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Successful Knowledge Transfer from Universities of Applied Science in Germany

Analysis of Best Practice Examples based on empirical analysis and expert interviews

It is commonly accepted that universities are a source of new knowledge and an important part of innovation systems. Innovation and new knowledge are key drivers for regional economic growth and the overall economy of knowledge-based societies. Yet, regardless how prosperous universities' research establishments prove to be, the success in terms of economic effects and economically successful application strongly depends on how effectively the gathered knowledge and created innovation is transferred to society, the industry, and innovation networks. Therefore, the organization and governance of knowledge transfer has become an important strategic issue for universities. In times of performance related allocation of funds, this holds especially true for German universities of applied sciences, as they are very dependent on contract research and successful knowledge transfer as a source of funding for research activities.

The interface between academic research and the conversion and application of knowledge offers high potential – both for success and failure. Several models of governance and support exist. Governments and universities invest millions in knowledge transfer departments with a high diversity of jobs and tasks. Some financially encourage research and knowledge transfer in general. Others are convinced that only the most successful establishments should be promoted. Support can be organized centrally or peripherally in the university departments, in private companies or private-public-partnerships.

The following paper investigates models of organizing and supporting knowledge transfer focusing on German universities of applied sciences. By developing a composition of important indicators and applying empirical analysis on nationwide databases, seven best practice examples are identified. Further best practice analysis is accomplished by online research, site and region inspection and expert interviews with the universities' representatives for knowledge transfer. The investigation proves that successful knowledge transfer depends on both internal and external factors. Analyzing the internal factors, it is underlined that no perfect way for organizing and managing knowledge transfer exists. But investigating the varying successful models, several conform features and interesting similarities can be identified.

Keywords: Knowledge Transfer, German Universities of Applied Sciences, Best Practices Analysis

1 Introduction

There are a high number of studies analyzing the regional effects of universities, either concentrating on a single institution¹, on all university institutions in a city or region² or in a whole country³. Academic literature agrees that universities can influence the economic development of their surrounding region due to expenditure-based and knowledge-based impacts. Expenditure effects comprise the expenditures of the university itself, staff, students, and their effects on local employment and production – basically, universities' expenditure effects do not differ essentially from similar effects of any large expenditure generating institution or entity.⁴ More interesting, but also more difficult to evaluate are knowledge-based impacts that public and economy in the university region can benefit from. As these knowledge-based impacts are not only transferred from university to university region, but also vice versa, academics use the term “Knowledge and Technology Transfer” (KTT).

The article at hand summarizes the results of a study on KTT from universities of applied sciences (UAS) in Germany, published by the Niederrhein Institute for Regional and Structural Research, based at the Niederrhein University of Applied Sciences.

The research objective is, ...

- ...to generate a comparative, indicator based review of the situation of knowledge transfer between universities of applied sciences in Germany and the economy (empirical analysis)
- ...to identify, analyze and compare extraordinarily effective and efficient models of knowledge transfer (best practice analysis) among a UAS, public, and economy of the university region
- ...to gain deductions and strategic recommendations for successful organization of knowledge transfer and specifically for encouraging cooperation between university and regional economy

A combination of quantitative and qualitative research is applied in this study. The article at hand focuses on the qualitative part and introduces seven successful systems of research and KTT from different universities in Germany: Bonn-Rhine-Sieg UAS, Bremen UAS, Cologne UAS, Deggendorf UAS, Lausitz UAS, Muenster UAS, and Zittau-Goerlitz UAS. Each of these universities and their surrounding regions have certain characteristics, a clear research and KTT profile and offered interesting case studies. For further information and the full research report, contact Niederrhein Institute for Regional and Structural Research at Niederrhein University of Applied Sciences.

¹ E.g. Hamm / Wenke (2001) Niederrhein University of Applied Sciences, Germany; Pavel (2008) Technical University Berlin, Germany

² E.g. Ekos Consulting (2007) Sheffield Universities, England; Strauf / Behrendt (2006) Universities in the canton Luzern, Austria; Spehl/Feser/Schulze (2007) Scientific Institutions in Rhineland-Palatinate, Germany

³ E.g. Cowan/Zinovyeva (2009) Universities in Italy; Duch/Garcia/Parellado (2008) Public university system in Spain

⁴ Varga (1998), p.8

2 Knowledge and Technology Transfer

The most important commodities, a university can offer, are innovation and new knowledge that is mostly transferred to regional economy via different transfer channels and which enhances the regions productivity.⁵ KTT comprises any process, by which basic understanding, information, and innovations move from a university to firms in the private sector.⁶ The objects of knowledge can be implicit or explicit knowledge, artefacts, technological concepts and processes, know-how or capabilities.

Knowledge, and hence KTT, is a complex phenomenon. Summarized, KTT' occurs

- on differing levels,
- in differing forms and channels, and
- in differing intensity, effectiveness and efficiency.

KTT can be analysed on different levels: the micro level (within a research institution), the meso level (among several research institutions), and the macro level (outside the research institution).⁷ The study at hand focuses on the macro level.

KTT is not a coincidental event, but an explicit and planned process that takes place through communication and interaction of different nature.⁸ This process occurs by several transfer channels. Generally, these knowledge transfer channels can be differentiated into the direct and indirect forms (illustrated in Figure 1).

Indirect forms of KTT:

- Regarding indirect effects, KTT occurs using a transfer medium (e.g. journals, employment market).
- Transfer channels are publications, “Via People”, scientific networks, start-up support.
- Literature agrees that the most prominent indirect transfer channel is “Via people”.

Direct forms of KTT:

- Regarding direct effects, KTT occurs directly, not using any transfer media
- Transfer channels are spin-offs and start-up companies, licensing of intellectual properties, as well as cooperation in research and development between industry and academia
- Literature agrees that the most prominent direct transfer channel is cooperation in research and development between industry and academia

Finally, KTT occurs in differing intensity, effectiveness and efficiency. The objective of the research at hand is to investigate, which models of KTT among a university, the economy and public reaches high effectiveness and efficiency.

⁵ Hamm/Wenke 2001 p.92

⁶ Parker / Zilberman, p.89

⁷ Boettcher (2004), p. 6

⁸ Wilkesmann (2007), p.5

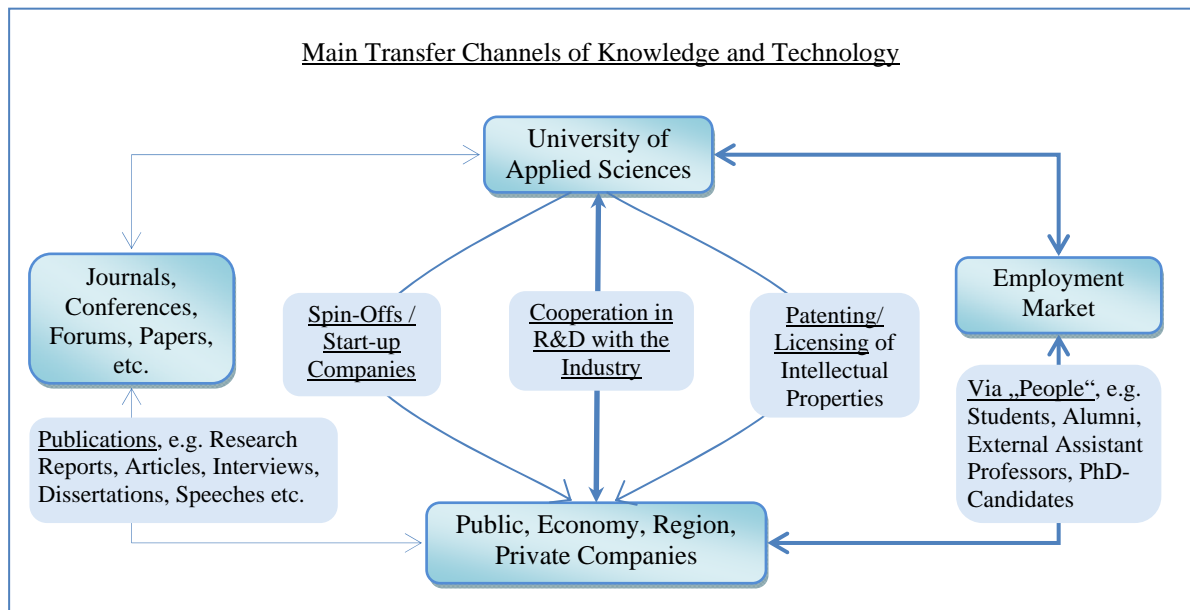


Figure 1: Main Transfer Channels of Knowledge and Technology (Adapted from Fritsch 2007, p. 12)

3 Research Design

The Research Design is composed of five successive stages, as illustrated in Figure 2. First, a thorough literature review created the scientific basis. A high number of studies and articles, both German and international, underlines that the topic “Knowledge and Technology Transfer” between universities and university regions is already well researched. To reach the objective to identify successful models of KTT, empirical research based on indicator analysis proves to be an easily applicable and appropriate method that has been applied in numerous studies. Nevertheless, KTT is a complex phenomenon. It is nearly impossible to evaluate and empirically compare all knowledge transferred from a university to its surrounding region and vice versa with that of another university. Knowledge transfer from each university is individual. Therefore, a combination of quantitative (indicator analysis) and qualitative research (expert interviews, online research, site inspection) is applied. Finishing the empirical analysis and best practice analysis, this article focuses on the best practice approach and the deduction of strategic recommendations.

Quantitative Approach - Empirical Analysis

The quantitative empirical research is based on an indicator analysis with the objective to identify universities organizing KTT successfully. The sample consists of all 104 public universities of applied sciences in Germany that do not have an education and research approach that is solely focused on one area, e.g. universities of arts and pedagogy.⁹ The universities are ranked considering eight indicators covering the most important transfer channels “Alumni” and “Cooperation with and Research for

⁹ In Germany, universities (a) and universities of applied sciences (b) are generally differentiated. Differences include the rather fundamental academic (a) vs. rather directly applicable research (b), governmental funding for research (higher for a than for b), human resources, the right to award PhDs (only a), etc.

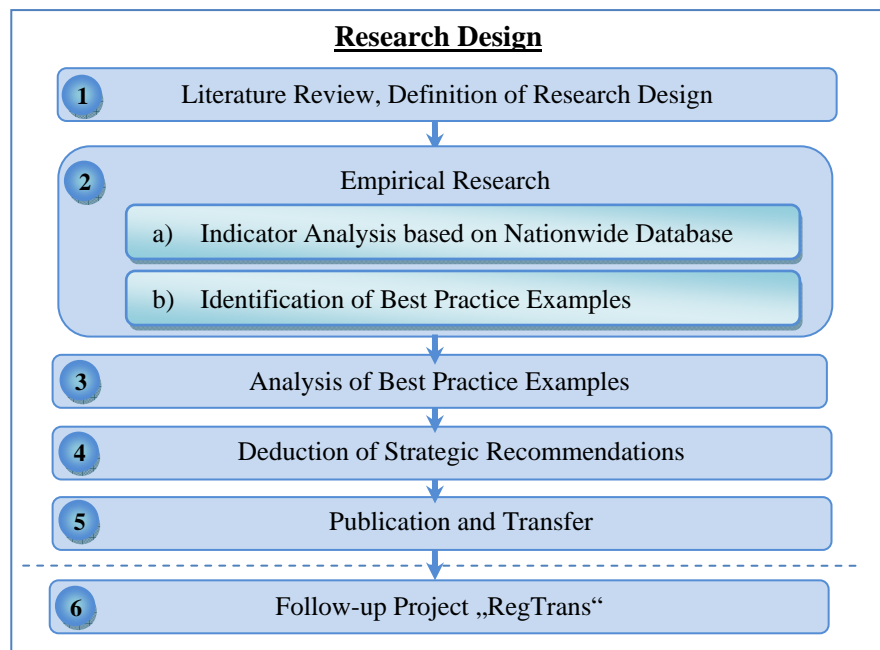


Figure 2: Research Design as Process (Own Figure)

Companies”. There are different rankings considering each year in the time span 2001-2008, additionally the arithmetic mean for all years was calculated for each indicator.

Instead of calculating an index or a cumulative ranking, it was decided that the selection of best practice examples bases on the two most appropriate indicators and further considerations. The basis indicators cover the transfer channel “Cooperation with and Research for Companies”, as it is difficult to compare universities according to their success in the transfer channel “Via Persons”. When comparing persons and their knowledge, quantitative aspects (e.g. number of bachelors, alumni) only consider half the picture – qualitative aspects are of very high importance. The two indicators chosen are supposed to mirror a) effects of efficiency, relating to relative indicators and b) effectiveness, relating to absolute indicators. The indicators “Third-party-funding from Commercial Industry per Professor” and “Overall Third-party-funding” are selected and further analyzed. Further considerations include the representative dispersion of universities concerning size, geographic allocation, economic and general background of the university region, and a broad allocation of education and research areas, thus excluding universities that focus primarily on areas where high third-party-funding is common. A final fact that naturally had to be taken into consideration is the openness and willingness of the university to cooperate.

Qualitative Approach - Best Practice Analysis

Based on this database, thorough online research and further considerations, seven best practice examples were selected:

- Bonn-Rhine-Sieg University of Applied Sciences (North Rhine-Westphalia, Germany)
- Bremen University of Applied Sciences (Bremen, Germany)
- Deggendorf University of Applied Sciences (Bavaria, Germany)

- Cologne University of Applied Sciences (North Rhine-Westphalia, Germany)
- Lausitz University of Applied Sciences (Brandenburg, Germany)
- Muenster University of Applied Sciences (North Rhine-Westphalia, Germany)
- Zittau/Goerlitz University of Applied Sciences (Saxony, Germany)

To analyze the selected best practice examples, online research, expert interviews, and site inspections are carried out. The online research focuses on the university internet presence of the university and secondary online information of trustworthy sources, e.g. the Federal Statistic Office. The site inspections offer an additional view of the university and its surrounding region.

The expert interview is generally a prominent data collection strategy in qualitative research and is highly recommendable for the study at hand, as it is “aimed at collecting ‘rich’ data on only a few individuals that highlight their personal opinions and views on a specific aspect or topic investigated by the researcher”.¹⁰ In this case, the analysis focused on the experts’ input on KTT, and more important on their special knowledge about the analyzed university and its surrounding region. The interviewees are either university vice presidents for research and/or KTT, or the universities’ official representatives for KTT. The seven interviews were semi-structured and based on a rough interview guideline. The dialogue was tape-recorded with the permission of all interviewees. The accomplished best practice analysis combines the consolidated findings of all three qualitative approaches.

4 Best Practice Examples

Figure 3 introduces the seven best practice examples at a glance, giving an overview of their geographical allocation, and presenting key figures. Moreover, they will be described more detailed.

Bonn-Rhine-Sieg University of Applied Sciences (North Rhine-Westphalia, Germany)

The Bonn-Rhine-Sieg UAS is a young (Foundation 1995), innovative, and modern university, focused on fast and continuous growth concerning student numbers, teaching and research facilities, applied research, and networking. The board of directors strongly supports and sponsors research and KTT within the framework of a clear strategy and defined organisational structures. The university’s research profile is very transparent; there are two intensively supported main research focuses, the corresponding organisational structure comprises two research institutes. Key success factors are network building, the sensible utilization of high external and public funding, strategic and continuous partnerships, e.g. leading to 12 endowed professorships. Cooperation in R&D with the commercial industry and spin-offs are important transfer channels, the licensing of intellectual properties and support of publications are rather neglected. The support of KTT is mostly organized in a strong

¹⁰ Finn et al. (2000), p. 32

The Best Practice Examples at a Glance

Datenbasis: 2008

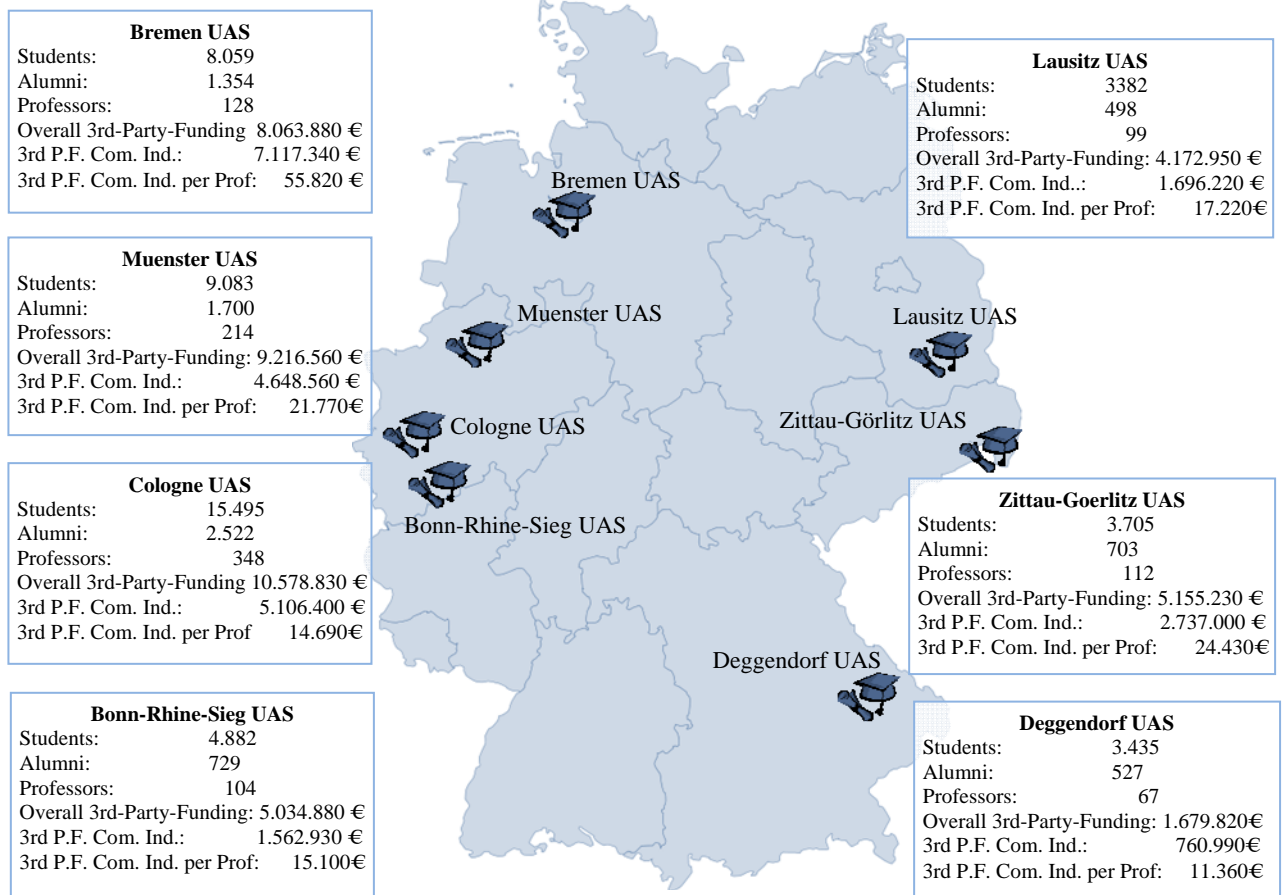


Figure 3: Best Practice Examples at a Glance (Own figure, based on public data basis of Federal Statistical Office 2010)

Legend:

Overall 3rd Party Funding: overall third-party-funding, the university receives

3rd P.F. Com. Ind: overall third-party-funding, the university receives from commercial industry

3rd P.F. Com. Ind. per Prof: third-party-funding, the university receives from commercial industry per professor

central knowledge transfer department and two business campuses (business incubators). The UAS profits from a stable regional economy, a well networked and surrounding region, the knowledge intensive regional economy, and high financial investments that were made in the context of the “Agreement on compensation measures for the Bonn region” between 1994 and 2004.¹¹

Bremen University of Applied Sciences (Bremen, Germany)

Bremen UAS is a very interesting case study, as two contradictory factors are combined: on the one hand, scarce financial resources to be invested in research and KTT, on the other hand extraordinary KTT success as indicated by the key figures “Third-Party-Funding from Commercial Industry” and

¹¹ In the context of the move of the German capital from Bonn to Berlin in the 1990’s, an amount of 1.4 billion € was invested into the region of Bonn as financial means of compensation and support. Mostly, the money was invested in the industry of science, technology and research – e.g. the Bonn-Rhine-Sieg UAS was build, investing high amounts in modern teaching and research facilities.

“Overall Third-Party-Funding”. On the downside, there is no central knowledge transfer department, relatively low financial investments in KTT and research, and no clear research profile as there are more than 50 research institutes and competence platforms. On the upside, there is strong support given by the board of directors, strategic partnerships and cooperation, and a high number of proposed PhDs. A key success factor is networking: the Bremen UAS is part of strong and continuous networks, strategic partnerships; cooperation and joint research collaborations with other universities and economy, both regional and national. The university’s financial funding of research and KTT focuses on “future light houses”¹² and thereby facilitates financial support only for PhDs and small kick-off-projects that are supposed to encourage further externally funded research projects. Hence, strategy focuses on promoting research potential. Support of other transfer channels is organized on the basis of voluntary work, peripheral activities (in departments/faculties), and cooperation. Due to the regional networking with other research and university facilities, a patent centre and strong start-up and spin-off support is cooperatively organized and applied.

Deggendorf University of Applied Sciences (Bavaria, Germany)

In 1994, Bavaria opened seven new universities of applied sciences, one of them in the city of Deggendorf. The area has a stable economy, but is rather rural and low-populated; there are no nearby research and university institutions that offer potential for competition (as an advantage) or synergies and cooperation in KTT and research (as a disadvantage). The Deggendorf UAS grew fast in terms of student numbers, research facilities and achievements and quickly gained high regional perceptiveness. The board of directors strongly supports cooperation in R&D with the regional economy - therefore, the most successful university research groups are supported with a subject-specific technology campus, which comprises a high technology research centre and a business incubator to support networking and spin-offs. Five technology centres were built from 2009 onwards in collaboration with and on the basis on strong financial support (around 10 million € per centre) of the regional industry, the local authority districts, and public funding. The technology centres already caused noticeable direct employment effects. Summarized, the university’s KTT key success factors are networking, joint research and a clear, successful research profile in high technology areas.

Cologne University of Applied Sciences (North Rhine-Westphalia, Germany)

The Cologne UAS is the biggest university of applied sciences in Germany and traditionally a very renowned and successful research institution. The range of research topics is consequently rather broad, the university reached the highest amounts of overall third-party-funding of all universities of applied sciences in Germany, the relative figure (third-party-funding per professor) though reveals further research potential, as it was only the 16th highest amount in 2008. The university focuses on national and international, both contract research and public-grant-funded research. The board of

¹² Quote from the expert interview with Prof. Dr. U. Apel, Bremen UAS

directors developed a solid strategic framework, underlining in their mission statement the equivalent importance of research and education as university tasks. Key success factors are networking, a high number of PhDs, and strong support of KTT. The surrounding region, the city of Cologne, hosts as many as 14 universities and further research institutions (high competition, but also potential for cooperation). Consequently, a number of transfer channels are supported in joint collaborations: lectures and seminars, support of spin-offs and start-ups, licensing and patenting, and support for applications for EU-funded research. Also, Cologne hosts a vivid economy and employment market that focuses on services and knowledge intensive economy, which results in a very capable absorption capacity for alumni, contract research, and research cooperation.

Lausitz University of Applied Sciences (Brandenburg, Germany)

Lausitz University of Applied Sciences was founded after the Fall of the Wall in 1991 in a rather rural area with low population density, a comparatively weak economy and high unemployment rate. There are neither other universities nor research institutions to be found in a range of 100 km. The region benefits from the university in several ways and hence, the regional awareness of the university is high in public and economy. In the last years, Lausitz UAS reached strongly growing student numbers, third-party-funding, and research success. The main transfer channels are cooperation in R&D with the industry and generally joint research collaborations. The university receives intensive public financial support (both by the state of Brandenburg and the surrounding regional communities) to encourage the region's economy via KTT. Benefits are modern research and education facilities, a central knowledge transfer department and an innovation centre that is currently under construction to support spin-offs and networking of innovative industries. Further key success factors are strategic partnerships and networks (with other universities, industry, and KTT facilities), independent research facilities, a high number of PhDs and strong support by the board of directors.

Muenster University of Applied Sciences (North Rhine-Westphalia, Germany)

Muenster UAS is, comparable to Cologne UAS, a traditionally successful and renowned research oriented university with an economically strong surrounding region with mostly small and medium enterprises (SME). Hence, the most successful transfer channel is contract research and cooperation in R&D with the industry. To encourage further research success, support KTT, and enable the SME to cooperate with the university in R&D, there are two well staffed central knowledge transfer entities. One is an internal department focusing on all activities beginning with the signing of the research contract; one is an external private limited agency that focuses on earlier activities in the process of KTT. There are support activities covering all kind of transfer channels: start-up support (organized using cooperation potential), licensing of intellectual property, alumni-club activities (carried out peripherally in the faculties), a central graduate institute to support PhDs, support for writing

applications for publicly-funded research, etc.. The board of directors focuses the strategy on a relatively clear research profile (three defined research focuses) with corresponding research structure (small number of institutes) and intensive internal financial research funding. The strategy implementation bases on the ‘Academic Scorecard’, an adaption of the Balanced Scorecard, comprising vision, mission, operative and strategic objectives, plans and measures, and a comprehensive controlling and quality management system. Furthermore, Muenster UAS is a successful networker, participating in regional and national networks, benefitting from a number of strategic and continuous partnerships with companies, other KTT institutions and universities. Research and KTT are organized as a clear strategic process with vision, mission, operative and strategic objectives and measures.

Zittau/Goerlitz University of Applied Sciences (Saxony, Germany)

The Zittau/Goerlitz UAS is – although it is situated in an economically weak area with high unemployment rates – one of the most renowned and strongest universities of applied sciences in Germany concerning research and KTT. The success in research and transfer faces a long tradition, as Zittau/Goerlitz UAS used to be a research intensive university before the Wall fell in 1990; after the Fall of the Wall, it was ‘degraded’ to a university of applied sciences. The long research tradition and orientation is continuously fostered by the board of directors and has lead to a good reputation in terms of KTT and research, strong networks and continuous, strategic partnerships with industry and other universities. The board supports a bottom-up-approach in research funding, supporting the institutes as self-dependent research units and the professors’ initiatives. Hence, more than half of the professors continuously research are in topic-specific networks and collaborations, and renowned in contract research. The success in contract research is a necessary means to additionally finance research, as the university can invest only a comparatively small budget in research and KTT. The university comprises a small central KTT department; additional transfer assistance is financed by public-grant-funds and organized in programmes, as e.g. a mentoring-network and start-up support. Once the governmental funding of these programmes finishes, the offer cannot be continued by the university.

5 Analysis and Strategic Recommendations

The analyzed universities differ in terms of size, topic areas of research and education, funding of research and KTT, geographical allocation, and time of foundation. The analysis of the surrounding regions produced a heterogeneous picture, encompassing economically rather weak regions with high unemployment, like Zittau/Goerlitz, as well as economically strong regions that focus on knowledge and research intensive industries, like Cologne and Bonn. It has to be taken into account that a certain diversity of geographical allocation and university size is implied by the preselection procedure.

Notwithstanding the differences, interesting similarities could be identified when comparing the different institutions. First of all, and most important, each analyzed university has special characteristics, a distinctive profile and focus in knowledge and technology transfer and in research in general. These facts are important, as they help establishing the university's brand. With the long-range expectancy of declining student numbers due to demographic changes, the growing competition of freshly founded universities, it becomes more and more important for universities to elaborate a brand. The analyzed university managements focus on different, but clear strategies with transparently communicated visions and objectives, to support and further increase reputation, research success and key figures. With increasingly performance-related allocation of public funds, limited resources that cause the necessity of additional financial sources for research, achievements in externally funded sciences, contract research and KTT are often the focus of these strategies.

Focusing on a more detailed analysis, Table 1 gives an overview over the university institutions and the analyzed aspects using a simple traffic light system. The following analysis comprises three parts:

- I. Strategic and Structural Aspects,
- II. Activities in Transfer Channels, and
- III. III. Networking and External Factors.

Strategic recommendations are deducted and highlighted; also they are summarized in the appendix.

5.1 Strategic and Structural Aspects

Strategic aspects

Support by university board of directors

The support and orientation on research and KTT are of high significance in all considered universities. The university managements of all universities supported and promoted research and knowledge transfer to a high extent. The boards' support and orientation on research and KTT was not only verbally expressed by the interview partners, but was also transparently communicated in the universities online presences and mission statements. Furthermore, the university management commitment to research and KTT was also transparently represented inside the university due to a corresponding strategy (e.g. academic scorecard focus on research), the allocation of the given financial resources and internal communication.

Research and KTT in the frame of a strategic process

All analyzed UAS have a mission statement and clear strategic approach, or a defined development plan that encompasses objectives and values. Research supporting regulations, organisational structures and a general framework are clearly defined. Controlling is accomplished by central units, research success and achievements and mostly communicated frankly in an indicator report.

	Bonn- Rhein- Sieg UAS	Bre- men UAS	Deggen- dorf UAS	Cologne UAS	Lausitz UAS	Muens- ter UAS	Zittau- Goerli- tz UAS
Facts and Figures							
Foundation	1995	1982	1994	1971	1991	1970	1992
Number of students (2008)	4.882	8.059	3.435	15.495	3.382	9.083	3.705
Number of alumni (2008)	729	1.354	527	2.522	498	1.700	703
Number of professors (2008)	104	128	67	348	99	214	112
I. Strategic and Structural Aspects							
Support board of directors							
KTT as strategic process							
Size of central KTT department / office							
University funding of research and KTT – strategy							
II. Activities in Transfer Channels							
Spin-offs/start-up support							
Patenting/licensing							
Public research funding							
Support of publications							
Cooperation with the commercial industry in R&D							
Endowed professorships 2011							
Strategic, continuous partnerships							
Cooperative PhDs in 2011	Ca. 20	Ca. 30	Ca. 10	Ca. 70	Ca. 25	Ca. 70	Ca. 60
University support of cooperative PhDs						Initiated	
Non-trad. study programs							
Practical orientation of education							
Support of career start							
Activities in alumni-networks							
Science, innovation & technology parks and incubators					Planned		
III. Networking and External Factors							
Networking in the region							
Topic-specific networking							
Networking KTT							
Networking in education and study programs							
Influence UAS on region <i>rather negative – rather positive</i>							
Influence region on UAS <i>rather negative – rather positive</i>							

Table 1: Comparison at a Glance (analysis based on interviews and online research)

Nevertheless, the more detailed analysis reveals more differences. For example, the Muenster UAS follows a planned, rather top-down strategic approach based on the Academic Scorecard. Contrasting, Deggendorf and Zittau/Goerlitz UAS underline their bottom-up approach, pointing out that researchers rely on freedom and support to be motivated and successful. It is emphasized that an overregulation can be disadvantageous when leading to bureaucracy, officialdom, or limited freedom of the individual researchers. Concerning the focus, detailed embodiment, and implementation of the strategy, there is consequently no clear recommendation to be deducted from the analysis.

Focus on knowledge and technology transfer

All analyzed universities focus on research and knowledge and technology transfer to a high extent; many claim their strategic orientation on applied research to be as important as their orientation on education. Nearly all interview partners especially point out that their university's main transfer channel is cooperation in R&D with the industry. This focus is important, as universities of applied sciences in Germany do not have the public financial support to achieve outstanding accomplishments in all possible transfer channels and research areas. Contract research is sometimes focused out of sheer necessity to accomplish additional research budget.

Internal research funding

Internal research funding is used as a strategic instrument to highlight the significance of research and KTT in the university and to implement the defined strategy. Universities can use internal research funding either selectively to support research core areas (forming research 'lighthouses') or support research in general, spreading the money based on indiscriminate distribution. All analyzed universities apply a selective research funding approach and focus their support on research core areas, most successful researchers and also self-dependent research units as research institutes or technology centres. As the university mostly invests internal research funding to reach a certain objective, it is sensible to combine the funding with target and performance agreements. Among the considered universities, these agreements are used with institutes, on occasion even with individual professors.

An interesting possibility, especially for universities suffering from a small budget, is the support of future research potential instead of only rewarding current success. Measures are pointed out by interview partners as promoting PhD candidates or programmes and kick-off research projects that focus on realizing further, bigger, and externally financed research projects.

Motivational incentives for researchers

The more professors are actively involved in research projects, the more overall third-party-funding is achieved. The same holds true for third-party-funding due to cooperation in R&D with the industry.¹³ Therefore, it seems rational to motivate a perceptibly high share of all professors to do research, to

¹³ For empirical evidence and the full research report, contact Niederrhein Institute for Regional and Structural Research at Niederrhein University of Applied Sciences

network, to use their private contacts for joint research collaborations – which is a strong basis for research achievements. This can be accomplished by installing motivational incentives for researchers. The analyzed universities use financial and time-related incentives, offer the professor supporting personnel, and a relatively high freedom and latitude about how to invest bonuses, as long as it is directed at research-supporting activities or amenities. Furthermore, all considered universities point out, they preferably assign new professors, who already have research experience and who are in topic-specific networks. The problem pointed out in Germany is the difficulty for the board of directors to influence appellate proceedings of professors. Another approach and probably an easier procedure to increase the probability of a new professor becoming involved in research, is to invite him/her (after the professor's appointment) and give detailed information on public-grant funded research programs, motivational incentives and the university's support possibilities. This is performed by five of the seven analyzed universities.

Deductions and recommendations considering strategic aspects:

- ➔ A key success factor is the support and promotion of research and KTT by the board of directors.
- ➔ The board of directors should not only be committed to on research and KTT. Additionally, this orientation should be communicated internally (strategy, allocation of financial resources, internal communication, etc.) and externally (mission statement, marketing measures, etc.).
- ➔ For successful research and KTT, a decisive strategic process is beneficial. This process should comprise a vision, the universities values, a strategic objective, a determined organisational structure and supporting regulations and framework.
- ➔ Internal research funding should be used selectively to support research core areas. This way, a university research profile can be generated.
- ➔ Internal research funding should additionally focus on support of future research potential, e.g. by promoting PhD support and kick-off research projects
- ➔ High internal research funding should be combined with target and performance agreements to ensure a sensible application
- ➔ Successful research and knowledge and technology transfer is an important focus for universities of applied sciences. To reach it, the transfer channel "Cooperation in R&D with the Industry" and more generally, joint research collaborations should be focused.
- ➔ Internal research funding should also comprise motivational incentives that are directed at professors who are actively involved in research
- ➔ Incentives can encompass financial and time-related incentives; offer the professor supporting personnel, and a relatively high freedom and latitude about how to invest their bonuses, as long as it is directed at research-supporting activities or amenities.
- ➔ The central transfer department should give detailed information on public-grant funded research, the university's motivational incentives, and support facilities to new professors.

Structural aspects

All analyzed universities have defined research core areas or currently plan a further research profiling by defining research core areas. This way, the research profile of the university is sharpened. Corresponding to research core areas, mostly peripherally organized, self-contained organisational

Case Study Analysis: Composition and Organisational Structure of Research and KTT			
	Research	KTT	Objectives and Plans
Bonn-Rhein-Sieg UAS	<ul style="list-style-type: none"> - 2 research core areas - 3 research institute - 2 competence platforms - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - Central department of KTT - 2 business incubator Centres - Institute & endowed professorship for entrepreneurship - 4 employees supporting KTT peripherally in the departments 	<ul style="list-style-type: none"> - Further definition and building of the research profile - Further support and promotion of research core areas
Bremen UAS	<ul style="list-style-type: none"> - More than 50 research institutes and competence centres (of varying activity) - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - No central department of KTT - Support of KTT in collaboration: patent& norm centre, licensing agency, business incubator centre and -network - Peripherally organized consulting support to apply for publicly funded research 	<ul style="list-style-type: none"> - Further research profiling via clustering and merging of research institutes - Increasing centralization of individual KTT offers - Development & implementation of central point of contact for cooperation inquiries
Deggendorf UAS	<ul style="list-style-type: none"> - Institute for applied research - 5 technology centres - Research groups - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - Central department of KTT and career service - Business incubator centre - Endowed institute for entrepreneurship & start-Ups 	<ul style="list-style-type: none"> - Implementation of further technology centres and business incubators
Cologne UAS	<ul style="list-style-type: none"> - 8 research clusters, structured in competence platforms, research areas&groups, 2affiliated institutes - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - Central department of KTT - Support of KTT in collaboration: start-up support, patenting, consulting service to apply for EU-funded research 	<ul style="list-style-type: none"> - Development of a universitywide graduate colloquium - Further development of research profile
Lausitz UAS	<ul style="list-style-type: none"> - 10 research institutes - Topic-specific research groups - Group of Young Scientists (publicly funded-program) - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - Central department of KTT - Support of KTT in collaboration: start-up support - Innovation centre in planning 	<ul style="list-style-type: none"> - Development of research profile by generating research core areas - Building an innovation centre
Muenster UAS	<ul style="list-style-type: none"> - 3 funded research core areas - 5 research institutes, 4 affiliated institutes - 5 competence centres - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - <i>Transferagentur FH Münster GmbH</i> (ltd. KTT agency) - Central department of KTT - Graduate colloquium - Support of KTT in collaboration: start-up support, <i>Gründungs- und Innovationspark Steinfurt</i> (cooperative incubus centre) 	<ul style="list-style-type: none"> - Further development of the universitywide graduate colloquium - Further research profiling by support and promotion of research core areas
Zittau-Goerlitz UAS	<ul style="list-style-type: none"> - 9 research profile lines, 2 traditional research core areas - 7 research institutes - Topic specific research in peripheral departments, faculties 	<ul style="list-style-type: none"> - Central department of KTT - Start-up support program - Seminars for PhD candidates - Support of KTT in collaboration: support of patenting 	<ul style="list-style-type: none"> - Further staffing of central department of KTT - Further support for PhD candidates

Table 2: Case Study Analysis: Composition and Organisational Structure of Research and KTT

Corresponding to research core areas, mostly peripherally organized, self-contained organisational units (e.g. institutes), research groups and the departments or faculties carry out the research. To support KTT, centrally or peripherally incorporated departments are installed. The universities have central KTT departments, except Bremen UAS who plans on developing more central offers. They are supported by a range of collaborations of different universities that carry out transfer activities. To give a comprehensive and detailed overview, Table 2 presents the organisational structure of research and KTT in the analyzed universities.

Activities of KTT: centrally, peripherally or in collaboration?

Often, activities of KTT are conducted in the faculties (peripheral). Nevertheless, the regarded UAS with the exception of Bremen UAS have a central incorporated department to support KTT. The staffing, models of financing and degree of incorporation differ. Also, a wide spectrum of different activities is carried out centrally, peripherally, or in cooperation, as Table 3 underlines.

It is apparent that each of the regarded approaches to KTT is individual. Important factors for ascertaining and organizing the activities are the

- the philosophy and strategy of the UAS (e.g.: bottom-up vs. top-down)
- the financial abilities of the UAS to support KTT
- the size of the UAS (certain tasks, as legal support, only become efficient for bigger universities)
- the demand of the main partners and the region (e.g. Muenster UAS has to offer a wide range of KTT-services to enable the mostly SME-sized regional industry to cooperate with a university)
- the university's background and tradition
- the number of surrounding universities and research institutions (potential cooperation potential)

Centrally organized activities of KTT should be provided, when expert knowledge outside the research scope of the involved professors is needed and for procedures with a high degree of bureaucracy and formalities. Examples are information on regulations and programs of publicly funded research, legal questions, patenting regulations, and public start-up support. Peripheral activities of KTT (in departments/faculties) are marked by a high degree of topic-specification and profession-relation, as in the support of PhD candidates, topic-specific networking activities, and research marketing. Another reason for peripheral activities is the more personal nature of contact, which is important e.g. for alumni networking and the initiation of new joint research collaboration. Professors should be encouraged to further engage in networking and topic-related contacts of personal nature, which interviewees underline to be of high importance for initiating research collaborations. Also considering these aspects, it can be beneficial to coordinate and complete peripheral activities on a centrally level. In research marketing, this is especially important, as a definite research profile can only be achieved with a consistent, centrally planned and corporate approach. Also, a central KTT department can act as first point of contact for inquiries of cooperation – the higher regional awareness of the university and its research facilities, the more inquiries are directed to a central unit.








Activities to support Knowledge and Technology Transfer –							
<u>Centrally</u> organized in knowledge transfer department / <u>Peripherally</u> organized in university departments / Organized <u>in cooperation</u> with other Universities or Institutes							
	Bonn-Rhein-Sieg UAS	Bremen UAS	Deggendorf UAS	Cologne UAS	Lausitz UAS	Muenster UAS	Zittau-Goerlitz UAS
Size of central KTT department / office							
Support and coaching of spin-offs / start-ups	Central	Cooperation	Cooperation	Cooperation	Cooperation, Central	Cooperation, Central	Cooperation, Central
Patenting / licensing: support, consulting service	Central	Cooperation	–	Central	–	Central	Cooperation
Information on public-grant funded research programs	Central, Peripheral	–	–	Central	Centrally	Central, Peripheral	Central
Informing new professors on support possibilities	Central	–	–	Central	Central	Central	Central
Legal support and consultancy (e.g. contracts)	Central	–	–	Central	Central	Central	Central
Consulting service to apply for publicly funded research	Peripheral	Peripheral	–	Central	Central	Central	Central
Support of cooperative PhDs	Central, Peripheral	Peripheral	Peripheral	Peripheral	Dezentral	Central, Peripheral	Central, Peripheral
Support in project-management, -controlling	Peripheral	Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral
Organization and marketing of KTT-related events	Peripheral	–	Central	Central	Central	Central	Central
First point of contact for inquiries of cooperation	Central, Peripheral	Central: Planned Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral
Acquisition of potential cooperation partners	Peripheral	Peripheral	Central, Peripheral	Peripheral	Central, Peripheral	Central, Peripheral	Peripheral
Fundraising, mentoring endowments	–	–	–	–	–	Central	–
Networking	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral
Research marketing	Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral	Central, Peripheral
Activities in alumni-networks	Central	Peripheral	Central	Central, Peripheral	Peripheral	Peripheral	Peripheral

Table 3: Activities to support KTT (Own figure based on interviews)

Collaboration with other institutions to support KTT is often very efficient and cost-cutting. For cooperating activities, the analyzed universities only focus on support of start-ups and spin-offs, and the transfer channel of patenting and licensing.

Deductions and recommendations considering structural aspects:

- ➔ It is of high importance to focus on a small number of research core areas with the objective to define a clear research profile.
- ➔ Research should be conducted mostly in self-contained, topic-specific organisational units.
- ➔ Every approach of KTT is individual. Nevertheless, there is always a combination of activities that are organized centrally, peripherally, and in collaboration with other institutions:

- Centrally organized activities of KTT should be provided, when a high degree of expert knowledge outside the research scope of the involved professors is needed and for procedures with a high degree of bureaucracy and formalities.
- Peripheral activities of KTT are marked by a high degree of topic-specification and profession-relation. Often, peripheral activities benefit from coordinating and completing central support.
- If possible, it is advisable to organize certain activities of KTT in collaboration with other universities or research institutions. The transfer channels support of start-ups and spin-offs, and patenting and licensing seem to be suitable for cooperation.

5.2 Activities in Transfer Channels

Cooperation in R&D with the industry is the most focused transfer channel in nearly all analyzed universities. Cooperating companies tend to be located nearby the university, with the exception of Zittau/Goerlitz UAS, which claims economical problems of the regional industry and therefore has to address companies located further away. Topic-specific networking and personal contacts of the professors are underlined as important factors. The form of cooperation in R&D with the industry ranges from short research projects to continuous, strategic partnerships with commercial partners. All interviewees underline the importance of strategic partnerships, as they lead to intensive collaborations as e.g. endowed professorships and innovation and technology centres, and business incubators. Most of the analyzed universities have cooperatively built and now successfully operate in these centres to support spin-offs, start-ups, joint research collaborations and topic-specific networking and research. Additionally, **publicly funded research programs** are successfully addressed by all universities regarded; the interviewees underline that these programs often base on research collaborations as well.

Knowledge and Technology Transfer „via People” encompasses a variety of forms: students working in companies, alumni, cooperative PhD procedures, etc. In the regarded universities, studies mostly have a very practical orientation. A high number of non-traditional study programs (Table 4) further encourage studies in close relation to the industry, which eases practical conversion of academic theory. Also, the collaborations with other universities and the industry are encouraged. Alumni network activities are operated in all analyzed universities, but mostly it is emphasized that in alumni networking, ‘success’ is hard to measure. Nevertheless, the interviewees agree that alumni tend to have a lifelong affinity to their university that can have a positive backwards influence, particularly if the alumni remain in the surrounding region. Cooperative PhDs are an important success factor and underlined indicator for research achievements, research continuance, and knowledge transfer for all regarded best practice universities. Hence, PhD programs and institutes supporting PhD candidates are supported intensively, either financially or with central graduate colloquium or seminars.

Non-Traditional Study Programs							
	Bonn-Rhein-Sieg UAS	Bremen UAS	Deggendorf UAS	Cologne UAS	Lausitz UAS	Muenster UAS	Zittau-Goerlitz UAS
Extra-occupational study programs	●	●	●	●	●	●	●
Extension studies, advanced trainings	●	●	●	●	●	●	●
Cooperative program of apprenticeship and study	●	●	●	●	●	●	●
E-Learning	●	●	●	●	●	●	●
English study programs	●	●	●	●	●	●	●
Further foreign language study programs	●	●	●	●	●	●	●
Bi-/ trinational study prog.	●	●	●	●	●	●	●
Research master study prog.	●	●	●	●	●	●	●
Study courses organized in cooperation with other UAS	●	●	●	●	●	●	●
Seminars/programs for kids	●	●	●	●	●	●	●
Seminars/programs for elderly	●	●	●	●	●	●	●

Table 4: Non-Traditional Study Programmes

Other transfer channels supported are spin-offs and start-ups, patenting and licensing of intellectual property, topic-specific networking of professors, and topic-specific forums, seminars, and dissertations. Publications are mostly expected to be written with regard to the professors' self interest. Interestingly, support of spin-offs and start-ups is given by all regarded universities, although it is underlined that this is not a profitable channel, and not a generic university task. Consequently, support of spin-offs and start-ups is mostly organized in cooperation or financed by public funds.

Deductions and recommendations considering activities in transfer channels:

- ➔ For successful KTT, the transfer channel cooperation in R&D with the industry should be focused intensively. Successful are intensive forms like continuous strategic partnerships, innovation centres, technology campuses, business incubators, and publicly funded research programs.
- ➔ Concerning KTT "via people", special focus should be put on non-traditional study programs (Table 4), and the support of cooperative PhDs.
- ➔ Concerning other transfer channels, further support should be given to spin-offs and start-ups (if possible, using cooperation potential), topic-specific networking of professors, forums, seminars, dissertations, and participations on conferences.

5.3 External Factors and Networking

External factors often have strong influence and offer a high potential that needs to be realized, but can hardly be influenced. Universities are generally subject to a generic framework of influencing con-

ditions, which comprise national (e.g. federal research funding) and international factors (e.g. economic crisis). More important and individual for each UAS are a number of **regional influence factors**:

- Infrastructure, accessibility of the region
- Attractiveness as a location for secondary education and research: Often, modern and urban university locations are preferred by students and researchers.
- Economical wellbeing and stability of the region: one interviewee underlined a simple fact: “Knowledge transfer is hindered, if there are no knowledge transfer partners”. Industry tends to invest more in R&D, if the economical situation is stable. As cooperation in R&D with the industry mostly focuses on regional partners, the region’s economical wellbeing is of crucial importance.
- Economic environment, e.g. Muenster UAS has to offer a high degree of services in KTT to enable the regional, mostly SME-sized industry partner to engage in cooperation.
- Industry focus on knowledge intensive industries: this focus can lead to cluster effects, cooperation potential, easily available personnel, knowledge intensive services, and image effects.
- Affinity of regional economic core areas and university’s educational / research focus: the higher the affinity, the higher are the possibility of cooperative research and alumni’s career opportunities.
- Regional demographic situation: UAS mostly have a regional catchment area for freshman students (in the regarded universities, up to 80% of freshman students originate from the region). Especially universities in rather rural areas increasingly have problems reaching their planned number of first semester students due to demographic developments in their surrounding region.
- Community support and financial funding by regional entities e.g. local district authorities, communes, cities, politics, large companies, etc..
- Networking in the region: It is easier to join already existing stable, topic-specific networks, than initiating and developing them.
- Existence of intermediating entities between academic research and real-life application.
- Other universities or research institutes nearby:
 - o Disadvantages: There is a high chance for competition for the best students, regional funding, and contract research for regional companies. Furthermore, the public awareness of an individual university might decrease, when there are several universities in a city.
 - o Advantages: the institutes can involve in joint research and education collaborations. Moreover, the institutes can cooperate and influence the image of the region towards a ‘scientific or university region’, from which a number of advantages can be derived.
- Other influences, e.g. the ‘Agreement on compensation measures for the Bonn region’ had a very positive influence on Bonn-Rhein-Sieg UAS.

It is important for universities that their officials and KTT representatives know and continuously reassess the regional conditions, to be able to react in an appropriate way and develop strategic responses considering an adaption in the areas of science, research or KTT.

Networking

Networks, networks, networks: in the analyzed universities, networks seem to be everywhere. In every interview, and all over academic literature, networking is underlined as the key success factor. More specifically, the networks, the regarded universities engage in intensively, can be differentiated in:

- a) Regional Networks: The regarded universities are regionally networked and involved in regional activities. Important are networks to regional politics, industry representatives, chambers of commerce and industry, etc..
- b) Topic-specific network activities: here, mostly professors with high topic-specific knowledge engage in network activities. Those activities are an important basis for topic-specific personal contacts, and often the starting point for the initiation of joint research projects. Important topic-specific networks are networks of the regional industry, supraregional topic-specific networks, and other research institutes on topic-specific research areas.
- c) Networking in KTT:
 - Many universities engage in collaborations to offer support programs for KTT. Preferred transfer channels for cooperative KTT-related activities are support of spin-offs, start-ups, patenting and licensing. Often, public funding can be applied for further financing.
 - There are (mostly state-wide) networks of the official representatives for KTT and/ or research that some of the regarded universities engage in. Moreover, the networks UAS7 (Universities of Applied Sciences) and EUA (European University Association) are repeatedly mentioned in the interviews as important networks for KTT.
- d) Networking in education and study programs: All researched universities engage in networks to provide further study program potential. The network partners are either industry partners (e.g. in co-operative program of apprenticeship and study) or other universities (e.g. cooperatively organized study courses). Apart from further study possibilities for students, the evolving networks are often supported by public funds, and also encourage topic-specific partnerships that can lead to practice-oriented education and even research projects.

Deductions and recommendations considering external factors and networking:

- ➔ Universities should know and continuously reassess the external factors that are of influence, to be able to react in an appropriate way and adapt considering research, education and KTT aspects. A special focus should be put on regional conditions and effects.
- ➔ Universities of applied sciences should focus intensively on network activities. Four kinds of networks are important to focus on: regional networks, topic-specific networks, networking in KTT, and networking in education and study programs.

6 Conclusion

The article at hand describes the results of a comprehensive research project that analyzes knowledge and technology transfer (KTT) from German universities of applied sciences, based on a combination of empirical research and best practice analysis. The article focuses on final results. The seven regarded best-practice universities prove that success in research and KTT in terms of key figures, reputation and research achievements is not reserved to well-equipped and well-financed universities only, but can also be reached by universities of applied sciences.

The analysis of the seven universities of applied sciences offers interesting findings. Most importantly, each regarded UAS has memorable characteristics, a decisive strategic outline and a clear research profile and focus. The profile and focus is of high importance as it helps to develop and maintain a strong and clear university brand. A focus in research and KTT is also important, as universities of applied sciences do not have the public financial support to achieve outstanding accomplishments in all possible transfer channels and research areas. In the context of the analysis, further results were deducted concerning structural and strategic aspects of organization and incorporation of KTT, and the activities in the different transfer channels.

Nevertheless, also external factors play an important role in the universities success in research and KTT. Even though it is possible to deduct strategic recommendations from the study at hand, governmental and other studies, there is no silver bullet or royal road to successful, effective and efficient knowledge and technology transfer. The system and organization of KTT has to be adapted to the given circumstances, to internal and external influences, to the universities' tradition and history on the one side and strategic objective on the other side.

List of References

- Finn, M., Elliott-White, M., Walton, M. (2000). *Research Methods – Data collection, analysis and interpretation*. Harlow, England: Pearson Education.
- Fritsch, M.; Henning, T.; Slavtchev, V.; Steigenberger, N. (2007). *Hochschulen, Innovation, Region – Wissenstransfer im räumlichen Kontext*. Hans-Böckler-Stiftung (Hrsg.), Düsseldorf.
- Hamm, R.; Wenke, M. (2001). *Regionalwirtschaftliche Effekte der Fachhochschule Niederrhein*. In: *Schriften und Materialien zur Regionalforschung*, Heft 10. Rheinisch-Westfälisches Institut für Wirtschaftsförderung, Essen.
- Parker, D. P., Zilberman, D. (1993). *University Technology Transfers: Impacts on Local and U.S. Economies*. *Contemporary Policy Issues*, Vol. XI, p. 87-99.
- Statistisches Bundesamt (2003 - 2010). *Bildung und Kultur – Monetäre hochschulstatistische Kennzahlen 2001 - 2008*. Fachserie 11, Reihe 4.3. Statistisches Bundesamt, Wiesbaden.
- Varga, A. (1998). *University Research & Regional innovation – A spatial Econometric Analysis of Academic Technology Transfer*. Massachusetts, USA: Kluwer Academic Publishers.

Appendix:

Summary of Deductions and Recommendations

Deductions and recommendations considering strategic aspects:

- A key success factor is the support and promotion of research and KTT by the board of directors.
- The board of directors should not only be committed to on research and KTT. Additionally, this orientation should be communicated internally (strategy, allocation of financial resources, internal communication, etc.) and externally (mission statement, marketing measures, etc.).
- For successful research and KTT, a decisive strategic process is beneficial. This process should comprise a vision, the universities values, a strategic objective, a determined organisational structure and supporting regulations and framework.
- Internal research funding should be used selectively to support research core areas. This way, a university research profile can be generated.
- Internal research funding should additionally focus on support of future research potential, e.g. by promoting PhD support and kick-off research projects
- High internal research funding should be combined with target and performance agreements to ensure a sensible application
- Successful research and knowledge and technology transfer is an important focus for universities of applied sciences. To reach it, the transfer channel “Cooperation in R&D with the Industry” and more generally, joint research collaborations should be focused.
- Internal research funding should also comprise motivational incentives that are directed at professors who are actively involved in research
- Incentives can encompass financial and time-related incentives; offer the professor supporting personnel, and a relatively high freedom and latitude about how to invest their bonuses, as long as it is directed at research-supporting activities or amenities.
- The central transfer department should give detailed information on public-grant funded research, the university’s motivational incentives, and support facilities to new professors

Deductions and recommendations considering structural aspects:

- It is of high importance to focus on a small number of research core areas with the objective to define a clear research profile.
- Research should be conducted mostly in self-contained, topic-specific organisational units.
- Every approach of KTT is individual. Nevertheless, there is always a combination of activities that are organized centrally, peripherally, and in collaboration with other institutions:

- Centrally organized activities of KTT should be provided, when a high degree of expert knowledge outside the research scope of the involved professors is needed and for procedures with a high degree of bureaucracy and formalities.
- Peripheral activities of KTT are marked by a high degree of topic-specification and profession-relation. Often, peripheral activities benefit from coordinating and completing central support.
- If possible, it is advisable to organize certain activities of KTT in collaboration with other universities or research institutions. The transfer channels support of start-ups and spin-offs, and patenting and licensing seem to be suitable for cooperation.

Deductions and recommendations considering activities in transfer channels:

- ➔ For successful KTT, the transfer channel cooperation in R&D with the industry should be focused intensively. Successful are intensive forms like continuous strategic partnerships, innovation centres, technology campuses, business incubators, and publicly funded research programs.
- ➔ Concerning KTT “via people”, special focus should be put on non-traditional study programs, and the support of cooperative PhDs.
- ➔ Concerning other transfer channels, further support should be given to spin-offs and start-ups (if possible, using cooperation potential), topic-specific networking of professors, forums, seminars, dissertations, and participations on conferences.

Deductions and recommendations considering external factors and networking:

- ➔ Universities should know and continuously reassess the external factors that are of influence, to be able to react in an appropriate way and adapt considering research, education and KTT aspects. A special focus should be put on regional conditions and effects.
- ➔ Universities of applied sciences should focus intensively on network activities. Four kinds of networks are important to focus on: regional networks, topic-specific networks, networking in KTT, and networking in education and study programs.