Knowledge Processes Case Studies: Pharmaceutical Biotechnology and Feature Film Technologies in the larger Munich area.

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1. Introduction

1.1 The region: The federal state of Bavaria

Bavaria, one of the sixteen federal states in Germany, covers the largest area (some 70.000 km^2) among the Länder and counts the second highest population (some 12.5 Million inhabitants). The capital city is Munich; other major cities are Nuremberg, Regensburg, Augsburg and Erlangen. With a gross national product of 385.2 billion EUR, and a GNP per head of 31,976 EUR in 2004, Bavaria's economic performance is considerably higher than the German and European average. The state has, as other Länder in the German federal system, a significant amount of autonomy in several policy areas. The reform of the federal constitution in 2006 even increased the states' capacities to pursue their own policies since the large majority of competencies in the fields of educational and research policies were delegated to the subnational level. Bavaria's capacity to pursue its own policies was also considerably strengthened by a landmark decision of the government to privatize most of its public companies. Therefore, during the last decade, Bavaria has been able to invest a considerable amount of money (about 4.2 billion EUR) primarily in the state's public R&D infrastructure. In the context of the "Future Offensive Bavaria" about 3.05 billion EUR were allocated to science and research in strategic fields of Bavaria's economy. As part of this high-tech campaign, investments were made primarily in the fields of life sciences,

information and communication technologies, advanced materials, environmental technologies, and mechatronics.

More recently, financial investments became less important instruments in Bavaria's public innovation policies. Rather, with the "Alliance Bavaria Innovative" the regional government initiated a cluster programme that is primarily aimed at the coordination of relevant actors. Its main goal therefore is to intensify positive networking effects through increasing interactions among companies, universities, research institutes and other actors in 19 technological sectors in which the Bavarian economy has competitive advantages.

1.2 Bavaria's position in regional benchmarking (WP4 tool)

The EURODITE regional benchmarking project classified Bavaria in general as a knowledge-intensive region which has, more specifically, a "German high tech industrial profile" that is characterized by average scientific activity, very high technological activity, a relatively strong position in diversified manufacturing, and a medium educational level. In general, we agree with that assessment. However, since our TKD research was focused on the larger Munich metropolitan area, we suggest that this profile is less informative for the area, on which we did our research. This holds especially in comparison to the classification of Berlin as the only German region that has not been profiled as a German high tech region, but as a "high tech" metropolitan region. We think that this classification is somewhat misleading. As the WP4 report rightly states, Berlin has a rather weak position in (employment in) services. This is simply because the service industry is rather decentralized in Germany with strongholds in Frankfurt (banking, advertising), Munich (insurance, media, advertising), Hamburg (advertising, media) and Düsseldorf (banking, advertising).

In comparative perspective, we would also put into question the assessment of a high scientific activity and a high level of tertiary education in Berlin. This holds especially in relation to Munich where the density of universities and non-university research organizations is significantly higher than in Berlin. Some indicators would also raise concerns about the assessment of a high technology activity in Berlin. If one looks, for example, at patent applications per 100.000 inhabitants (at the NUTS-3 level), the leading German "metropolitan" area is Stuttgart (10.7 percents of patents applications), followed by Munich (8.6 percent) and Duesseldorf (3 percent).

1.3 The sectors: pharmaceutical biotechnology and feature film technology

The Munich team did empirical research on three FKDs that belong to two different sectors: pharmaceutical biotechnology and feature film technology. These technologies along with the respective industries have, as we were able to show in our WP5 report, a relatively strong position in Bavaria. In this section, we provide a short overview of the main characteristics of both sectors.

1.3.1 Pharmaceutical biotechnology

Modern pharmaceutical biotechnology has already crossed at least three paradigmatic phases. During the first phase from the 1970s to the mid-1980s, the creation of fundamental new knowledge led to the development of the industry's basic inventions, i.e. the recombinant DNA technology and the Polymerase Chain Reaction. Both allowed for the isolation, recombination and (mass) production of genetically modified human proteins, such as insulin. The business models and product portfolios of first generation biotech corporations such as Amgen, Biogen or Genentech relied exclusively on that paradigm, but were at least initially not clearly focussed on pharmaceutical applications. Continental European countries have, for several reasons, not been able to play a role in this phase of biotech commercialization. The technology and the markets were thus from the very beginning dominated by a relatively small number of U.S.-based biotechnology firms which managed to develop into fully integrated – biotechnology based – pharmaceutical companies.

Since the second half of the 1980s, a second wave of modern biotechnology has been kicked off primarily by public and private initiatives to sequence the human genome. This phase was thus characterized by the development of various platform technologies, which supported the identification of a large number of new potential targets for drug compounds. The birth of European biotechnology industry clearly falls in this phase. Accordingly, the commercialization took place through the establishment of hundreds of start up firms, which originated mostly from universities or other publicly funded research organizations (PROs). Therefore, it is mostly due to the underlying technological paradigm of this phase that many European biotechnology firms were initially engaged predominantly in the development of platform technologies and less oriented towards drug development. For those companies the development into a fully integrated pharmaceutical company could hardly be a promising strategy. This second phase thus provides strong indications that the differentiation of

business and financing models in the pharmaceutical biotechnology sector is to a large extent technologically driven.

A third paradigmatic phase seems to be ongoing at the moment and can be associated with increasing efforts in the field of stem-cell research. This phase is not only characterized by a new scientific approach, but also by considerable controversies about ethical implications, which take place both in Europe and the United States. Given this it might be that stem-cell research will be the technological wave in modern biotechnology that encourage commercialization mainly in Asian countries where ethical concerns are hardly raised.

When speaking of the German biotech industry, Munich is an uncontested leader. The city is the leading national biotech cluster, being home to more companies with more revenues, which employ more people and produce more so-called “drug candidates” than anywhere else in Germany. In 2006, Munich was home to approximately 97 biotech firms, not far behind its 2002 peak when there were 99 firms listed, which together employ some 2,360 people. The overall number of “life sciences” firms and subsidiaries of larger pharmaceutical corporations stands at about 180. Those firms are embedded in a dynamically developing and geographically concentrated public research infrastructure mainly established by two universities, two university hospitals and three Max-Planck institutes. The latter are specialised in large-scale basic research, and thus of great importance for the cluster itself, whether as a partner for cooperation or as a source of spin-off firms.

1.3.2 Feature film technology

The sectoral context of feature film technology is a highly specific one. On the one hand, the film-business is increasingly shaped by globalization and internationalization. Films are more and more produced in one-stop locations around the world; the production supervision however is mostly dominated by the Hollywood majors. On the other hand, the creation of a new feature film is basically the result of a multitude of knowledge processes building on known and not necessarily new knowledge composites. In more recent years, however, technological progress affected at least parts of the feature film industry. New digital technologies emerged primarily in the post-production phase of feature film making while the main distribution channel (i.e. cinemas) are still mainly using analogue presentation technologies.

The Munich feature film industry is characterized by the existence of small and medium-sized film-makers and distributors, which are embedded in one of the largest media-locations worldwide, with publishers, IT-companies TV-Stations and a huge advertising industry. Compared to its major competitors in Germany the Munich film cluster performs remarkably well. In 2003 Munich was home to 14,000 media firms employing 187,000 people. In 2002 these firm's consolidated revenues amounted to 24.5 billion EUR. Even during the “difficult” post tech-boom years of 1999 to 2002 revenues within the Munich cluster increased by 28 per cent. The gamut of media sub-sectors is represented in Munich. With regard to broadcasting 51 per cent of private German TV programs are produced in Munich. 21 of the 45 nationwide TV stations are based there. Munich is also the leading national location for information and communications as well as multimedia and Internet technologies.
Today Germany's four larger centers of film production are located in Munich, Cologne, Hamburg and Berlin. Within the German context, the Munich cluster certainly is in the leading position. Munich’s share in the total number of employees and firms is 14 percent. In 2002, the 1,190 firms in the Munich film sector generated 2.7 billion EUR. This amounts to more than 40 percent of the industry’s nationwide annual revenues. The Bavaria Film studios south of Munich are today the biggest film production facility in Europe, with estimated revenues of some 281.7 million EUR per year.

In terms of the global feature film market, however, German film productions hardly play any role on the international and even on the European market. We have examined each of the top 10 cinema movies of the last ten years in the World, the United States, the European Union and Germany. The result shows, that the ranking of the commercially most successful films in the World, the United States, and Europe are remarkably coherent. German productions thus had a market potential only on the domestic market. However, it can be seen that they do relatively well within the national context. In 2003 and 2004, five German productions were among the 20 most successful films. In 2004, two of them were even able to rank at first and third place.

Whereas in terms of production, financing, and distribution, the Munich feature film industry is only marginally integrated in into the global industry, the situation is different in terms of highly specialized technologies used in the production process. This refers, inter alia, to

cameras and camera equipment. In that specific segment of film technologies the Munich cluster holds an extraordinary strong position on the world market.

In order to shed light on Munich's strong market position in film technologies an inventory was made of scientific and engineering awards specific to the film industry that Munich-based companies have received in recent years. More specifically, we looked at the "Technical Achievement Award", the "Academy Award of Merit", and the "Scientific and Engineering Award" which are rewarded on a yearly basis by the U.S.-American Academy of Motion Picture Arts and Sciences. In this respect, the position of the Munich cluster is outstandingly strong, not only compared to other German locations. Since 1980, Munich-based film technology firms won 19 out of the 367 technology Oscars. The crucial point we make here is that the Munich film cluster could not attain the strong world market position in this critical technological field without the necessary competencies for such performance.

2. The Case Studies

2.1 TKD 1: The Munich Biotech Cluster

The first Territorial Knowledge Dynamic (TKD) covers the Munich Biotech Cluster and its development shift in research activities and business strategies of the included biotech-firms. As carried out in the WP5 report the firms did not only change their research scope towards cancer, but they also focused on new modes of knowledge production through in-lincensing. Most of todays firms of the Munich Biotech Cluster are using this in-licensed knowledge to execute research on new therapeutic compounds. The strategic shift did not guarantee a business success, because as our research clearly shows some in-licensed failed.

Interestingly the change in firm-strategy consist of two approaches occurring simultaneously in a significant number of cluster-firms. On the one hand is the adjustment of the medical indication towards cancer and on the other hand the introduction of an active in-licensing policy. Currently most of the pharmaceutical compounds under development in Munich-based firms were not invented at the location but relate to research from other biotech-areas. The dominance of imported inventions in the Munich Biotech Cluster further emphasize if we

differentiate between products that are very close to the market and those in earlier clinical phases. The earlier ones stem from more geographically distant arena and originate by majority from overseas public and private research organizations in the USA, Japan and Great Britain. This in-licensing trend at the Munich location started in the years 1999 to 2001, when most of the on-site firms decided to change their predominant field of research and development towards the indication of cancer. It is important to mention that the Munich cluster is the only biotech site within Germany at which that kind of knowledge dynamic occurred in such density.

This phenomenon of simultaneous strategy change is not related to an inter-firm interaction on formal levels but as far as our research indicates related to changes in key-personal. Firm-hopping is used to describe this development. This occurs even there existed an informal agreement among leading Munich biotech firms. The strategic change is of great interest because most of the established biotech firms at the Munich location are young and new to the market. This is considerable as in-licensing was dominated by established mid-sized pharmaceutical companies due to cost-efficiency. The consequence is that young biotech companies are often forced to license high-risk products or those with a rather weak patent protection. All in all these products carry substantial risks for small and young biotech businesses. There are three basic motivations to move the mode of knowledge production to in-licensing of compounds.

First the newly acquired compound fits well to the existing in-house technology. Second internal research activities and in-house technology failed and new businesses need to be open. Third external actors induce a strategic extension of the product portfolio to secure operations of the firm or to speed up development of current pipeline-products. Munich biotech firms did not use the in-licensing as a complementary to in-house developments. Most of the in-licensing activities were induced from external actors often in combination with a failure of in-house projects as in the case of Medigene. Especially Venture Capitalist use this inducing approach to extend the portfolio of a firm or to combine their firms on specific research projects. External Venture Capitalist as the reason for strategic redirecting activites holds especially true for the Munich Biotech Cluster, because most of the Munich firms share one or several financiers. Furthermore at the time of the start of the in-licensing activities

these firms were in favourable financial circumstances and could afford the costs of in-licensing.

The turn to the indication of cancer as the main business activity is justified more easily. Cancer is still a lethal threat and the regulation authorities tend to approve new treatments as soon as they extend the lifespan even if only for a few weeks. Another reason is the organisation of clinical trials. Cancer trials tend to comprise far less patients as any other indication.

A further combining feature of most of the Munich-base Biotech firms is their early orientation to international research collaboration activities. We found out that by far more collaborations were established on the international than in the national or cluster-level. The included figure of the collaboration network of the Medigene AG enlightens this internationalization.

Most of the Munich-based companies follow a certain collaboration pattern. Strategic collaborations on a technology level are often established with institutions and organisations in geographical proximity and product-related collaborations and licensing agreements are mainly forged on a global level. A second common strategic mode of knowledge acquisition among Munich biotech-firms is hiring key scientists who were working with the compound beforehand. This buying of heads not only incorporates knowledge and experience with the compound, but also new key contacts abroad.

The strategic change towards in-licensing was not facilitated by specific policies. The political support of the Biotech cluster in Munich occurred in several other ways. It is very important to note that the sub-national political support benefited the firms much more than from any other policy level. The state of Bavaria was in the comfortable situation to have approximately 4.2 Billion EUR at its disposal to invest. These privatization gains were invested in several technology-supporting programmes (Berger 2002) and the biotechnology received a large amount of approx. 500 M. EUR, geographically focused on the area of Munich. Apart from the financial promotion various policy instruments were established to fuel the development of biotechnology in Bavaria and in specific at the Munich cluster. The concentration and upgrade of public research and the modifying of the system aiming at a

higher availability of venture capital had great consequences on the development of the biotechnology industry. These activities followed the setup of an innovation networking organization for intra- and intercluster partnering and networking. This company was established as a public company and therefore was more flexible in acting and reacting on the market. In addition to this networking organization the Bavarian Government established a subsidized biotech incubator in 1995. This incubator served to most of the analyzed biotech firms as a starting facility. Finally an onther innovation policy instrument is the Munich Business Plan Competition. This competition was unique at the time of its start and provided the awarded business ideas a platform to present themselves to a large number of promoters ad supporters. Since 1997, 39 prices were awarded and out of these 12 can be assigned to biotechnology.

In the following the findings of the TKD biotechnology, which is much more elaborated in our WP5 report, will be related to the FKD of Polyphenon. Polyphenon is an ointment developed by the Medigene AG located in Munich. It is supposed to cure skin warts. The active agent is based on an extract of green tea leaves and is part of the family of tea catechins. The development of Polyphenon by Medigene clearly support the above mentioned research findings for the TKD biotechnology in Munich. Especially because the in-licensing of Polyphenen did not relate to any other in-house project or in-house technology.

2.1.1 FKD 1 – Biotechnology - Polyphenon by Medigene

Introduction

The chosen and described FKD is a the company Medigene AG located in Munich and its development activities regarding the new drug Polyphenon, which came to the market by the end of 2006. Polyphenon is an ointment, which is supposed to cure skin warts. The research and development phase covers more than 25 years since the first discovery of its healing potentials. This long period is marked by several changes of ownership and many different actors were involved in the process that led to the development of Polyphenon. The drug is based on an extract of green tea leaves and belongs to the family of tea catechins.

It was first developed and patented by the Japanese company Mitsui-Norin in the early 1980s. The core patent is a co-patent with the Chineses Academy of Medical Science. In 1997 the patent for Polyphenon was out-licensed to the Canadian firm Epitome Phramaceuticals from which Medigene acquired the patent in 1999. After a period of clinical tests in Germany,

Russia, the United States of America and Romania the development of Polyphenon was finished in 2004 and got market authorization for the USA and the EU in 2006 and 2007. Apart from the international perspective on the development of Polyphenon through the various participating international patent owners of the last 25 years, the Munich-based Medigene AG carried out the final R&D activities.

This case study is of great interest for our concerns, because it shows some characteristics that hold true for several young biotech firms in the Munich area, constituting the early and above described TKD.

The type of development it represents

The core of the presented FKD Medigene is the product development of the drug Polyphenon. This product has been soundly researched for more than 25 years with several changes of ownership and was thus advanced by many different actors. Therefore the development of Polyphenon constitutes a suitable and interesting example of an FKD especially because it combines global and local knowledge acquisition processes and reflects characteristics that holds true for several young biotech firms in the Munich area.

The development of the ingredients of the drug is mainly fuelled by the acquisition of external knowledge through in-licensing. Until the acquisition through the Canadian biotechnology firm Epitome Pharmaceuticals Polyphenon was neither explored by a biotech or pharmaceutical company nor by a public research organization. Medigene in-licensed the drug from Epitome in 1999. This acquisition was possible as Polyphenon had the status of a high risk compound, because out of two clinical testing studies carried out by Epitome one failed before the selling to Medigene. The acquisition of high-risk compounds is one possible strategy for young and small biotech companies to increase the internal knowledge base and the patent stock relatively cheaply. Often such acquisition of external knowledge through in-licensing is advised, demanded or even induced by external actors in most cases by Venture Capitalists. The case of Polyphenon underlines this scheme and is representing most of the product and firm biographies at the Munich biotech area. The later development process of Polyphenon is marked through additional acquisitions of several complementary patents from Epitome to extend the application range of the active agent towards a specific kind of skin-cancer. Such acquired knowledge and the related patents were responsible for a successful

development of the current active agent Polyphenon E curing skin warts. At this point an important reference has to be made to internal knowledge and production technology. Both did not contribute in the first sight to the success of development process of Polyphenon E. It is most likely that the acquisition of several external patents in the aftermath of the acquistion of Polyphenon did secure business success for Medigene. The importance of the ointment for Medigene is subject of the following paragraphs.

Over all the development process mostly relied on external knowledge and internal management capacities. Furthermore the role of external actors, especially Venture Capitalists is important for the understanding of the knowledge dynamics at the Munich Biotech sight. The political influence on the FKD and the developed product is indirect. There did not happen any direct financial contribution for the acquisition of patents or external knowledge. Instead financial support from political actors did contribute to the setup of the office in the Munich Biotech incubator and through a state-owned venture capitalist firm providing funding for high-risk projects. The third aspect of political contribution related to the presented FKD is the support of Medigine by the cluster agency BioM AG. These contributions initiated by the political authorities did supply the necessary infrastructure, minimal funding and important contacts and access to networks for young and small biotech firms.

Its significance to the business

The analysis of the development process and the later described knowledge biography show the significance of Polyphenon E for the Medigene AG. The significance of external knowledge for Medigene is underlined by the failure of all internal development projects by 2002. This occurred in parallel to the acquisition of several complementary patents to Polyphenon from Epitome Pharmaceuticals in Canada, which already was the licensing partner for Polyphenon. Furthermore the acquired knowledge and patents did not fit with the internal technology or other patents apart from the Polyphenon patent. This has two consequences for the analysis of this FKD. On the one hand the in-licensing of Polyphenon and the complementary patents in the aftermath were initiated by external actors like Venture Capitalists and on the other hand that the decision to acquire the high-risk compound Polyphenon and the complementary compounds later was a strategic decision to secure

business operations. This is strengthened by the missing connection to the existing technology and internal knowledge base.

With concerns to Hypothesis 2 in the EURODITE context it is obvious that the most important knowledge to secure business operations and business success was not created internally, but flew in from external sources and partners. With the in-licensing of different patents Medigene internalized important knowledge, this internalization would have not been possible without a high internal knowledge stock and technology expertise. Therefore the internal knowledge domain did not actively contribute to the success of the FKD, but prepared the ground for a successful development process of the Polyphenon E compound and the market authorization of the ointment curing skin warts in 2006 and 2007.

The sequence of events – the knowledge biography

In general it is hard to assess different stages or phases in the development of Polyphenon E as the core of the first FKD. The biggest identified cut in the knowledge biography is the acquisition of the patent itself from Epitome Pharmaceuticals in 1999. This in-licensing marks the beginning of the first phase, which lasted until the 2000 when the clinical phases began. The first patent was filed in the early 1980s from the Japanese food and nutrition company Mitsui-Norin. By that time the Chinese Academy of Medical Science held a co-patent. In 1997 the first change of ownership happened and the Canadian based biotechnology firm Epitome in-licensed Polyphenon. After one negative and one positive clinical test the compound was considered high-risk and in 1999 Medigene in-licensed it. The in-licensing extended the portfolio of Medigene by this time and was considered to increase the productivity of Medigene.

“What”?

The development of Polyphenon E by the Medigene AG starts with the acquisition of the patent for Polyphenon from Epitome Pharmaceuticals. This acquisition required the knowledge about the existence of this high-risk compound and the capabilities to finance such a deal. The initiative for the in-licensing came from one of Medigene’s stakeholder and Venture Capitalists. Therefore the acquisition has to be seen under strategic terms, especially as the compound did not fit the existing internal technology and product portfolio. The BioM AG, the local networking and cluster agency supported the in-licensing from Epitome through

its various contacts to several biotechnology firm. After the acquisition Medigene continued the development and internalized the knowledge by hiring the scientists working on the compound before. This approach of internalizing through acquisition of heads did turn out successfully.

As a conclusion it is obvious that there were involved several functional knowledge types. First the knowledge about product and its capabilities to became a real product. Which seems to be one core qualification of the Medigene team because research was already going on for 25 years without any concrete product in the market. Second there was sufficient knowledge about financing the in-licensing. This knowledge was provided by external actors respectively Venture Capitalists and stakeholders. The third functional knowledge domain is about the acquisition of IPR. This is in general a core business for young and small biotechnology firms and holds especially true for the Munich Biotech cluster as shown in the TKD about the Munich Biotech Cluster in WP5. Finally the knowledge about integrating not only the acquired patent but the external knowledge about it is the forth functional knowledge domain which contributes significantly to the success of the described FKD. The failure of internal developments forced Medigene to internalize external knowledge and externally started research fast and sufficient. The intellectual foundation of the compound are the original patent of Polyphenon and the later acquired complementary patents, which reflect the involved direct knowledge. This external knowledge was coupled with the internal knowledge on technology and processes of production of compounds. The challenge is the acquisition of internal or tacit knowledge that is not part of the formalized knowledge within the patent. This challenge solved the Medigene AG through the acquisition and integration of former researchers and employers from the patent parent companies. The knowledge about the importance of tacit and internal knowledge and the ability to integrate these human resources is one pillar of Polyphenon’s success.

Strategic knowledge in the development of Polyphenon E laid in the knowledge about the higher acceptance rate of high-risk compounds and about the marketing and development in North America, which was gained through a marketing and development agreement with a US-based firm. This underlines that knowledge is sector-specific and sometimes regional specific; in the case of Medigene the involved regions are the Munich Biotech Cluster and the Canadian biotechnology area in Nova Scotia. But the development of Polyphenon is centred

at the Munich Biotech cluster. With regards to the Eurodite hypothesis 1 this indicates that external knowledge about the product and the development dominated the internal knowledge, but that internal knowledge about integrating human resource and tacit knowledge are required for a business success, too. Regarding hypothesis 2 external and internal knowledge play an important role, but external knowledge dominates internal knowledge in the case of Polyphenon and the firm Medigene.

“How”?

The development started with knowledge inflows through in-licensing. External knowledge is incorporated in the business process of Medigene through the acquisition of Polyphenon in 1999. This was the first major external acquisition of patents for Medigene. From the beginning in 1999 Polyphenon was considered as one of the strategic key pillars. Because of the lack of internal knowledge for developing compounds and market-ready products out of the newly acquired patent Medigene did acquire the knowledge regarding Polyphenon as well. Scientists and researchers working with Polyphenon were hired to access their knowledge. This recruiting of experienced scientists and researchers prevented the firm of any breaks in the development process and contributed to a fast build-up of sufficient internal knowledge to continue research and development of drugs. Learning from customers is one option to acquire new knowledge, but this did not take place at all in this period.

The marketing in the US and the production were outsourced, because the lack of such specific knowledge was requiring Medigene to find new partners with respective experience in these areas. Therefore an agreement with a North American firm was sight and the production was outsourced to the original patent holder Mitsui Norin using its production facilities in China. Therefore this case study does not confirm the EURODITE hypothesis 11. Medigene itself has close ties to the local science and research entities and universities. Consequently these contribute indirectly to the development process through junior researchers and the initial education of most of the employees and leading entrepreneurs.

Such indirectness supports hypothesis 11, but it is not clear at which level below the firm’s commercial activity. Regarding hypothesis 12 and the gender imbalance one has to make clear, that there was not an imbalance in the process of acquiring the patent and the hiring of the working scientists is related to their prior experience with the compound and not to

gender. In the development consumers were not involved and the high-risk of the compound strengthens the early stage of the drug. Therefore hypothesis 13 does not hold true for the presented FKD. In line with the argument regarding hypothesis 13, it is obvious, that hypothesis 14 cannot hold true as well.

In conclusion this again underlines the importance of external knowledge for the development of the drug and that the main governance mechanism to acquire such knowledge in the presented FKD is in-licensing.

“Who”?

The key players in the development of Polyphenon to a drug are the firm Medigene as the in-licenser, the venture capitalists and stakeholders that initiated and demanded such a strategic change and the BioM AG as the cluster agency. Each of these key players has its very own stake. The firm Medigene itself carried out the research and the clinical testing phases in Europe, Russia, North America and Romania to prove the ability of the compound.

The venture capitalists and stakeholders want to see return of their investment and until the acquisition of Polyphenon there was not any compound developed internally with the capability to reach market authorization in the near future. Therefore a strategic change and extension was necessary from the venture capitalists’ perspective. This strategic reorientation was one motivation for the firm itself, too, because to develop own compounds and drugs sufficient financing and resources are crucial. With the acquisition of Polyphenon Medigene took the first step towards a knowledge and portfolio extension. The goal was creating a solid market base to finance own internal developments.

The third key player in this FKD is the BioM AG, the cluster agency at the Munich Biotechnology Cluster. The interest of this player is the security of knowledge, the success of local firms and the binding of knowledge at the location. Therefore the acquisition of the patent and the related knowledge is crucial for the development of the cluster in the perspective of the cluster and network organisation BioM AG.

Furthermore an important stake has the Marketing and development partner for the North American market, because the capabilities of Medigene are very limited. Lacking knowledge

and experience were compensated with sufficient marketing and development knowledge in the key market. The drug approval authorities in the USA – the FDA – and in the European Union are external key players, that are not contributing to the development of the compound or the drug, but influence the success of a newly developed drug through testing and its approval. This short look at the involved key players clearly supports the EURODITE Hypothesis 3, that not only firms, but also involved stakeholders such as Venture Capitalist select knowledge for its relevance and strategic contribution.

“Why”?

The development of Polyphenon has the simple business model of selling a compound to the market that cures skin warts. The gained revenue is required to secure the business operations of Medigene. Therefore the acquisition was directed at securing knowledge in the long-term approach, but shorthand the survival of the business was the aim of purchasing and developing the originally high-risk classified compound Polyphenon E. The development has financial as well strategic factors that influenced the development. The engagement of Venture Capitalist did have an important influence on the development of the FKD, because due to their strategic concerns the acquisition of the patent was made.

“When & where”?

The FKD mainly concerns the Munich Biotech Cluster as the firm Medigene is located and most of its ties to public research organisations and universities are locally organized. The local spatial dimension is strengthened by the influence of the local cluster and networking agency and the biotechnology incubator funded by the Bavarian state. Apart from that the biggest link is to Nova Scotia in Canada. There the former owner of the Polyphenon patent Epitome Pharmaceuticals is located. Medigene in Munich developed the compound on the basis of the acquired Polyphenon compound. After all internal developments failed Medigene was required to further acquire external knowledge and develop sufficient mechanism for internalization of various knowledge domains. This knowledge was again found in Canada.

In parallel to the in-licensing of the complementary compounds several clinical phases took place to prove the curing capabilities and the safety of the ointment. Clinical phase II and the crucial phase III took place in several countries. The latter one started in Europe in 2000 in 30 clinical centres in Germany and Russia. The North-American Phase III study was finished in

2004 and carried out in about 50 clinical centres in North and South America and in Romania. With a successful passing of clinical phases III in the mentioned countries the first step for a successful market approval is made.

In 2005 Medigene submitted the drug to the FDA for the US market and the respective European Counterparts for the domestic market of the European Union. In 2005a marketing and development agreement with Bradley Pharmaceuticals for the U.S.-American market was closed. Bradley also committed itself to invest in the further development of Polyphenon for the exploration of different application fields. Future results of the Bradley research are supposed to be shared also with Medigene. The latter gets the right exploit those results outside the United States.

Medigene received final market approval in the United States in 2006 and in Europe in 2007. The original inventing company Mitsui Norin in China carries out the production of the compound.

Overall summary of knowledge biography

The chosen new drug came to the market by the end of 2006. The compound Polyphenon E is an ointment, which is supposed to cure skin warts. It was soundly researched for more than 25 years and it is marked by several changes of ownership and was thus advanced by various actors. The end of the compound's current journey is the Biotech Cluster Munich. The small and young biotech firm Medigene acquired this high-risk compound to widen its product portfolio and set the business model on one more pillar. The FKD of Polyphenon E constitutes a suitable and interesting example of an FKD, especially because it shows some characteristics that hold true for several young biotech firms in the Munich area, especially because of the strategic changes after the acquisition of external patents and knowledge.

The knowledge paths of Polyphenon span a global network in terms of knowledge origin. After the acquisition through Medigene and the later additional acquisition of complementary compounds the Munich-based Medigene became the center of this network. Originally the compound stems from Japan and China. After a longer ownership by Epistome Pharmaceuticals in Canada, Medigene took over the ownership. Nowadays there is a North American marketing and development partner and the production facilities are located in

China. Not only different origins and location are involved in the development, but also various types of knowledge. First of all functional knowledge about business processing, acquisition and IPR is required, furthermore the Human Resource knowledge to integrate tacit and informal knowledge in the organisation are vivid for the success of the product. This functional knowledge is amended by marketing and localization knowledge through partners. This clearly underlines Hypothesis 2 of EURODITE, that the most important knowledge is knowledge of different external and internal knowledge domains.

Gender

At a general level, the gender dimension is hard to assess. According to our research gender never was a specific issue for the development of the compound. For example the characteristics of knowledge networks did not determine the level of female or male participation within the respective organization or public institution. Furthermore gender imbalances in the exploration of knowledge did not contribute to gender imbalances in the product.

2.1.2. FINDINGS AND CONCLUSIONS FROM TKD 1-FKD

The above presented FKD of Medigene and the development of the ointment based Polyphenon E to cure skin warts represents mainly a combination of examination and analytical and synthetic knowledge according to the WP6 Matrix of knowledge types and knowledge phases in Appendix 5.

The patent and the basic development of the compound existed already before and it was soundly researched for more than 25 years. Consequently this period of search and research cannot be credited to Medigene. The internal development phase of Polyphenon from 1999 until 2005 ,when the market agreement was signed and the drug was submitted for approval, is equivalent to the knowledge phase Examination of the EURODITE context.

In this Examination phase two types of knowledge were effecting the development. On the one hand Medigene's advancement with the original compound required analytical knowledge and on the other hand synthetic knowledge was needed for the the execution of the clinical tests in this phase, which were required for the market approval of the ointment.

The firm in-licensed the patent from another biotechnology firm and consequently acquired the explicit knowledge with the license and patent on Polyphenon to further develop the compound. With explicit analytical and synthetic knowledge such development efforts would not be possible, consequently the integration of tacit knowledge regarding the compound was required, because this knowledge was not codified in the patent. Medigene implemented this tacit knowledge by hiring the researchers working on the compound before acquisition and integrating them into the workforce of Medigene.

This leads to the conclusion that despite of all positive regional and sector specific framework conditions the innovation is still the result of different knowledge types and a combination of external and internal knowledge. On the other hand the analysis underlines, that an innovation can occur with in one single knowledge phase.

2.2. TKD 2 – Feature Film Technology cluster Munich

The second TKD, which is under examination by the Munich partners, concerns the relative success of the Munich feature film-cluster in a highly globalized industry. We observed a regional commitment by several actors, including producers, distributors, financiers and policy-makers, to explore a new market niche, Hollywood films hardly can occupy. In so doing the Munich feature film cluster gained a nationwide leading level of competitiveness and clearly dominates German film billboard charts.

The technical dimension of that TKD is predominantly about the exploration and occupation of a specific market niche, by using stable networks in areas such as production, financing, and distribution of feature films. Also technical is to be seen the use and production of innovative equipment devices and post-production facilities and technologies. The comprising FKDs are situated in that context. The nature of the TKD in terms of cumulative and composite- knowledge, is clearly biased towards the latter one. A new feature film is basically the result of a multitude of knowledge processes building on known and not necessarily new knowledge composites. So is the coordination of a film-cluster-network. We identified an institutional arrangement of leading firms that establish a core group for the coordination, financing as well as for the production and distribution of niche market feature films.

The film-business is increasingly shaped by globalization and internationalization. Films are more and more produced in onestop locations around the world the production supervision however is mostly dominated by Hollywood firms. The Munich situation is different. The location is shaped by the existence of small and medium-sized film-makers and distributors which are embedded in one of the largest media-locations worldwide, with publishers, IT-companies TV-Stations and a huge advertising industry. Interesting and eligible for further research is the fundamental switch of the Munich feature film industry refocusing its resources into a new market niche. In so doing several actors, including political authorities, have coordinated and readjusted their focus and established in the end a stable and successful network. The whole sector is marked by and partially dependent on public promotion. This holds true for most countries and regions outside Hollywood. The promotional system displays distinct multi-level governance characteristics. Especially in Europe with film promotion programs on the European, national and often regional level.

For decades film exports played virtually no role while Hollywood productions sustained a market share of 80 to 90 percent. Under these conditions, the German feature film industry developed quite differently at its various locations. Compared to its major competitors in Germany the Munich film cluster performs remarkably well. In 2003 Munich was home to 14,000 media firms employing 187,000 people. In 2002 these firm's consolidated revenues mounted to 24.5 billion EUR. Even during the “difficult” post tech-boom years of 1999 to 2002 revenues within the Munich cluster increased by 28 per cent (IHK 2003). The gamut of media sub-sectors is represented in Munich. With regard to broadcasting 51 per cent of private German TV programs are produced in Munich. 21 of the 45 nationwide TV stations are based there. Munich is also the leading national location for information and communications as well as multimedia and Internet technologies. The Munich sector amounts to more than 40 percent of the industry’s nationwide annual revenues. The Bavaria Film studios south of Munich are today the biggest film production facility in Europe, with estimated revenues of some 281.7 million EUR per year.

The network dynamics within the Munich feature film cluster are thus particularly intense within a relatively small group of organizations. These organizations have almost monopolized the production, distribution and financing of local motion pictures. The most

obvious explanation for the density of this network is the existence of strong, trust-based personal interrelations of individuals within these organizations. Whereas in terms of production, financing, and distribution, the Munich feature film industry is only marginally integrated in into the global industry, the situation is different in terms of highly specialized technologies used in the production process.

This refers, inter alia, to cameras and camera equipment. In that specific segment of film technologies the Munich cluster holds an extraordinary strong position on the world market. Two corporations dominate the motion picture camera market. Panavision, based in California and ARRI (abbreviation for Arnold & Richter Cine Technik GmbH & Co. KG), headquartered in Munich. The relation between these two firms is in a way unique, as Panavision is not only a rival but also a customer of ARRI products. In fact, Panavision acquires ARRI cameras in large scale and modifies, "panavises" them, to rent them to film production companies through their own rental services. Furthermore, given the fact that cameras are rarely sold, but mostly rented, the two manufacturers both run their own rental houses. In addition several independent rental companies exist. These deal predominantly in ARRI products. ARRI not only produces cameras and equipment but also manufactures so-called "digital labs", a laser system "ARRILASER" used in postproduction for the re-exposure of digital material onto the film. This technology has turned into an industry standard and is completed by the "ARRISCAN" enabling scanning of film roles.

The position of the Munich cluster is outstandingly strong, compared to other German locations. Apart from ARRI that has received nine awards since 1967, several other companies in the Munich area also won awards. The crucial point we make here is that the Munich film cluster could not attain the strong world market position in this critical technological field without the necessary competencies for such performance. This includes financial as well as infrastructural resources that certainly are the crucial preconditions for the cluster's competitiveness at least within the domestic and the European sphere.

The film technology sector is represented by two organisations on the national and regional level. The FGF Bayern – Fördergemeinschaft Filmtechnik – is a forum for all firms providing or developing film technology in Munich. On the national level the VTFF – Verband Technischer Betriebe für Film und Fernsehen – is representing the interests of the film

technology industry towards national institutions and organizations. The VTFF is interesting in the Munich context because the President is the Chief Executive Officer of the Cinemedia AG, a Munich based production and postproduction company.

The Munich film sector with regards to technology not only includes well-known educational institutions and funding support through the regional investment factors, moreover the bi-annual CINEC fair is taking place in Munich organised by the FGF Bayern. This fare is the only film technology event in Germany with a European coverage and in conjunction with the NAB in Las Vegas and the ILC in Amsterdam one of the leading film technology fairs worldwide. The show was started in 1996 and since 2002 the CINEC Award is granted for extraordinary and innovative developments in the area of film technology. The award is hosted and granted by the FGF Bayern.

Public support for the feature film industry takes place at different levels of government, from the state and federal level to the European Union. The main reason for this division of labour is that the German constitution allocates the authority to regulate cultural affairs to the federal states of Germany ("Länder"). the Munich film cluster profits significantly from various public policy measures that have been implemented by the Bavarian state government. By and large, those activities can be characterized either as the direct financial promotion of film productions or as specific sectoral infrastructural measures. In the latter case, the Bavarian state government has most recently established a cluster-oriented approach for various modern industrial sectors, such as biotechnology, nanotechnology or the media sector. The direct promotion of film productions falls under the responsibility of the previously mentioned Bavarian film and television fond ("FilmFernsehFonds Bayern", or FFF).

The state of Bavaria, private and public broadcasting companies, and incomes from matured investments finance the FFF. In 2007, the fund supported the production of 33 cinema movies and 20 television films. Apart from direct financial contributions, the state of Bavarian has made significant investments in the infrastructure of the Munich feature film cluster.

In 1991, a state initiative led to the establishment of the Bavarian Film Center ("Bayerisches Filmzentrum Geiselgasteig") also located on site at the Bavaria studios. This film center provides office space and services to newly established small companies in the film sector.

Today, the film center is under joint sponsorship of the Bavarian Ministry of Finance and the Bavaria Film Corporation. Public support and sponsorship also exist for a number of specialized organizations and events in the Munich film cluster. This holds not only for the Munich Academy for Television and Film, but also for the Bavarian Movie Awards, the Bavarian television award as well as, the Munich Film Festival and the annual international media convention "Medientage Munchen" which is the largest event of this kind in Europe.

The German federal government explicitly supports the production of feature films, but not of television programs. This is done through its film promotion agency ("Filmförderungsanstalt", FFA). The FFA has implemented two major instruments: Project Promotion and Reference Support. The production companies receive financial support, which has to be reinvested in new projects. The Munich feature film cluster benefits greatly from federal support. Of the 31 projects the FFA supported in 2004, 16 were produced in Munich (Filmförderungsanstalt 2005).

2.2.1. FKD 1 – FEATURE FILM TECHNOLOGY: THE ARRILASER

Introduction

Film and film technology have an outstanding and long lasting tradition in the Munich region. The Munich film sector not only was and is known for its diverse and versatile creative outcomes, but also for its film technology. The following FKD occupies the salient field of camera production and technology and focuses especially on the development of a new digital postproduction device, the so-called ARRILASER. The remarkable track record of the inventing firm ARRI started on September 20th, 1917, when two students August Arnold und Robert Richter founded the company (FilmFernsehFonds 2007). The first major breakthrough in filming technology was achieved by ARRI in 1936 with the launch of Arriflex 35 (Deutschlandradio 2008), the first 35mm film camera with integrated mirror-reflex allowing the cameraman to see what is filmed in real time. This tradition was continued and led to twelve technical Oscars only for ARRI, the last one in 2002 for the ARRILASER. That development over 90 years of continued innovation appears remarkable in the film technology industry and is, as we found out directly connected to the film cluster of Munich. ARRI

Cinetechnik and its Research and Development were always located in the city centre of Munich.

By developing the ARRILASER and in follow-up the ARRISCAN the firm is focusing on diversifying its activities into the digital realm (Arnold & Richter 2008, p. 3). The "Digital Lab" and especially the ARRILASER are conceived to bridge the gap from digital to analogue through enabling a seamless and uninterrupted transfer from film roles to digital data and back on the film. Still up to 95% of the worldwide cinemas are using analogue projectors. Consequently analogue film roles are necessary. Especially nowadays as a simultaneous global movie launch is sometimes required or wished by the production companies to prevent the illegal sharing of movies over the Internet or black market. For a global launch roughly 20.000 copies or prints are necessary. These copies are based on master copies, which are done with an ARRILASER.

This FKD shows clearly that initiating knowledge was created at the regional level of Munich, amended by special expertise from various, but not too far distanced locations. The knowledge for the improvements and the detailed specifications of the ARRILASER emerged on the one hand from the company's internal knowledge-base about digital postproduction technology and on the other hand from the continuous exchange with customers from digital postproduction services and camera technology. All together the location and the position of ARRI within the Munich film sector and the Munich region facilitated the knowledge transfer about needs and demands and enabled the firms to produce a market-ready innovative device. After the local proof of the market readiness the global export started.

The type of development it represents

The development of the ARRILASER is a product development situated in the area of film technology. The development started in 1993 and was finished with the market introduction of the concrete device in 1999. The product consists of many different single components and combines knowledge from various areas of digital and analogue film technologies. Knowledge from the following areas especially contributed to the ARRILASER: film handling, optical technology, laser technology as well as software and interface development. This technology mix laid the fundament for the success of the device and represents a strategic turn in the development and business activities of ARRI. The product development

benefited from the established market position of ARRI as the main film camera provider worldwide. The ARRILASER did affect the strategy of ARRI, because it was the first step towards the new business area of digital film technologies. The development started as a little jolly boat next to the steam boat of ARRI's camera development. The successful development resulted in an established market position of ARRI in digital recording technologies, an business area ARRI never was active before and lead to the consecutive development of the complementary ARRISCAN focused on film scanning.

Consequently the ARRILASER is not only a product, that was developed, but also a strategic cornerstone in the business activities of ARRI in Munich and let to a new area of business and further customers and revenues.

Its significance to the business

The development of the ARRILASER and in follow-up the ARRISCAN is the firm's foundation for the future development of the film technology industry. The firm is focusing on diversifying its activities into the digital realm (Arnold & Richter 2008, p. 3). The "Digital Lab" and especially the ARRILASER are conceived to bridge the gap from digital to analogue through enabling a seamless and uninterrupted transfer from film roles to digital data and back on the film. Still up to 95% of the worldwide cinemas are using analogue projectors. Consequently analogue film roles are necessary. Therefore the all-digital cinema and movie industry is far away. The two devices and the later in detail analyzed ARRILASER are the cornerstones of ARRI's strategy to prepare for the digital cinema and the bridging the period until its arrival. Nowadays as a simultaneous global movie launch is sometimes required or wished by the production companies to prevent the illegal sharing of movies over the Internet or black market. For a global launch roughly 20.000 copies or prints are necessary. These copies are based on master copies, which are done with an ARRILASER. This device allows a higher quality; sharper and better-colorized master prints, which increase the number of possible showcase copies from master prints up to 1.000. Consequently a production firm needs only 20 master prints for a global movie launch. But it is not only big production companies using the ARRILASER. Due to its size comparable to an average refrigerator and its easy handling a variety of movie related firms are today using the ARRILASER, especially small and medium-sized Digital Intermediate and Postproduction firms. One device costs round about 460,000 EUR and currently around. The ARRILASER

itself is a product of the cooperation between ARRI and the Fraunhofer-Institute for Physical Measurement Techniques (FHI) in Freiburg. This institute experimented before with the laser exposure of photo paper. The cooperation appeared as a mutual completion. The FHI was searching for a partner to develop its laser technology for exposure and ARRI was looking for an experienced scientific partner in the area of laser development.

Overall it is obvious that the development of the ARRILASER and the strategic orientation towards the digital realm in film technology are well preparing ARRI for the upcoming challenges. In the light of the development process it is clear, that most important knowledge stem from internal and external knowledge domains and knowledge providers. Consequently the EURODITE Hypothesis two holds true for the technology combined in the ARRILASER.

The sequence of events, i.e. the knowledge biography

The core of the now analyzed FKD is the development of the ARRILASER by the firm ARRI in Munich. The development process of the ARRILASER is hard to cut into stages or phases and from an analytical point of view it makes sense to regard it as one whole phase. The development mainly took place internally and the key players over the time of the project were the same, especially the lead actor. Furthermore the knowledge during the development phase was mainly firm internal. The development started some 15 years ago by ARRI because of unsatisfying experiences with film recorders in the company's own digital postproduction facility. Digital postproduction of films was at that time already one of ARRI's business units mainly engaged in the postproduction of advertising and video films.

Consequently ARRI, due to its own business unit and a close relationship with customers through its camera and rental business, was aware of the problem of film recording. The development was one step to establish a further pillar for ARRI in the digital intermediate business. The ARRILASER itself is a product of the cooperation between ARRI and the Fraunhofer-Institute for Physical Measurement Techniques (FHI) in Freiburg started in 1993 and launched in 1999.

"What"?

The ARRILASER combines very different types of knowledge within its development. Functional knowledge domains that flow into this project cover especially the area of product

and development knowledge and strategic knowledge about the future development of the film technology sector and the movie production. Technical product knowledge was mainly provided by internal sources. The setup of a recording machine was framed by ARRI's internal postproduction department, especially the combination of the recording device with a single interface for the digital image signal and the knowledge about the size requirements of the device. The fridge size perfectly fits the space scarcity of small postproduction firms worldwide. The requirement was to be able to move the device through the upper window of the postproduction department. Further functional internal knowledge was used in the area of film handling and optical technologies about exposure.

ARRI's Vienna facility provided the knowledge about film handling and the optical technology experts were at that time located in Munich. The external development partner Fraunhofer Institute for Physical Measurement Techniques (IPM) in Freiburg provided the functional knowledge in the area of laser technology. This relationship occurred by accident. The internal project team was looking for new exposure technologies and was connected to the IPM through a firm in Brixen (South Tirol, Italy). The FHI was searching for a partner to develop its laser technology for exposure and ARRI was looking for an experienced scientific partner in the area of laser development. The project between ARRI and the FHI in Freiburg was an industry-cooperation and no financial aid from local, regional or national institutions was used. The cooperation between ARRI and the FHI revealed itself as successful because every partner was working in his own domain and complementing the development process, there was no interference between the project partners.

The specifications and technical requirements were formulated by ARRI as the leader of the project. Due to own experience and its close ties to local and global customers in the film industry, these specifications achieved the customers' wishes. This is for example reflected in the bundling of the recorder with a central control unit enabling one-stop data transfer. At the headquarters of ARRI in Munich, which comprises also the R&D department, the main portion of the project happened to be executed. The development and mounting of the recording machine itself took place there as well. This single mounting approach at one location is important because the company is able to control the quality of the single parts and the interplay of the system itself.

Another important functional knowledge domain was the strategic overview of the ARRI management in Munich. The granted independence of the parent company and its business activities and the long-term strategic commitment towards the digital realm in film technology enabled the project team to build such a business success according to the project manager of the ARRILASER. This strategic overview was coupled with functional knowledge about the best educational facilities to recruit new project members. This recruitment took place in Freiburg, Cologne and Munich, which are known for the quality of technicians in the required areas of electrical engineering, optical and film technology.

To summarize this first aspect of the knowledge biography it is clear, that ARRI combined knowledge from intra- and extra-regional sources. This knowledge was more region- and sector-specific than time-specific. Interestingly the regional focus of ARRI's knowledge acquisition is not geographically limited but regarding a common language and time zone (EURODITE Hypothesis 1). The knowledge used in the development of the ARRILASER was mainly internal, therefore this FKD does not fully support the EURPODITE hypothesis 2, but strengthens the fact, that knowledge for innovations is not limited to the innovating firm and external inputs are required to fuel the development by providing or complementing key technologies.

"How"?

Knowledge flew into this project from very different ankles. Most of it was developed in the camera development, which was started 90 years ago at ARRI in Munich. Especially the knowledge about film handling, analogue optical technologies and exposure is internal knowledge. Knowledge about film handling flew in from the ARRI location in Munich, which develops such technologies for all analogue film cameras from ARRI. The laser technology and the laser setup flew in through the cooperation with the Fraunhofer IPM in Freiburg. This knowledge was acquired by ARRI with a development contract between ARRI and the IPM. Knowledge about the external setup of the device and the user-interface and the size were provided by the internal postproduction department and from various customers. Even learning-by-doing and trial-and-error were sources of knowledge. The first prototypes were tested in cooperation with a Munich-based producer parallel to the finalization of the device. The knowledge inflows were coordinated and connected by the internal project management team of the ARRILASER development.

Contrasting this FKD against the research hypothesis 11, 12 it is obvious that neither of them holds true. Universities contribution to this product is relative low and the Gender imbalance did not have an consequences on the research project, because the development team did not include women. The development process of the ARRILASER supports to a small extend EURODITE's research hypothesis 13. Consumers as customers influenced this development, because customer centricity was the aim of the project. Hypothesis 14 cannot be confirmed because the communication revolution and new communication technologies did not integrate consumers more in the project, moreover the interviews underlined the importance of personal exchange with existing customers and users than the involvement of consumers through new communication means.

"Who"?

The Key players and actors in this project are ARRI with its various internal stakeholders and departments as well the Fraunhofer IPM in Freiburg. Fraunhofer research facilities are obliged to develop applicable technologies, therefore the Fraunhofer IPM wanted to make use of their developed laser technology and expand the possible use-cases to underline the manifold applications. The project with ARRI was an industry-cooperation project and provided financial resources for further research projects.

ARRI itself wanted to explore the opportunities in the segment of digital intermediaries, expand its business activities, acquire new customers and secure the strong market position even under the digital threat for the analogue movie business. The management of ARRI recognized the strategic importance of the digital intermediary market and saw the chance for expansion of business activities. The postproduction unit supported the project, because of its negative experience with existing recording solutions and the feedback from customers. The project team and all other internal departments providing technologies and knowledge are at the centre of the development and consequently play a crucial role. According to the project manager of the ARRILASER their intentions and aims were to support the business development of ARRI and serving customers. The different key players and their intentions clearly support hypothesis 3 of the EURODITE research hypothesis.

“Why”?

The reasons for the development of such a project are manifold The development of the ARRILASER was influenced by the continuing digitalization of the film production. Cameras, production, postproduction are mainly digitalized already. The gap between analogue and digital technology is between the film production and the movie screening. Only ten percent of the cinemas worldwide are using digital projectors. The prospected market is huge. The firm ARRI was not established into this digital intermediary technology until the development of the ARRILASER. The management had the clear intention to position the firm in this area, because ARRI was a very well established film technology developer and had an immense international customers base. Market analyses estimate, that 50% of the worldwide movie sets are equipped with ARRI cameras. The negative experience of the internal postproduction department with existing recording technologies and the strategic overview to start a new business field in the area of digital intermediaries fuel the development of the ARRILASER. According to the project manager the strategic independence of the ARRILASER’s development from the rest of the business activities and the strong internal support were the strong supporting components in the development reflecting again the strategic overview of the management and the corporate commitment to new technologies.

An important push was the technical Oscar in 2002. This award is the accolade in the film technology industry and according to the head of technology at ARRI strongly supports business activities. The film sector Munich influenced the development indirectly through a cooperation between ARRI and a Munich film producer at the end of the development when the ARRILASER was used to record the film and the results were cross-checked immediately for final adjustments in the hard- and software of the device.

“When & where”?

The development started in 1993 in Munich. The final product, the ARRILASER, was launched in 1999. In 2002 the machine was awarded with the technical Oscar. A deeper differentiation of the time line cannot be provided, because the development process includes overall a workload of roughly 15 man-years and an unlimited number of milestones. More information is available on the spatial setup of the FKD. The driving force was the internal development team located in Munich. Further research within ARRI was done in Vienna. But

such a project, according to the project manager, integrates a vast amount of technologies, which are provided by completely different partners. Interestingly most of these partners and technology suppliers are located on a virtual connection from Freiburg via Munich to Vienna. This regional use of technology has according to the firm two basic reasons; first the technology existed at these locations, which were known for its expertise and reputation. Second same time zone, a travelling distance of roughly 1000km and a common cultural working approach extremely facilitates project management according to ARRI.

At the headquarters of ARRI in Munich, which comprises also the R&D department, the main portion of the project happened to be executed. The development and mounting of the recording machine itself took place there as well. This single mounting approach at one location is important because the company is able to control the quality of the single parts and the interplay of the system itself.

Overall summary of knowledge biography

The ARRILASER is a film-recording device that is bridging the digital to analogue gap in film. The production and postproduction of a film today are digital, the screening in cinemas is to 90% analogue. In 1993 ARRI in Munich started the development of the ARRILASER. The aim was to bridge this gap but also to open new areas of business preparing the firm for the future challenges of the ongoing digitalization in filmmaking. The development of this innovation was mainly done at firm location in Munich and Vienna. Most of the used knowledge originated from inside the firm. External knowledge was provided by the Fraunhofer IPM in Freiburg. This research institution developed the laser technology, which is used in the ARRILASER for recording the digital signal on analogue film roles.

The configuration and quality of the machine reflect the various requirements of internal and external stakeholders. The device is equipped with a single input interface to secure the compatibility with different digital signals. These configurations and the used technology led to the awarding with the technical Oscars in 2002, which continues the technical Oscar tradition of ARRI. The technological domain of ARRI were cameras and light technologies. The strategic move towards digital intermediary technologies has to be credited to the ARRI management that not only gave the direction, but also provided the development team

sufficient independence to succeed according to the project manager of the ARRILASER development.

So far ARRI sold approximately 250 machines worldwide with a global market potential of 1.000 units. The customers are mainly small and medium sized firms in the United Kingdom, Australia and of course the United States. These companies chose the ARRILASER due to several reasons. From the high quality and the system integration of the product itself to the small size of the device – it fits even into little digital intermediate companies in the packed SOHO district of London – and because of the ARRIs customer service (Arnold & Richter 2008: 50). The export ratio of the ARRILASER is up to 96%. This is in complete contrary to the development process of the ARRILASER.

In conclusion the innovation ARRILASER is the result of a combination of internal firm knowledge with a long-lasting technology orientation and external applied research matching the firms need. According to the project manager this match of technologies and the complementary competence profiles of the involved partners were the key success factors.

Gender

The film and new media sectors generally have a relatively high portion of female employees. In the technical knowledge domains and in film technology, however, female employees are rare. In the technical development of ARRI was no female employee involved.

According to the project manager the gender issue is not related to the firms hiring or searching policy, because there is a sufficient amount of female employees in other areas of the company. The issue lies in the amount of female technicians in general. Most of them are working for big companies in the area of automotive and electrical engineering. The characteristics of knowledge networks did not determine the level of female or male participation within the respective organization or public institution. Furthermore gender imbalances in the exploration of knowledge did not contribute to gender imbalances in the product.

2.2.2. Findings and Conclustions from TKD 2-FKD 1

The ARRILASER bridged the gap between the digital and analogue edges of film technology. But it was not the invention of digital film recording. It was instead the first time that optical laser technology was used for this purpose. ARRI has a long-lasting tradition in technological leadership in the film technology sector. The Fraunhofer IPM in Freiburg developed the laser used in the above-described FKD. At the beginning IPM did not intend to use the laser for film recording purposes. ARRI discovered the improvements in recording quality through the IPM's laser.

Consequently ARRI's development of the ARRILASER in cooperation with the IPM is best described in the EURODITE context as an examination phase. In contrary the configuration of the device regarding the single input interface, the central processing unit and size and weight are results of ARRI's knowledge about customer needs and own experiences with similar devices. This phase is equivalent to the knowledge phase Exploitation in the EURODITE language.

The development of the ARRILASER is based in synthetic knowledge, which in the case of the Fraunhofer laser was explicit. Regarding film handling technologies and exposure the knowledge was tacit within ARRI. This is valid as well for the symbolic knowledge about market requirements and customer needs. Through its tradition in film technology ARRI had tacitly developed this knowledge.

In contrary to the afore-mentioned FKD in Biotechnology this innovation combines two technology sectors, two knowledge phases and two knowledge types.

2.2.3. FKD 2 – FEATURE FILM TECHNOLOGY: FLOWLINE

Introduction

The second FKD analyzed within the feature film technology TKD is last year's winner of one of technical Oscars in March 2008. The Flowline simulation system was developed under the roof of Scanline in Munich in 2004. It is another innovation in film technology for postproduction processes.

With this software mainly 3D artists are provided with a new flexibility in simulating any kind of liquid, gas or fire. Apart from the flexibility in simulating the materials the unified selling position of Flowline is the easy-to-simulate interplay of various types of liquids, gas or fire. The software simulates each material based on physical equations and each material has its own simulation. But within the system the simulations can be combined. Flowline in contrast to its rivals is not 100% physically exact. This is, however, a (marketing) advantage insofar as by reducing the physical accuracy the system gains far more flexibility. The results of the simulation are more adaptable to the needs and demands of the 3D Artist or director but on the same time looking and behaving like a physically exact simulation. For example within the feature-film “Chronicles of Narnia” the huge water god is appearing out of a river at the end movie. With a conventional solution this is a very high complex simulation and if the director does not like the look or the way the creature moves, the simulation has to be calculated from the very beginning. With the Flowline system the parameters do not have to be recalculated from the beginning, but the 3D artist can easily change the look or the motions of the water god in this specific case.

This innovation was selected as the second FKD, because the Munich film cluster played a vital role in supporting the development of the Flowline system. On the one hand the firm Scanline is already an established player and has sufficient experience and knowledge in visual effects especially in German and Munich based film productions. On the other the first two movies using the Flowline system to simulate water in action were German TV productions “Megalodon - Haialarm auf Mallorca” (2004) and “Die Sturmflut” (2006). Both movies were not produced or shot in Munich, but supported by the Bavarian Film Fund. This underlines the indirect correlation between technological innovations and knowledge creation in the Munich film cluster on the one hand and the public funding system on the other, as producers are obliged to invest state granted money in regional and local firms.

Interestingly the knowledge for this development emerged at the Munich film location within the firm Scanline. The knowledge creation was not induced by any other external public or private source nor was a university or any other research institution part of the development process. But the business success of the Flowline system is global.

The type of development it represents

The development of the Flowline Simulation system is at its core a software product development, that simulate any kind of liquid, gas or fire. The Software is connected to a set of libraries that contain the information about behaviour and acting of different liquids or gases. One specialist of the firm Scanline developed the basic idea. The system Flowline is the result of a continuous progress of the developers' experience. It also can be seen as a continuous development of the postproduction and visual effects related knowledge of the firm Scanline. When Scanline started business in 1989, they were mainly doing Logos and 3D graphics for German TV broadcasts (Koch 2008). Through the years they developed to one of the three bigger firms for postproduction at the Munich feature film cluster (see TKD).

Furthermore the development brought a new business model for simulating liquids etc. Until the innovation Flowline such simulations were calculated and created by specific companies e.g. ILM in Los Angeles. Each time the simulated effect needed an adjustment; everything had to be recalculated by the specialist. With Flowline enables an ordinary visual effects specialist to simulate and adjust according to the preferences of movie directors etc. on the set or in the postproduction phase of the film production.

Its significance to the business

The development of the simulation software has significance to the business of the participating developers and firms, but to the postproduction business, too. All developers are freelancers and only affiliated with the firm Scanline. Scanline Munich provided the money and in return could use the system in various film productions. Nowadays Scanline Los Angeles is providing the roof for development and market activities. The significance for the freelancers is very high. There professional future partly depended on the success of the Flowline project. For Scanline Flowline meant a new orientation in business activities and a focus of the Los Angeles branch on simulation and visual effects. Therefore the consequences for Scanline were significant, too.

Finally Flowline had significant influence on the development of the postproduction business. As already mentioned it changes the ways and methods of simulating liquids, gas or fire. It increases the ability to easy adjust calculated simulations to match the requirements of directors etc. Hypothesis 2 in the EURODITE contexts holds partially true. All developers

work or worked for Scanline at a certain point in time, but the idea and knowledge to develop this system is based on external experiences and coincidences. External inputs dominated internal knowledge domains.

The sequence of events, i.e. the knowledge biography

At the core of this FKD is the Flowline System for simulating liquids and gases in film productions. Flowline was developed between 2002 and 2007 in Munich by five developers with close ties to the Munich film sector. The first running version was available in 2004 when used in the first national and international film productions. This development process does not contain clear phases. The development time is relatively short and the system is under constant ongoing additional development, because each project or film with new simulations adds these to the library of existing simulations.

“What”?

The development of Flowline involves various type of functional knowledge about producing such software including the libraries with simulations. Most important are the knowledge to develop and write software programs and the physical knowledge about simulations in specific the Navier-Strokes-Equations. Apart from that according to the project manager and lead developer knowledge about visual effects and their creation on computers is necessary to create a system like Flowline. Finally knowledge about filmmaking is required to understand the needs and requirements of film-makers, visual effect and 3D artists.

Strategic knowledge involved in the development was required to support the project from the beginning and to provide the developers with a sufficient amount of independence. The system was originally planned for internal purposes, but with the ongoing success external projects could buy the system. The knowledge for this development emerged at the Munich film location within the firm Scanline. The knowledge creation was not induced by any other external public or private source nor was a university or any other research institution part of the development process. Regarding the hypothesis 1 and 2 this FKD draws a very indifferent picture. The developers did combine internal and external knowledge, but most of it was available at the Munich film sector. Therefore it holds true, that knowledge is region specific, but it was combine above sectors and time. The knowledge domains used in the developments

were mainly internal or internalized by hiring freelancers. Therefore Hypothesis 2 holds only partially true.

“How”?

The different kinds of knowledge about writing software, calculating Navier-Strokes-Equations, visual effects and film-making flew into the development of the Flowline System from different sources. The development team consists of five people with different educational backgrounds covering the areas of programming, filmmaking and visual effects.

Through training and learning-by-doing the knowledge about physical behaviour of liquids etc. was integrated into the development team. Recruiting and hiring were used to fill competence and knowledge gaps within the project team. Nowadays customer and user are an important source of knowledge, because they are developing new simulations, which have to added to the library of existing simulations. All together this FKD underlines that universities never contributed directly or indirectly to the project and therefore Hypothesis 11 cannot hold true. The development was male only due to the lack of applications from female developers. Therefore Hypothesis 12 is irrelevant for this FKD. Consumers are the people watching the films in cinemas and on TV. They do not have a direct input or contribution to the development of this FKD, therefore Hypothesis 13 and 14 of EURODITE do not hold true, too. Nevertheless customers and users of the system have an important stake in advancements of Flowline.

“Who”?

The core project team consists of five developers. This team developed the solution, wrote the software and is responsible for further developments and advancements of the Flowline System. The core team consists of two software engineers, one former architectural student and two electronic/business engineer. Their motivation was to secure employment and living. After the first experiences in the visual effects business the impetus changed to creating a new, more user-friendly and applicable solution for simulations and visual effects.

The firm Scanline financed the development of Flowline and plays an important role in the first applications of the new system and the acquisition of the first use-cases. Additionally the Flowline System underlined the competences of Scanline in the area of visual effects and increased the attractivity of the firm for customers and future employees.

The third important stakeholder regarding Flowline is the Bavarian Film Fund. This public actor did not fund the technological development directly, but indirectly through the funding of the first two German TV productions “Megalodon – Haialarm auf Mallorca (2004)” and “Die Sturmflut” (2006). Both movies were not produced or shot in Munich, supported by the Bavarian Film Fund. According to Flowline developers these two TV films were opening the intrnational market and were followed by the use of Flowline in the movies “Poseidon” (2006) and “300” (2006).

The selecting process of the project partners is in line with EURODITE’s Hypothesis 3, that knowledge is selected by the firms for its relevance to their strategic objectives and goals, and is harnessed to these objectives.

“Why”?

The development of Flowline is according to the project manager the result of chance and coincidence. There was a window of opportunity and willingness by the involved persons to take the risk of failure. Two important factors influenced the success significantly. On the one hand the almost monopoly of Industry Light Magic in the simulation of liquids etc. and on the other hand the willingness of Scanline to finance the project.

Indirectly the Flowline System profited from the funding policy of the Bavarian Film Fund and its support for the two German TV productions.

The current business model itself is different to traditional models in the visual effects industry, because customers buy the software, get training and develop with the development team advancements for the software. Furthermore they are obliged to publish new simulations in the library to be accessible for every future customer of Flowline. This business model emphasized the business success of Flowline.

“When & where”?

The development of the software system started in 2002 and was ready for public use in 2007. In between five developers were working on the project, three of them as freelancers under the

roof of the firm Scanline in Munich. The Flowline system was an inhouse product of Scanline and used mainly for their own postproduction projects. Recently the innovation is attached to the Scanline branch in Los Angeles.

The first project was the German TV production “Megalodon – Haialarm auf Mallorca” in 2004 and the film “Die Sturmflut” in 2006. After these two successful use-cases, the Flowline system got into public attention and was used again in the film productions “Poseidon” and “300” in 2006, “Harry Poter” (2007) and “Chronicles of Narnia” (2008).

2008 marks a very important step on the road to a broader acceptability and visibility of Flowline. In this year it was awarded with the technical Oscar and its market position further established. All core development of the Flowline System was carried out in Munich. This is very similar to the before presented FKD of the ARRILASER and underlines the strong position in terms of knowledge and innovation of the Munich film technology cluster.

Overall summary of knowledge biography

The Flowline System and the software provide mainly 3D artists and visual effects specialists with a new flexibility in simulating any kind of liquid, gas or fire. Apart from the flexibility in simulating the materials the unified selling position of Flowline is the easy-to-simulate interplay of various types of liquids, gas or fire. The software simulates each material based on physical equations and each material has its own simulation.

The development of the software system started in 2002 and the whole development team consisted of five developers. The main developers were three persons working under the roof the firm Scanline in Munich. The Flowline system is mainly an in-house product of Scanline and was used for own postproduction projects.

The Munich film cluster played a vital role in supporting the development of the Flowline system. On the one hand the firm Scanline is already an established player and has sufficient experience and knowledge in visual effects especially in German and Munich based film productions. On the other the first two movies using the Flowline system to simulate water in action were German TV productions. Both movies were not produced or shot in Munich, but supported by the Bavarian Film Fund. This underlines the indirect correlation between

technological innovations and knowledge creation in the Munich film cluster on the one hand and the public funding system on the other, as producers are obliged to invest state granted money in regional and local firms.

The knowledge for this development emerged at the Munich film location within the firm Scanline. The knowledge creation was not induced by any other external public or private source nor was a university or any other research institution part of the development process. The final consequence was the application for the Technical Achievement Award 2008.

Gender

Film and new media are sectors with a relatively high portion of female employees. In the technical knowledge domains and in film technology female employees are rare. In the development team of Flowline was no female developer involved.

Similar to ARRI and the development of the ARRILASER the gender issue seems not related to the firms hiring or searching policy. The issue lies in the amount of female technicians in general. Most of them are working for big companies in the area of automotive and electrical engineering. Therefore from today's perspective Hypothesis 10 and 12 are not holding true.

2.2.4. FINDINGS AND CONCLUSIONS FROM TKD 2-FKD2

The Flowline system started in 2007 with a very small track record of successful projects in the market for simulations and visual effects. This market was dominated by one big established single player in California, US. The market entry and the success are the results of the flexibility and user friendliness of the system.

The development is based on existing and established technologies. Therefore the knowledge phases of the innovation in the EURODITE context are Examination and Exploitation. The difference to the existing systems was the method of processing and stimulating, which overruled physical laws and secured realistic, but easy-to-modify visual effects.

The development itself is characteristic for Examination and the used knowledge was synthetic, because there was no research for new technologies, it was only the combination of existing technologies. The market introduction and commercialization of Flowline by the

development partners is a typical Exploitation phase. In this phase symbolic knowledge was applied to develop a system matching customer needs. According to the lead developer most of the knowledge was neither codified internally nor externally until three months ago. This draws the conclusion that the used synthetic and symbolic knowledge was exclusively tacit. In summary this FKD adds a third combination of knowledge types and phases to our case study research underlining the divers characteristics and origins of innovations.

3. CONCLUSIONS AND COMPARISONS

3.1. Conclusions about micro-level knowledge dynamics – who, what, where, why

In terms of micro-level dynamics our three case studies show very different constellations of actor constellations and interactions, the rationals for the introduction of the respective innovative projects as well as in regard of different modes of knowledge production. In general, our three cases represent the three basic forms of processes of technological development:

1. the *intramural modus*, i.e. a process in which the knowledge for the development process largely exist within the firm. In our sample, this is the Flowline case where the project was launched primarily to broaden the internal knowledge base for post-production services in the feature film industry.
2. the *limited extramural modus*, i.e. a process in which the a company initiates interactions with only few strategic partners who can offer the knowledge that is required for the inhouse development process. In our sample, this modus is represented in the ARRI case where the firm utilized a mode of knowledge production that is quite typical for the German innovation system in which it is the mail role of the Fraunhofer institutes for applied sciences to support technological developments in small and medium-sized companies.
3. the *global extramural modus*, i.e. the acquisition of knowledge in a process in which there is typically no need to closely interact with the external knowledge provider. This modus, which is in our sample the Medigene case, mainly depends on the availability of highly codified knowledge that allows for the assessment of the potentials and risks that associated with a purely market-coordinated acquisition of external knowledge.

While we found significant variations across cases in terms of the modes of knowledge production the cases share some similiarities in view of the rationals for the initiation of the different knowledge interactions. In the two cases in which extramural knowledge production played an import role, the companies engaged into these processes for strategic business reasons. This is primarily the case with Medigene, because the company had to react to the failure of its internal R&D processes and thus started to in-licence product candidates which had the potential to significantly reduce the firm's time-span to the market. Here it is important that such a critical shift in business strategy would not have taken place without the support and managerial influence of external actors, esp. venture capital providers who were already invested in that firm. Even in the ARRI case, the product development process was clearly linked to a strategic management decision to enter a new market that had emerged because of the introduction of digital post-production technologies in the feature film industry.

This shift in business strategy was of course not as radical as in the case of Medigene. Rather the two cases of ARRI and Medigene provide for a differentiation between radical and incremental business change. In this respect, the latter one is characterized by the continuity of existing product lines and by the compatibility between those and the new product line.

3.2 Conclusions in relation to the WP5 main parameters

The territorial perspective reveals that processes of knowledge production and knowledge interaction vary significantly across sectors and projects, but nevertheless show some sector-specific characteristics.

In this respect, the Medigene case certainly represents typical processes of knowledge production and dissemination in the biotechnology industry. A large part of in-licensing efforts cross regional and national boarders. As a consequence Medigene had to face the question how to internalize the in-licensed knowledge. Especially due to the fact, that the in-licensed compounds had no connection at all to the in-house competencies. A predominant mode which was pursued not only by Medigene, but also by other Munich firms was to hire the key scientists who were occupied with the in-licensed compound beforehand. This strategy provided a further advantage. By "buying" the key scientist, the company got not only valuable experience with the in-licensed compound, but also potentially crucial and new

network contacts abroad. Therefore, Medigene did not try to rebase those scientists, but left them, if possible in their (external) working environment and set-up a new subsidiary abroad that embraced those scientists.

Our two cases from the feature film industry impressively show the importance of proximity for the devolopment and especially the pre-market testing of innovative film technologies even if this industry is much more globalized than most other sectors. Indepent of the mode of knowledge production and the significance of external knowledge, both the ARRI and the Flowline case show the importance of the firms' regional embeddedness. As we discussed in much more detail in our WP5 report, the Munich feature film cluster has established a core group of actors who are of special importance in the different aspect of feature film making. In so doing they set-up a stable network, composed of several producers, service-providers and financiers, as well as policy makers, covering the whole value chain in that sector.

ARRI certainly benefited from the different actors in the Munich feature film cluster. The company recruited a number of developers from various German universities, but especially from Munich which is a location well known for its expertise in electric engineering and information and communication technologies. Close ties exist between ARRI and the University of Television and Film Munich through the teaching assignment of the Chief Technology Officer of ARRI, Franz Kraus, about film technologies and the use for directors, cameramen and producers. Interestingly he was the Head of R&D during the development of the ARRILASER.

The ARRI case also shows that the initial knowledge was created at the regional level while special expertise originated from various, but not too far distanced locations. This points to the fact that for the structuring of knowledge generation processes at the firm level even transnationally organized inter-regional relations can play an important role. They still guarantee relatively "short distances" for interpersonal interaction, but at the same time enlarge the geographical area for the incorporation of external knowledge. The knowledge generation for the improvements and the detailed specifications of the ARRILASER took place both at the local and the global arena. It emerged on the one hand from the company's internal knowledge-base about digital postproduction technology and on the other hand from the continuous exchange with customers from digital postproduction services and camera

technology. In sum, however, the location and the position of ARRI within the Munich film cluster significantly facilitated the knowledge transfer about product related needs and demands and thus enabled the firm to supply a market-ready innovative device. After the local proof of the market readiness the global export started.

With respect to the case of Flowline, the regional embeddedness was of even more importance since this technological development process was an internal one. On the one hand Scanline was already an established player and had sufficient experience and knowledge in visual effects especially in German and Munich based film productions. On the other hand the first two official movies using the Flowline system to simulate water in action were German TV productions “Megalodon - Haialarm auf Mallorca” (2004) and “Die Sturmflut” (2006). Both movies were not produced or shot in Munich, but supported by the Bavarian Film Fund. This underlines the indirect correlation between technological innovations and knowledge creation in the Munich film cluster on the one hand and the public funding system on the other, as producers are obliged to invest state granted money in regional and local firms.

These these two TV films opened up the international market. Consequently international follow-ups as the movies “Poseidon” (2006) and “300” (2006) in which Flowline was used for visual effects and simulations of fire, gas and water, could be attracted. These international film projects and the success of the system proved the market-readiness of the Flowline system to other producers and directors. The final consequence was the application for the Technical Achievement Award 2008.

3.3 Conclusions in relation to WP6 hypotheses

With regard to the WP6 hypotheses, all of our three case studies point in the same direction. This holds because:

- *Hypothesis 1* is fully confirmed by the Medigene case in which the role of external knowledge is indeed region, sector and time-specific. It is partly confirmed by the ARRI case in which external knowledge is at least region and time-specific.
- *Hypothesis 2* is too unspecific. At this general level it is quite difficult to assess how this hypothesis should not be confirmed.

- *Hypothesis 3* is confronted with a similar problem. We can, however, say that in both the Medigene and the ARRI case the acquisition of external knowledge was due to strategic managerial decisions.
- *Hypothesis 4* is fully confirmed by the Medigene case. It is, however, important that KIBS, i.e. venture capitalists in the case of biotechnology, play such an significant role only in this sector. We would also stress that intermediary cluster organizations play at least a similar important role. This confirmed by all of our cases. A respective hypothesis was proposed by the WP2 report of the Munich team, but unfortunately not assumed by the WP6 team.
- *Hypothesis 5* is supported by all of our case studies.
- *Hypothesis 6* was not confirmed insofar as modern communication technologies played no significant role for ourscourcing actitivies.
- *Hypothesis 7* was not directly confirmed in our FKD research, but was supported by TKD analysis insofar as Munich biotech firms shifted their research to the indication of cancer not least because of this indication provides lower requirements in clinical testing and market authorization.
- *Hypothesis 8* is confirmed by out TKD and FKD research. Regional (public and private) financial incentives play an important role both in the biotechnology and the feature film sector.
- *Hypothesis 9* is confirmed by the Medigene case, because patent protection is a precondition for knowledge transfer through the in-licensing of compounds.
- *Hypothesis 10* was not confirmed. If there was a gender imbalance it was due to sectoral specificities.
- *Hypothesis 11* is confirmed insofar as knowledge generated at universities is of highest importance in the knowledge exploration phase. However, in terms of human resources universities clearly impact on the the success of R&D phases that are very close to the market.
- *Hypothesis 12* was partly confirmed on a very general basis. The fact that hardly any women work in the field of feature film technology can to some extend related to the fact that only relatively few women decide to start university studies in informatics or engineering.

- *Hypothesis 13* was confirmed with respect to customers, but not consumers. This result is, however, influenced by our case selection. In our FKDs consumers do not play an important role.
- *Hypothesis 14* does not apply to our cases.

3.4 Conclusions about abstract categories of knowledge

In our FKD research we experienced no difficulties in applying the different types and phases of knowledge to the case studie's processes of knowledge production and diffusion. One main advantage of these categories seems to be that they are "sufficiently abstract" in order to relate them to different kinds of knowledge production processes – from traditional R&D processes to organizational innovations or more consumer-oriented design innovations.

3.5 Policy conclusions

Both in our TKD and FKD research we found sufficient evidence that processes of knowledge production and diffusion at the regional benefit most from a broad but also specific portfolio of public policy instruments.

Across our three FKDs and the two sector we found that the state of Bavaria has:

- significantly **invested in the infrastructure** both of the biotechnology and the feature film industry. In biotechnology large parts of the privatization revenues dedicated to were used to upgrade and concentrate publicly financed research organisations in the Munich area. In so doing several departments of the University of Munich, comprising those for pharmacy, chemistry and biology were relocated to a campus area in Martinsried near Munich. In the feature film industry public subsidies were used to build up a special studio hall, which is strictly reserved for cinema movie productions. The hall is the largest on the European continent. With this investment the state government made sure that the Bavaria studios were able not to dedicate a predominant amount of studio capacity to productions for television.

- provided varies crucial **financial mechanisms that supported the commercialization** in both industries. In biotechnology, the Bavarian Government supplemented federal measures to establish a regional venture capital industry by

setting up a state owned venture capitalist, “BayernKapital”, in 1995 providing financial aid to Bavarian biotech start-up companies. “BayernKapital”, spent till today about 128 million EUR exclusively for young Bavarian knowledge based firms, a large part of them in the Munich biotech cluster. As an indirect consequence the number of private VC firms in the Munich area rose enormously to more than 40 in the year 2004, the highest concentration of VC in the whole of Germany. Further instruments were employed to establish a biotech incubator and to establish a local business plan competition. In the feature film industry the state provides significant means for the production of movies within Bavaria. Production firms which received financial support invested more than 86 million EUR (or roughly 317 percent of the FFF aid) in films produced in Bavaria. The state of Bavaria, private and public broadcasting companies, and incomes from matured investments finance the FFF. In 2007, the fund supported the production of 33 cinema movies and 20 television films. Further more, in 1991, a state initiative led to the establishment of the Bavarian Film Center (“Bayerisches Filmzentrum Geiselgasteig”) located on site at the Bavaria studios. This film center provides office space and services to newly established small companies in the film sector. Today, the film center is under joint sponsorship of the Bavarian Ministry of Finance and the Bavaria Film Corporation.

- engaged heavily in the coordination of the relevant actors in both industries. In biotechnology, the state established an independent intermediate organisation in 1997. The so called BioM AG became responsible for intra- and inter- cluster partnering and networking. The organisation became also a crucial actor in the regional innovation system, due to its endowment with both, public and private Venture Capital. In the feature film insdustry, public support and sponsorship exist for a number of specialized organizations and events in the Munich film cluster. This holds not only for the Munich Academy for Television and Film, but also for the Bavarian Movie Awards, the Bavarian Television Award as well as for the Munich Film Festival and the annual international media convention “Medientage München” which is the largest event of this kind in Europe.

4. GENERAL CONCLUSIONS

4.1 Conclusions of knowledge case studies (FKDs) based on the empirical findings

See section 3. No additional comments**.**

4.2 Conclusions from your own perspective and theoretical background

EURODITE's main achievement as an interdisciplinary project certainly has been the establishment of a common research framework on which partners from different academic fields could agree on. As a consequence, it is quite evident that such a common framework can not fully satisfy all the different disciplinary perspectives.

From a political science perspective and in light of the fact that the project has an explcitit role in providing advice to policy practitioners, however, the WP6 research design is not fully convincing especially in terms of establishing the link between firm activities within specific sectoral contexts and the role and capacity of the state to improve their ability to coordinate their knowledge generation processes. This deficit mainly affects the governance context where the project still lacks sufficient consideration of the different coordination mechanisms that are at hand for public and private actors. It remains to be seen whether output WPs 7 and 8 can provide this on the basis of the project's empirical work.