowledge flows in the pharmaceutical biotechnology industry are primarily important in the phase of knowledge examination. This holds not only for the number of different knowledge flows, but also for their relative importance. In the exploration phase, external knowledge plays of course a role concerning the commercialization of initial technologies or products. Furthermore, biotechnology firms are also engaged in the acquisition of complementary technologies for knowledge exploration. In the phase of knowledge exploitation, those knowledge flows gain importance, which are related to the marketing of products and technologies or to the selling of corporate knowledge assets.

The different knowledge flows we identified with this biographical tool also allow us to contribute to a differentiation between knowledge phases and knowledge categories introduced into WP3 efforts by Phil Cooke. In terms of knowledge phases we can observe that the different kind of knowledge flows in the innovation process in pharmaceutical biotechnology range across all these phases. However, this seems to be not the case in view of knowledge categories. As pharmaceutical biotechnology is a science-based industry, analytical knowledge plays an important role at the beginning of the innovation process. This does not necessarily mean that all corporate actors are still involved in this phase. Many of them are specialized in different fields of synthetic knowledge while symbolic knowledge seems to be of no importance in this sector.

Knowledge Categories for Sectors *following meeting 12/07/06*

1. K. categories → / **2. K. phases ↓**	Analytical (Science-based)	Synthetic (Engineering)	Symbolic (e.g.) Advertising	Other (if relevant)
Exploration (Search, including Research)	Identification and validation of molecular targets	Gene Expression Analysis; High-Throuput Screening; Bioinformatics		
Examination (e.g. trialling, testing, standard-setting or benchmarking)		Preclinical Testing; Three phases of clinical evaluation		
Exploitation (Commercialisation of innovation, sale on market, or socially useful & used)		Market authorization, production, marketing		
Re-Examination	Aim to extent authorization of a pharmaceutical product/threapy to further indications.	Aim to extent authorization of a pharmaceutical product/therapy to further indications.		

3. Learning Dimensions

In a second step we relate these different kinds of knowledge flows to the territorial dimension. In the case of Medigene it becomes obvious that only a minority of knowledge flows are embedded solely within the local or regional context. Basically, the regional cluster is of predominant importance with regard to the initial technology or product, which normally stem from the local public science base. Moreover, in this case the local environment also played a role concerning the selling of corporate assets. This is due to the fact that the continuation of corporate activities was dependent on both the take-over of the local workforce and the involvement of intermediary organizations and financiers at the regional level.

The territorial dimension of knowledge-flows in the Medigene-case				
	Local/regional	*national*	*European*	*global*
Categories of knowledge flows				
Acquisition of technology or product	X		X	X
In-or outlicensing of technology or product		X		X
Dropping of technology or product				
Marketing agreement				X
Acquisition of complementary knowledge		X		X
Initial technology or product (candidate)	X			
Strategic development cooperation		X	X	X
Selling of corporate knowledge asset	X			
Contract research projects				

In a third step we evaluate what might be learned from such a biography for the Munich cluster or the whole sector. In our first report we already showed that the relative success of the cluster's firms is linked to their active in-licensing strategy. All the knowledge biographies we conducted so far indicate that in-licensing led to a reorientation of those firms towards a new field of indication, namely cancer. That yields several advantages, as clinical trials in the cancer field are easier to conduct and often cheaper. Another advantage is the lower regulative demand for the market authorization of the drug. For the Munich firms this reorientation brought up new challenges in view of the internalization of huge and comprehensive amounts of external knowledge. Most of the firms solved that problem by employing the key staff that was already responsible for drug development in the former organization. This indicates that the pharmaceutical innovation process contains a significant amount of tacit knowledge although the transfer of a project from one another phase requires comprehensive codification of the characteristics of a compound.

Finally we aim at categorizing the major results of our two reports along the Knowledge Responses/Knowledge Drivers dichotomy introduced into WP3. By doing this we considered it necessary to slightly change the given structure. Since we do not see sector specific relations between market structure as a knowledge driver and related knowledge responses, we introduced public policy (outside regulation) as a possible driver. For the reason of coherence with our knowledge biographies, we also changed corporate objectives into organizational innovations. The respective result is as follows:

Framework for Sectoral Studies WP3 *following meeting 12/07/06*

1. K. responses → / **2. K.drivers ↓**	Organisational	Market	Product/ Process	Professional
Regulation	Listing at foreign stock exchanges	Cancer becomes a dominant indication for biotechs.	Orphan Drugs, ICH Harmonization	
Public Policy	Promotion of spin-offs and R&D networks with PROs	Correction of „market failure“ in providing early stage financing	Financial support and coordination for clinical development	
Supply chain (Networks)	Vertical integration of biotechs in foreign lead markets	Importance on inter-organizational networks in the pharmaceutical innovation process	Biotechs specialize in certain phases of the innovation process	
Organizational innovations	Employment of specialized staff for IP management and clinical development	Establishment of an own marketing organization	Take-over of staff along with an in-licensed compound	

3. Learning Dimensions

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