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Developing new roles for higher education institutions in structurally-fragmented regional innovation systems

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Developing new roles for higher education institutions in structurally-fragmented regional innovation systems

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Abstract

Over the course of the last decade, increasing political emphasis has been placed on the "third role" of universities and universities of applied sciences in German higher education policy, i.e. to these institutions socio-economic contribution their regional environment.

Against this background it is the first central aim of this study to take account of the existing regional activities of higher education institutions in Germany and to establish whether any effects of regional policymakers' and university management efforts to support such activities are already felt at the level of the individual researcher. Based on survey data, we find that a large array of decentralised projects is being performed by individual academics for multiple reasons, but also that evidence of effective centralised incentive-setting for such activities remains limited. Nonetheless, universities have undoubtedly become integrated into strategic considerations of regional co-operation to a stronger degree, as evidenced by a number of publicly supported programmes and the long time implicit "third role" of universities of applied sciences. Consequently, the second main aim of the paper is to illustrate how such strategic approaches could be designed against the background of the concrete regional demand of the industrial sector in a case study region. With a view to the example of Upper Palatinate in Bavaria, our paper demonstrates how the formerly strict separation of missions and tasks between universities and universities of applied sciences has resulted in a certain structural fragmentation of competences that hinders the development of a substantial third role in the region. Additionally, it suggests some tentative approaches how this situation could be overcome by an increased co-operation between formerly quite separate institutions.

1 Introduction

Arguably, the last two to three decades have witnessed how disciplinary research in the proverbial 'ivory tower' of science has given way to a more application-oriented, transdisciplinary approach to solving problems, which some authors have labelled "Mode 2 of knowledge production" (Gibbons et al. 1994; Martin 2010).

In parallel, a substantial academic debate has taken place around the implications this may have on the role of higher education in society. One particularly common hypothesis in this regard was that the shift towards "Mode 2" of knowledge production would facilitate the evolution of a more pronounced "third role" of universities with respect to regional development (Gunasekara 2004). This notion of a "third role" was introduced to unite a number of different discussion strands ranging from 'community service' (OECD 1999), 'regional development' (Goddard/Chatterton 1999), 'regional engagement' (Holland 2001), to 'regional innovation organisation' (Etzkowitz 2002) and 'academic entrepreneurialism' (Etzkowitz/Leydesdorff 1999).

Beyond their classical role in research and teaching, it has convincingly been argued that organisationally restructuring "entrepreneurial universities" had greater potential to set up separate units in charge of this "third role" (Clark 1998; Kwiek 2008) and thus have a stronger economic and societal impact on their regional environment and more regular interactions with local partners.

On the one hand, the "third role" of universities is not really a novel phenomenon since many universities have contributed to their regional environment in some way for a long time (cf. Martin 2010). What has certainly changed, however, is the political attention that is increasingly devoted to this process in terms of support programmes as well as higher education policy itself. While regional involvement used to primarily be based on activities of individual professors, it has more recently become an integral part of institutional strategies in higher education. In other words, the institutional self-perception of higher education institutions has shifted from one of 'safe-havens of science' to one of active contributors to their regional innovation system (Cooke 2008; Fritsch/Slavtchev 2011).

In Germany, two principle forms of higher education institutions have evolved: universities and universities of applied sciences. While universities traditionally focused on basic research and teaching to prepare students for academic careers, universities of applied sciences focused on practically-oriented teaching and a moderate amount of application-oriented research.

Both kinds of institutions are involved in adopting the "third role". A certain level of structural fragmentation can be observed in those cases where higher education institutions lack the disciplinary orientation or research capacities to comprehensively connect with the economy. Nonetheless, as the system is continuously evolving, novel forms of co-operation across institutional boundaries are developing.

This paper aims to in a first section shed some light on the actual nature of the "third role" of higher education institutions on the one hand, and, in a second one, provide some detail on the internal differentiation of the German higher education system. Both of these sections aim to provide the conceptual basis for an understanding of the particular opportunities to improve the overall third role of higher education that will be discussed below. The third section presents the empirical results of a nationwide survey documenting the prevalence of certain forms of co-operation and their motivation as well as differentiating those between universities and universities of applied sciences. The fourth section, finally, discusses how the specific differentiation of tasks in the German higher education system has in the case of Upper Palatinate resulted in a certain fragmentation of competences relevant for establishing an effective third role in the region. Moreover, it discusses institutional approaches which may to suitable to overcome these fragmentations through closer co-operation between the different players within the regional higher education system. The study finishes with a summary of the findings.

2 The third, regional role of universities and universities of applied sciences

2.1 General conceptual background

A number of basic mechanisms can be identified through which universities exert influence on their surroundings. According to Power and Malmberg (2008), the first mechanism is the fact that they are major employers and purchasers, the second is that they have an impact on the local labour market through the students they educate, thirdly, academic entrepreneurship favours the creation of high-potential start-up firms in the region while, finally, the university conveys an image of competence and expertise from which the region as a whole can benefit. Although omitted in their contribution, concrete co-operations between universities and regional partners also play an important additional role.

To shed some light on the regional involvement of universities, several categorisations have been proposed to structure the channels through which universities can have regional impacts. In this regard, a recent approach presented by Uyarra (2010) provides a clear outline of the different channels through which a university develops a regional impact.

The five roles distinguished by Uyarra comprehensively sum up why universities matter.

- As a *knowledge factory*, the university puts the region in an exceptional position with respect to knowledge transfer opportunities and the pool of human capital locally available.
- As a *relational university*, it provides a central point of reference for co-operations with regional firms or other local actors that is not available elsewhere.
- As a potential centre of *academic entrepreneurship*, the university invigorates the entrepreneurial climate in the region and can help to infuse young firms with know-how.
- As a *systemic player*, the university helps to overcome barriers in thinking and persistent but outdated views that obstruct co-operation and knowledge adaptation in the region.
- As an *engaged university* with a regional identity which intentionally seeks the role of an active supporter of development processes in the region.

Like the debate on the "third role" as such, these findings are not new and draw on categorisations developed much earlier such as those proposed by Goldstein et al. (1995), who distinguished eight major "university outputs" that can be regionally absorbed. First, the creation of knowledge, i.e. the diffusion of papers and otherwise codified information that can benefit external users; second, human capital creation, i.e. the education of students, who then add to the human capital pool of the region; third, the direct transfer of know-how by patenting and licensing; fourth, technological innovation, i.e. the development of prototypes or otherwise applied solutions by the university itself, often in co-operative projects; fifth, capital investment, i.e. the capacity to act as a lead user; sixth, the university's ability to act as a "regional leader" and driver of broadly based development efforts; and finally, its ability to create a "knowledge infrastructure" by means of these actions and to "influence the regional milieu", i.e. to help the regional society become familiar with and acquire the necessary skills for knowledge exchange and exploitation.

Obviously, the process of regional university involvement was thus nothing new to the world, or for that matter Europe, even back in the 1990s. On the contrary, it builds on a

broad base of pre-existing ideas and structures as well as a large array of activities dating from the 1950s. As summarised by Drucker and Goldstein (2007), the regional impact of universities has been demonstrated in a number of academic studies, in part long before it received the increased policy attention it has recently enjoyed.

In spite of its increasing popularity in policy circles, there have been intensive debates at individual universities about how far they should go to fulfil this "third mission", i.e. to which extent research and teaching needs to be adapted to new requirements (Gunasekara 2004). On the one hand, the university engagement literature argued that a 'broader, developmental focus' should suffice to become a more relevant player in the regional context and would also be more in line with a university's overall mission. More specifically, this school argued in favour of refocusing the traditional university missions on 'research activities that have potential to benefit the regional society' and 'regionally focused teaching'. Contrary to this, others argued that universities needed to be more ambitious and attempt to assume a 'generative role' in regional development by strengthening science-government-industry co-operations in research and entrepreneurship education in teaching. In many cases, this was promoted using the 'Triple-Helix-Approach' proposed by Etzkowitz and Leydesdorff (1997), which suggested that science-industry-government relations should be strengthened in multiple ways.

The characteristics of universities – challenges and opportunity

Evidently, however, the regional embeddedness of universities is more limited in many cases than suggested by the approaches quoted above. Moreover, the type of involvement differs so that not all regionally-engaged universities play a similar "third role". Power and Malmberg (2008) have argued that there are three reasons for this:

Firstly, science as such is rather footloose. While there are indeed regional clusters of research performers, specifically around major, joint-use facilities and laboratories, this situation is the exception rather than the rule. Moreover, scientists in some fields are more inclined to co-operate with non-scientists than those in others. Naturally, this not only has implications on the university's overall potential for science-society interaction, but also for the opportunities and types of regional involvement.

Secondly, the question is if the results of university research, expertise or its teaching curricula are of relevance for partners from business and society. If the "third role" is going to go beyond general outreach and information activities, the activities of the university have to be conducted with at least some perspective of their potential practical utility. Unlike the first point, this not only covers the general interaction potential of cer-

tain fields (e.g. theoretical physics vs. mechanical engineering), but also the extent to which this potential is realised and leveraged.

Thirdly, the extent to which spillovers are realised does not depend on the university alone, but also on its regional environment. Just as the sectoral orientation and the prevalent business model (e.g. innovation- vs. production-oriented) of local firms determines the potential for R&D co-operation, the opportunities for local community involvement will depend on the social environment and the central stakeholders in the region. Consequently, a university not only has to get its own strategy right, but also has to find the right way to integrate itself in the regional innovation system and broader society. In certain cases, e.g. very peripheral regions, however, opportunities will by definition remain limited.

Beyond these considerations, which mainly point out the need for a match between universities and their environment in a general fashion, Asheim et al. (2007) have described in some more detail why regionalised science-business-society interactions inevitably differ from case to case. Their key argument is that this depends on the type of knowledge exchanged and processed.

Analytical knowledge is knowledge that can be codified and transferred without major difficulties by modern means of communication. The exchange of analytical knowledge is, for example, typical for academic and other basic research-oriented communities of practice that may meet every now and then but are usually able to exchange findings across large distances. Consequently, these fields tend to be quite footloose and are only anchored in a region if, for example, the type of research performed requires access to jointly used equipment and laboratories. As the sunk costs for scientific equipment can be quite high, however, this type of regional anchoring does indeed occur in a number of cases.

Synthetic knowledge is that needed to push forward incremental innovation processes, often via close co-operation with different project partners or between customer and supplier. Knowledge generation involves bringing together and consolidating multiple experiences, a process of learning that cannot be based on codified knowledge alone. Hence, it requires a multitude of face-to-face meetings to build and maintain mutual understanding. In these cases, spatial proximity is highly conducive as it facilitates such face-to-face interactions. The continuous co-presence of all involved actors, however, is not often required for such problem-oriented collaborations, nor is it necessary that they share the same "buzz".

Symbolic knowledge, finally, is the medium of exchange in the core services sector but also for some providers of customer-oriented services in industry. In these fields, it is important to be part of a local community in the sense of Florida (1995) and to be part of the latest "buzz" (Bathelt et al. 2004) regarding trends, fashions, and designs. Symbolic knowledge is less focused on actual capabilities but it enables the relevant actor to do the right thing at the right time, i.e. to introduce new services to the market when the environment is right.

In practice, these different types of knowledge are closely related to types of industries and academic fields and the forms of science-business co-operations that tend to emerge from their interaction. In recent years, this has been demonstrated in a number of case studies (cf. Benneworth et al. 2009).

The above mentioned approach helps to explain why not all universities are necessarily deeply embedded in their regional environment (Power/Malmberg 2008) and that a third role is nothing that self-evidently evolves. Instead, it understand that the "third role" that can be played by individual universities is contingent on a number of different factors both internal and external to the university (Coenen 2007; Martin 2010; Power/Malmberg 2008).

While several studies have already focused on the role played by the regional environment (Coenen 2007), this paper primarily explores the internal dimension, i.e. issues relating to the scientific orientation, overall missions and specific strategies of universities. These can be expected to predetermine the currently observed and future "third role" of universities and universities of applied sciences in Germany.

2.2 The German case: past achievements, current developments and remaining bottlenecks

Framework conditions

In contrast to the UK or Australia, the concept of the "third role" of universities and universities of applied sciences is a comparative newcomer to the German political discussion and is less broadly accepted by academia itself. While discussions about the universities' regional role as human capital providers date back to the 1960s and a number of new universities were founded based on exactly this rationale, a more comprehensive discussion of the topic has only gained momentum over the course of the last decade (Schmoch 2011). It is therefore not unusual to find professors who are unaware of or confused by the terms "third role" or "regional engagement of universities" even though regionally-oriented activities as such are well understood and quite com-

monly performed. One reason for this is that universities and universities of applied sciences have in fact been playing a significant role for their regional environment for decades, with activities substantially beyond simply providing human capital, although, until recently, this has rarely been a declared element of their strategy. Moreover, many regionally-oriented activities tended to be initiated at the level of individual professors and institutes, while the institutions' central administrations remained comparatively disinterested.

That a strategic consideration of these topics is beginning to take place can be documented by many specific cases, such as the involvement of universities in the leading-edge cluster competition[1], the new programme industry-science research campus[2] as well as projects in the context of the German Research foundation competition for excellence[3] (e.g. dresden concept). While it would be beyond the scope of this paper to document *how much* more prevalent regionally oriented considerations have become in the documented strategies and missions of German universities, the abovementioned examples provide evidence enough to speak of a certain trend in this direction.

A dichotomy of missions and division of tasks

Besides these comparatively new developments, regionally-oriented missions have for a long time been common among a certain type of institution: the universities of applied sciences. For that matter, it is relevant to raise the reader's attention to a particularity of the German system of higher education: the comparatively clear delineation between universities and universities of applied sciences. In many countries higher education is characterised by a broad range of missions from leading-edge research universities to mostly teaching-oriented universities of applied sciences, whereby the particular mission of an individual institution can typically be chosen by this institution itself with a certain degree of liberty – resulting in a continuum of orientations. Higher education in Germany, in contrast, has traditionally been divided into two distinct groups of institutions with a clearly pre-specified mission framework.

German universities' main mission is to focus on basic research and to offer courses needed for academic careers, while German universities of applied sciences traditionally focused on teaching applied curricula. Research activities, in contrast, were, if at

1 http://www.hightech-strategie.de/en/index.php

2 http://www.bmbf.de/foerderungen/16942.php

3 http://www.excellence-initiative.com/start; http://www.dresden-concept.de

all, not considered as central to their mission in the practical field – and thus not reflected in their internal employment and incentive structure. Consequently, German universities employ the typical mix of professors, post-docs and PhD students needed for research and research-oriented studies, whereas universities of applied sciences are mostly staffed by professors responsible for teaching and without the independent right to award PhDs (Kulicke/Stahlecker 2010). Compared to universities, universities of applied sciences publish less and engage in co-operative applied research with and contract research for firms to a greater extent. In both regards, however, they are outperformed by universities with a technical orientation. In line with their main teaching mission, universities of applied sciences are most strongly engaged in enabling students to write theses in co-operation with local firms and to employ professors with pre-existing contacts to industry (Czarnitzki et al. 2000). Moreover, they have a particularly high propensity to co-operate with local SMEs while universities, even if technically oriented, tend to focus on R&D co-operations with larger, technologically more ambitious firms. With respect to start-ups and spin-offs, universities of applied sciences can at least match the level of integration reached by technically-oriented universities (Czarnitzki et al. 2000).

Another main characteristic of universities of applied sciences is that their research and teaching activities are primarily focused on the natural science and engineering subjects. While in 2010 only about one third of German university students studied a related subject, their relative share at universities of applied sciences amounts to nearly 50%. With a view to the share of personnel in these scientific fields, the difference is similarly strong, with more than a third of all employees at universities of applied sciences working in those fields, but only less than a quarter at normal universities (German Federal Statistical Office).

Patterns of regional integration

While not always explicitly stating it as such, universities of applied sciences have for a long time been key drivers of localised science-business co-operation in Germany, thus playing a very significant "third role". Both their teaching curricula and their (increasing) R&D activities are application-oriented and many of their professors have worked for industry or continue to do so. Consequently, the contact threshold is much lower for enterprises as they share a common language and can more easily establish a mutual understanding of issues. On the other hand, their overall organisational set-up makes it difficult for them to fulfil a very comprehensive third role, as sketched in the conceptual section. In particular, therefore, most universities of applied sciences aim to play a cen-

tral role as the main point of leverage for co-operations between the higher education sector and the local population of SMEs.

In contrast to this, major technically-oriented universities can often draw on well-established co-operations with the large firms located in their region and beyond. In recent years some of them have extended these to specific PPP models to administratively promote and facilitate these co-operations (Rohrbeck/Arnold 2006). While some gaps between cultures persist and the fluctuation of personnel is limited, such high level co-operations have strengthened the major industrial players in Germany and continue to do so (Koschatzky/Stahlecker 2010).

In summary, the traditional division of tasks between universities and universities of applied science can be considered less than optimal from a regional perspective. In particular, the mentioned double strategy of science-industry integration represents a certain weakness from the perspective of the enterprise population in any selected region, as

- regional universities of applied-sciences quite successfully fulfil a regional mission, but often can not satisfy all demands, e.g. with respect to research, while
- regional universities could often complement much of the missing elements, but in many cases have set other priorities or not yet developed effective incentive systems to actually implement their ambitions to co-operate with the regional environment.

Furthermore, the co-operation between universities and universities of applied sciences has traditionally been quite limited. Consequently, the desirable development of a "co-ordinated third role" within regions had for a long time remained elusive for structural reasons.

In regional innovation systems this discrepancy will be particularly felt with respect to those fields of activity, where the profiles of the different types of institutions differ most strongly. One especially relevant example in that respect is the abovementioned difference in focus in the field of natural sciences and engineering. As many individual universities do not have an outstanding profile in these subjects, the absence of their contribution will be felt in a higher number of regional innovations – while at the same time the regional coverage of this area by universities of applied science can be considered among the broadest.

Certainly, therefore, the abovementioned fragmentation of competences will neither come to play in all regions nor with respect to all academic fields. It is, however, a potential point of weakness in the German system and we will demonstrate that, with re-

spect to the area of natural science and engineering, it can pose a real challenge even in quite wealthy regions.

In recent years, however, there has been a growing awareness that more overlaps should be allowed between the formerly strictly separated missions. Universities of applied sciences were encouraged to upgrade their research capacities (BMBF 2008; Kulicke/Stahlecker 2010), while universities were encouraged to interact more extensively with firms (including SMEs) in their regional environment, e.g. in the framework of the abovementioned initiatives.

As a result, the ability of universities of applied sciences to co-operate with larger firms has improved due to the general increase in R&D activities performed within these institutions. Additionally, curricula have been aligned by the Bologna process. Likewise, universities have made greater efforts to reach out to industry beyond their traditional corporate partners in the framework of the abovementioned strategic reorientation. Consequently, this paper will not only take empirical account of regionally oriented activities as such but also explore the co-ordination among different regional institutions' third role in some more detail.

2.3 Empirical approach and research questions

In a first step, the empirical part of this study will aim to assess the validity of the conceptual and literature based findings outlined above and to evaluate their practical relevance for the management of higher education institutions in Germany. It will seek to shed more light on prevalence and nature of regional co-operations between higher education institutions and partners from business and society and to document how they are motivated and supported by the universities' management. Based on a nationwide online survey answered by nearly 2,000 academics in Germany, the first empirical section of this study will answer the following research questions:

Research Question 1.1
What type of co-operation with regional partners is currently taking place and what are the main motivating factors for such activities?

Research Question 1.2
To what extent do the differences in the findings for universities and universities or applied science reflect these institutions' different set-up with respect to internal organisation and stated regional mission?

Secondly, it will seek to demonstrate to what extent the role of universities and universities of applied sciences do indeed differ in the way outlined above and if a fragmentation of regional research systems can factually be observed. To do so, the authors can draw on a broad based enterprise survey for the German region of Upper Palatinate which allows for a valid assessment of this situation. Against this background, they will analyse which attempts are being made by regional institutions of higher education to join forces and to overcome the traditional fragmentation of competences.

Research Question 2.1
Which concrete demands of the regional business sector can be identified with respect to human capital and with respect to co-operation in the field of knowledge and technology transfer? To what extent can those demands be satisfied regionally?

Research Question 2.2
To what extent has the regional university leadership recognized this situation and in what ways are they trying to develop a cross-institutional third role of the local higher education sector? Which concrete steps are being and could be taken?

3 The third role of German higher education institutions: empirical evidence and policy reactions

To on a broad basis identify and analyse the activities performed in the context of the "third role" of higher education in Germany, Fraunhofer ISI conducted an online survey with every professor at both universities and universities of applied sciences for whom contact details could be obtained[4]. Of about 40,000 professors in Germany, more than 15,000 could be contacted and responses were received from nearly 2,000 of them. While exact figures vary depending on the question; 1,929 questionnaires with meaningful entries of some sort were sent back. Of these, 1,519 stated to be working at a university while 221 were employed at a university of applied science while 189 did not indicate an affiliation. Naturally, the survey was predominantly completed by those professors engaged in regional activities. As a result, it allows us to draw conclusions regarding the structure of "third role" activities, but is not able to provide information

4 The survey was conducted in the context of the research project: "Involvement in regional networks and their impacts on internal governance structures at universities" which is funded by the German Federal Ministry for Education and Research (BMBF) (www.bmbf.de/foerderungen/13440.php).

about the propensity to engage in such activities. In general, however, the survey was able to confirm a number of conceptual assumptions for the German case[5].

3.1 General Overview

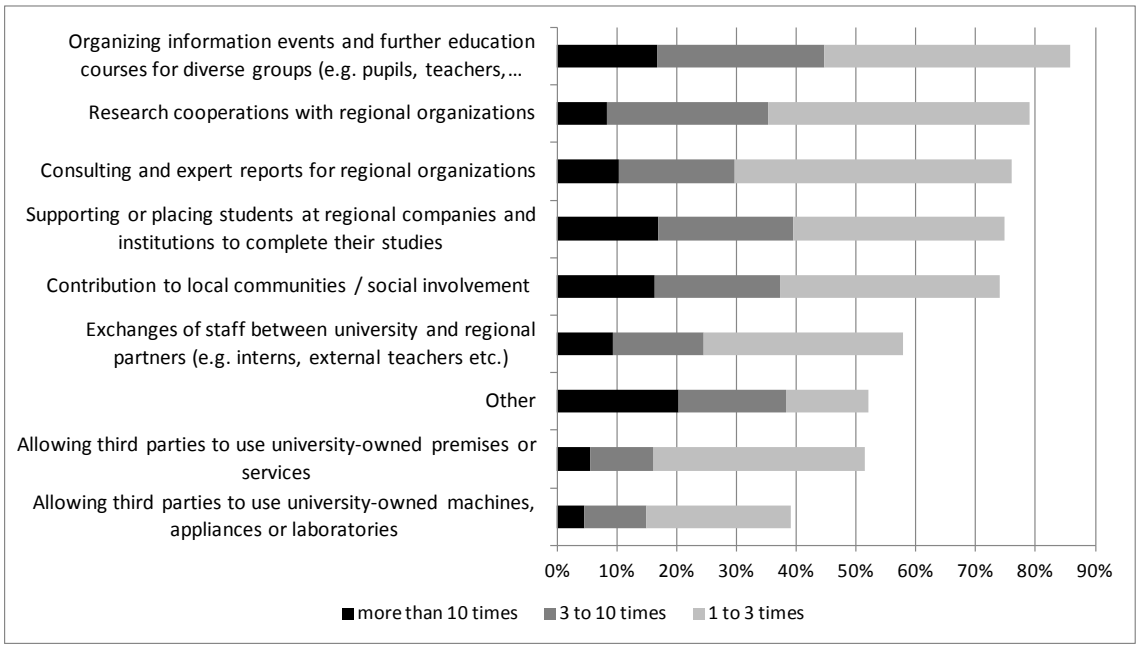
Firstly, the survey revealed that a broad range of quite different activities are performed with regional partners. While classic R&D co-operations are common, non-R&D-oriented activities such as consultancy and expert reports of various sorts play a next to equally important role as do activities related to teaching and those aimed at strengthening the local community. The joint use of machines, laboratories or premises, to the contrary, appears to be a specific, and less common phenomenon (see figure 1).

Secondly, it revealed that these diverse activities were motivated by the expectation of monetary rewards (from the university) to a lesser degree than by a general expectation to improve one's regional standing and visibility as well as regional networkedness. Moreover, aspects related to teaching play a surprisingly important role. Irrespective of the fact whether the higher education institution as such had a regionally oriented strategy our survey clearly reveals that many professors actively included regional opportunities into the planning of their own research and teaching and, implicitly, academic career (figure 2).

With a view to the role of university management, in contrast, scarcely 10% of professors report any, even if limited support, for their diverse regional involvement. Only at universities of applied science will the school's management at times take measures to lessen the high teaching obligations – to at all enable them to launch such activities in the first place.

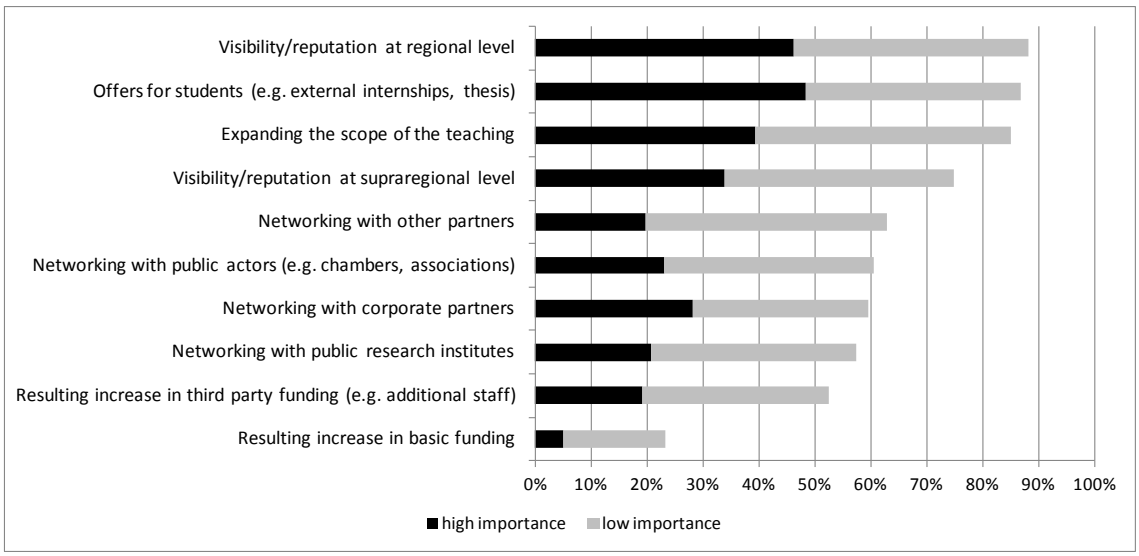
5 The presented analysis were carried out at the Fraunhofer Institute for Systems and Innovation Research ISI by a project team headed by Prof. Knut Koschatzky (Dr. Stephanie Daimer, Dr. Henning Kroll, Benjamin Teufel, Nicole Schulze, and Miriam Hufnagl) (http://isi.fraunhofer.de/isi-en/p/projekte/governance_regional_ko.php). We acknowledge the valuable support of our colleagues.

Figure 1: Frequency of interaction by type



Source: Own figure, based on a survey of German professors conducted on behalf of the BMBF, Spring 2011

Figure 2: Factors motivating activities in co-operation with external partners



Source: Own figure, based on a survey of German professors conducted on behalf of the BMBF, Spring 2011

With a view to Research Question 1.1

Firstly, regional activities of universities have been documented for nearly 5% of the country's professors (most of those who took part in the survey) and are likely to be

much more prevalent. Even though it has only become a common topic in policy circles quite recently, it can therefore convincingly be argued that, by merit of individual professors' activities, German universities have been performing a substantial "third role" for some time.

Secondly, the channels of their interaction with the regional environment are complex and diverse. Interestingly, however, none of the suggested alternatives was found to be substantially less relevant. The only exception from this general rule is the joint use of facilities and equipment, which requires a specific framework and, by definition, occurs only very rarely in a number of academic disciplines (e.g. social sciences). Consulting and general outreach activities, in contrast, are almost as relevant as concrete R&D co-operations.

Thirdly, the perceived effects and benefits of regional activities, among which increasing regional visibility ranks highly, suggest that professors are well aware of their environment and are interested in playing a role in the local community. Likewise, they acknowledge that increased interaction with local firms not only enables them to realise co-operative theses, but also to improve their curricula in general.

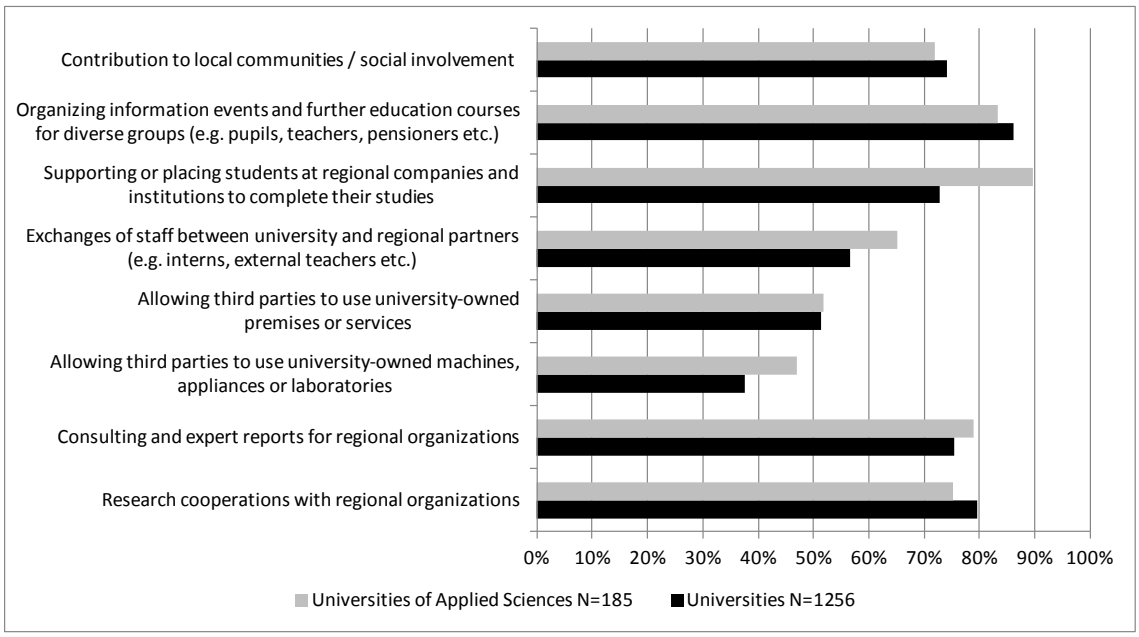
In sum, the notion of *regionally engaged academics* can be considered confirmed. As suggested in the conceptual section, in contrast, management level strategies to create *regionally engaged universities* appear to remain less effective – given that not many professors find themselves actively supported in that respect by their university's incentive system.

3.2 Differences according to institutional affiliation

With respect to the differences between universities and universities of applied sciences, the survey found that the overall pattern of activities differs less substantially than one could have expected with a view to their different missions and organisational set up. Nonetheless, a number of clear differences can be identified. While universities tend to be somewhat more active with respect to general involvement in the regional community, organising information events as well as concrete research co-operations, activities at universities of applied sciences are to a higher extent focused on theses written in co-operation with firms, temporary personnel exchanges and the joint use of equipment and laboratories. Likewise, the surveyed professors at universities of applied sciences placed greater emphasis on consulting activities than their colleagues at regular universities (figure 3).

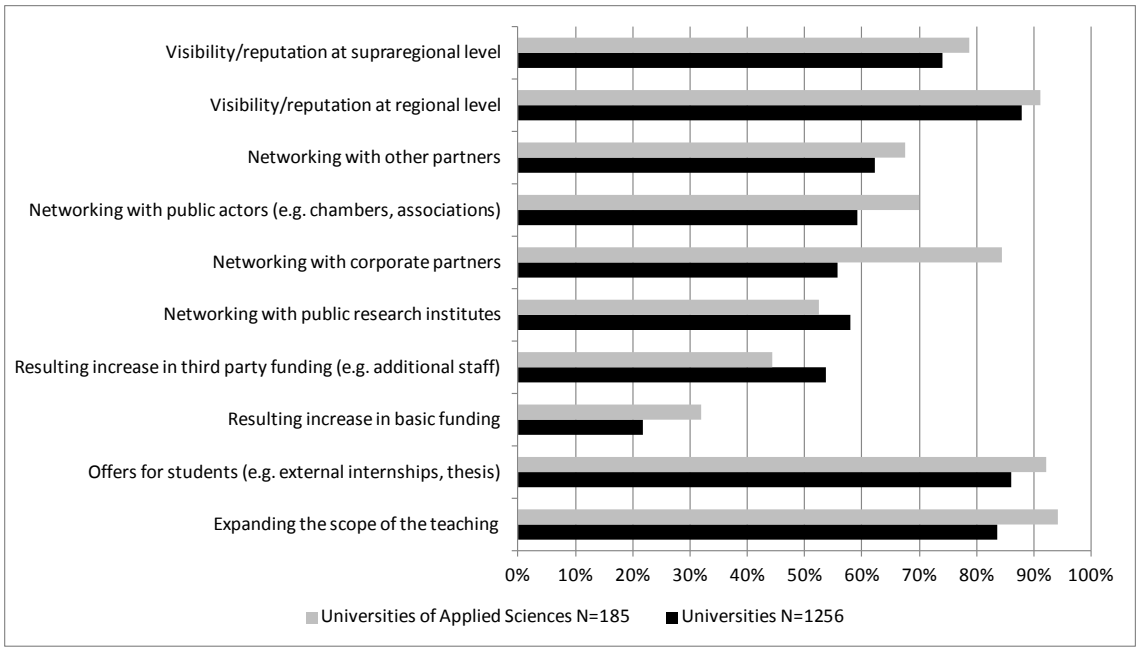
In line with their respective missions, this picture confirms the main orientation of universities towards research co-operations (accompanied by general promotion activities), while at the same time it corroborates the universities of applied sciences' higher tendency to collaborate at hands-on level, with a specific focus on practically-oriented teaching activities.

Figure 3: Activities performed in co-operation with external partners



Source: Own figure, based on a survey of German professors conducted on behalf of the BMBF, Spring 2011

Figure 4: Factors motivating activities in co-operation with external partners differentiated by universities and universities of applied sciences



Note: Share of professors indicating that factor has "high" or "low" importance

Source: Own figure, based on a survey of German professors conducted on behalf of the BMBF, Spring 2011

As a possible result of these differences, moreover, our findings illustrate that professors at universities of applied sciences tend to regard their activities with partners in the region as having greater benefits than university professors. In particular, they emphasise that those increase the degree of 'networkedness' with regional firms and other regional institutions, benefit their teaching activities as well as raise their regional visibility. University professors in contrast, tend to more commonly identify benefits with respect to third party funding and improved networking with non-university public research units, outcomes which are more likely to result from classical research co-operations. Again, however, the overall profile of perceived benefits does not differ as substantially between the two groups as their declared division of tasks might suggest. In both types of institutions, practically-oriented curricula, internship opportunities for students, as well as improved visibility are the most important perceived benefits – and thus potential future drivers – of regional involvement (figure 4).

In line with the structure of their activities, answers to another question reveal that universities of applied science can more commonly draw on external support from industrial partners, while co-operative projects at universities are more often sponsored by research councils, foundations or public programmes. Finally, professors at universities of applied sciences more frequently conclude that their regional activities have placed

them in a better position to launch projects, or to seed new ideas within their academic organisation or institute.

With a view to Research Question 1.2

Firstly, our survey has corroborated the existence of a remaining division of tasks between universities and universities of applied sciences. The profiles of regional activities performed by these institutions differ according to their general tasks and missions as outlined in the conceptual section. Evidently, the teaching-oriented universities of applied sciences are more focused on teaching and networking activities, while university professors focus more on concrete research projects. Moreover, there seems to be a stronger institutional response to "third role" activities in universities of applied sciences than in other universities.

Secondly, the survey has underlined that the overall pattern of co-operation activities differs by scientific field to a lesser degree than might have been expected. While a number of activities are by definition unlikely to be realised in certain academic fields, all other activities are fairly prevalent across the board. Apparently, science-business-society interactions are developed beyond the natural starting points that each discipline provides in different ways. The overall comparatively similar pattern of activities seems to suggest that the classical channels of interaction have been actively explored from different disciplinary perspectives.

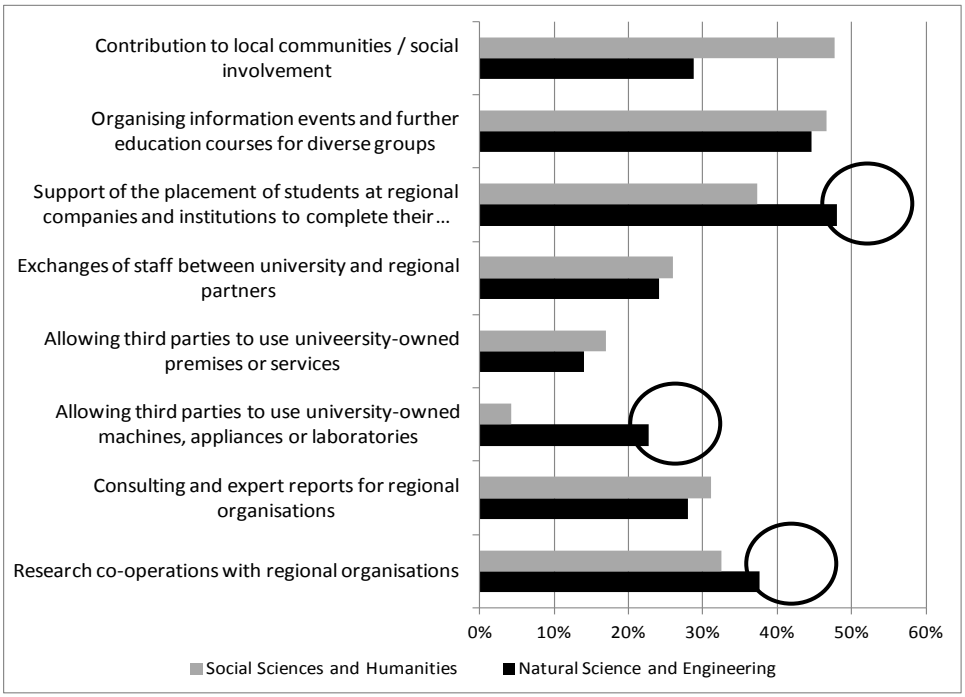
In sum, the survey finds that the pattern of activities at universities and universities of applied sciences has indeed developed along the lines of those institutions' missions as outlined in the conceptual section. On the other hand, the findings suggest that the two groups of institutions are (no longer?) different worlds. In practice, the extent of differences between them appears limited and co-operation between them a future option.

3.3 The science field specific dimension

On the other hand, the survey's findings also illustrate that these structural differences are not based on institutional differences alone. While, in general, however, the differences between the prevalence of certain regional activities in specific subject fields are less pronounced than one might have imagined, there are nonetheless a number of regionally-oriented activities, such as the joint use of equipment and laboratories, which are typical for science and technical subjects but uncommon among the social sciences and humanities. Likewise, the share of respondents stating that they had

awarded theses in co-operation with regional firms is highest in engineering fields, while this is particularly low in the humanities. Involvement in and contributions to the local community, in contrast, are an activity more strongly associated with social sciences and humanities. Moreover, it should be borne in mind that while the overall prevalence of activities may be similar, the number of professors with real experience with a particular type of co-activities may not be. The overall share of respondents stating that they had performed personnel exchanges, for example, only varies between about 55% and 65%, while the share of those having initiated more than three such activities varies – relatively much more substantially – between about 17.5% and 30%.

Figure 5: Academics having realised more than three regional activities, by field of science



Source: Own figure, based on a survey of German professors conducted on behalf of the BMBF, Spring 2011

For the reminder of this paper, therefore, it is important to remember that a certain focus has to be set when analysing the development of regional third roles with respect to one of their potentially most critical aspects: the local co-ordination between universities and universities competences in the field of natural sciences and engineering. As the nationwide analysis shows, two main types of regional involvement are of particular relevance in these subjects: co-operations in the field of technology transfer (joint R&D projects, joint use of equipment) as well as the placement of students at regional firms and institutions.

4 Developing the third role through local co-operation: the case of Upper Palatinate

4.1 Third roles and regional challenges

Possibly, one reason for the prevalent lack of incentive systems is that many strategies of public universities have so far only included general commitments to regional involvement but not necessarily clearly addressed specific, defined regional challenges and delineated the concrete contribution that the specific university aims to make. In practice, such distinct commitments are often prevented by the fact that their definition would require a regional, demand-oriented approach. As different regional higher education providers tend to compete rather than to co-operate, however, this will be hard to achieve. In this context, they may consider their regional options, but not necessarily think of themselves as regional players.

Nonetheless, the idea should not be considered academic. Undoubtedly, the "third role" in a particular region could best be developed if regional actors join forces to curb redundancies and make best use of their comparative strengths. As pointed out above, the deeply-rooted division of tasks between universities and universities of applied science and their traditional mutual disregard for each other is – in certain contexts – one central obstacle on this way. On the other hand, our broad based survey has provided that the regional activities of both types of institutions are similar enough to allow them at least an exchange of experiences. Moreover, the comparative similarity in the profiles of regional engagement suggests that while each institution has a greater depth of experience in some fields, it could always still profit from contributions of the other side. On that basis, co-operation seems possible.

For the purpose of this study, the region of Upper Palatinate has been selected as a case study to demonstrate what potential could be leveraged if a university and a university of applied sciences would join forces in addressing issues of regional development.

It was selected as it provides a typical example for a German regional innovation system in which the roles the two regional higher education institutions were so far quite distinct. While economically well endowed and facing but frictional unemployment the region has for a long time been characterised by a lack of co-operation between the regional university and the regional economy. So far, this task had next to exclusively been taken up by the regional university of applied sciences which, however, has not in all areas been able to sufficiently meet the demands of the local industry. As the region

is facing constant competition by nearby centres of excellence such as Nuremberg, this situation has for some time been recognised as dissatisfactory and led to strategic reconsideration on many levels. In brief, the region of Upper Palatinate makes for a good case study for two main reasons:

Firstly, there is real potential for a third role on the side of the higher education sector as well as real demand on the side of the regional economy. New solutions will thus be based on the potential to optimise rather than to start from scratch. Secondly, as to be illustrated, the local demand for a third role is strongly focused on the fields of natural science and engineering, thus demonstrating the problem of fragmentation in a particularly clear-cut way.

4.2 Upper Palatinate: A thriving regional innovation system with fragmented competences in higher education

The Upper Palatinate (Oberpfalz) region is one of the seven administrative districts in Bavaria and has a population of 1.08 million. Its major cities are Regensburg (134,800 inhabitants), Amberg (43,800 inh.) and Weiden (42,000 inh.). The total labour force here amounts to 560,300 persons. Compared to the Bavarian average, more people are engaged in primary (3.8% vs. 2.9%) and secondary sector activities (33.6% vs. 28.8%) at the expense of services (62.6% vs. 68.3%). The GDP per capita of 30,848 EUR in 2009 was slightly below the Bavarian average of 33,897 EUR. However, with 67,498 EUR, the city of Regensburg had the third highest value among the Bavarian municipalities signifying the economic strength of the region's capital city (Federal Statistical Office of Germany).

117,000 persons are employed in manufacturing. The manufacture of electrical equipment is the most important industry accounting for 24,700 jobs, followed by manufacture of machinery and equipment (16,700 employees) and manufacture of motor vehicles, trailers and semi-trailers (16,200 employees). The regional economy is characterised by the manufacture of electrical equipment, glass, refractory products and other non-metallic mineral products. With regard to the former, the region accounts for 26% of employment in Bavaria, with regard to the latter for 20%. Important employers are firms like BMW, Krones, Infineon, Continental or Osram, which have headquarters, R&D or production sites in the region.

With regard to higher education institutions, the University of Regensburg with about 17,000 students and the University of Applied Sciences Regensburg with about 6,500 students share a joint campus in Regensburg. The University of Applied Sciences Am-

berg-Weiden is located in Amberg and in Weiden with 1,500 and 1,150 students, respectively. In the following, the focus will be put on the two main higher education institutions in Regensburg.

While the University of Applied Sciences in Regensburg specializes in the so-called German MINT disciplines (mathematics, informatics, natural sciences and engineering sciences), the University of Regensburg focuses on non-technical disciplines with an emphasis on languages and cultural studies. The number of graduates in 2009 reveals that 54% of graduates from the University of Applied Sciences graduated in a MINT subject compared to 11% at the University. Over the last few years, the University of Applied Sciences has become even more strongly oriented towards these subjects and new subjects have been introduced. In 2009, 60% of first year students enrolled in a MINT course. In parallel, the share of first year students studying a MINT subject at the University increased to 20%. While the difference between the share of first year students and that of graduates in the MINT disciplines can be partly explained by higher dropout rates in these disciplines, there have been particular efforts made at both institutions to boost research and education in MINT disciplines.

The number of first year students in the MINT subjects highlights the respective profiles of the two higher education institutions in this respect. Most of the five most frequently chosen study courses at the University in 2009 were bachelor degree courses in biology, pharmaceutics, chemistry, business informatics and physics. At the University of Applied Sciences, the study programmes with the five highest enrolment figures were bachelor degree courses in mechanical engineering, renewable energies and energy efficiency, electronic and information technology, mechatronics and business informatics.

Against the background of the region's specialization in manufacturing, the clearest gap with respect to academic research and teaching can be identified with respect to the engineering disciplines – in particular at the University. While the University of Applied Sciences offers various programmes mainly at bachelor degree level, it cannot award Ph.D.'s. Moreover, its teaching curricula as well as research activities are more application-oriented so that, despite recent changes, the qualification level of its graduates is not yet the same.

In summary, while both local higher education institutions are attempting to meet the regional business sector's demand for qualified graduates and R&D collaboration, there are structural barriers hindering them in different ways. As defined by its mission, the University of Applied Sciences has its focus on applied education and the estab-

lishment of close networks with the local industry, which it efficiently fulfils. While attempts are being made to engage in research activities, the limits set by its institutional set-up cannot easily be overcome. The University, on the other hand, has the needed mission as well as some professorships in relevant fields but it lacks contacts to the private sector to initiate such activities as well as an engineering department that could provide the organisational framework to provide the more conceptual, high-level education that is missing in the region. With potentials thus left incomplete on both sides, neither the University not the University of Applied Sciences will be able to meet the locally existing demands in the foreseeable future.

4.3 Matched and unmatched needs of the regional business sector: The third role of regional higher education in Upper Palatinate

Currently, both local higher education institutions are involved in providing qualified young professionals to the regional innovation system. In addition to their regional involvement as educational institutions, both universities are regional partners in research and development. As pointed out above, however, each of them has a quite different mission and focus with respect to their profiles in research and teaching.

To better understand these regional demands of the business sector, a survey has been conducted among manufacturing and service firms in Upper-Palatinate with the support of the regional chamber of commerce[6]. In total, filled questionnaires were returned by more than 260 regional firms, with the exact number of valid replies depending on the question.

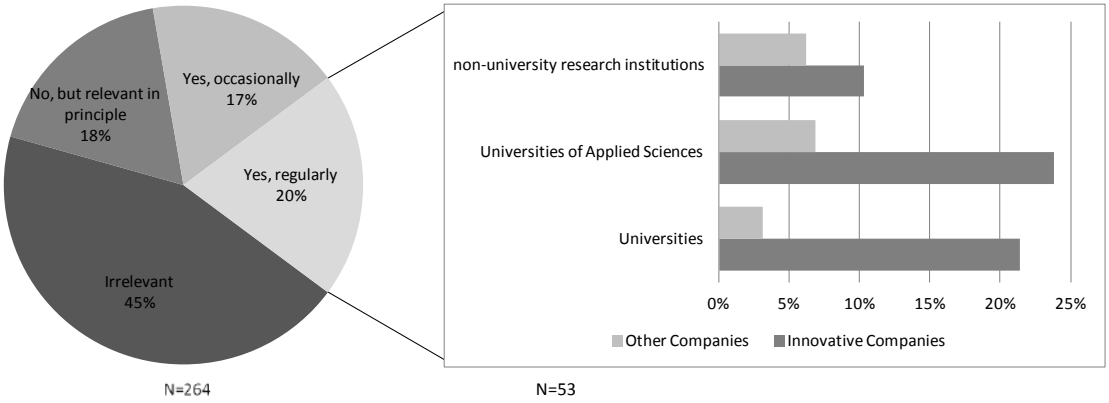
The first main purpose of this survey in the context of this study is to document whether a regional demand for co-operation in teaching, research and development can actually be identified – so that a reconsideration of the regional third role appears at all needed.

With a view to the regional demand for R&D co-operation, the survey documented that about 37% of 264 surveyed companies co-operate regularly or occasionally with public research institutes – regardless where those are located geographically – whereas 45% indicated that interaction with the science sector is not relevant for them (figure 6). The remaining 18%, in contrast, stated that such co-operations had potential but were

6 The survey was conducted in the framework of a project commissioned by the City of Regensburg. The use of the raw data has been authorised by its representatives while its interpretation in this paper is entirely that of the authors and unrelated to the project.

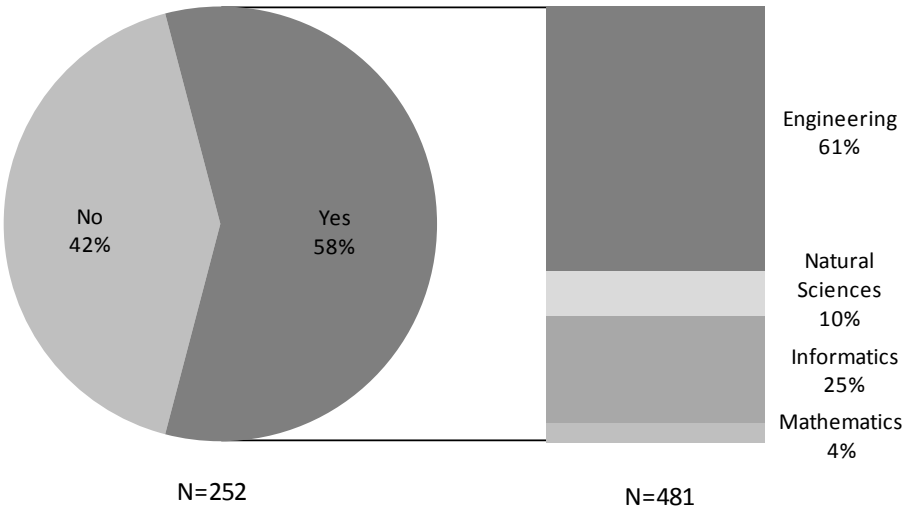
not currently realised. Among the possible research partners, universities and universities of applied sciences are the most relevant co-operation partners for companies, with a certain focus on universities of applied science – likely the regional ones. As to be expected, moreover, firms having innovated in the past three years realised co-operations more often than their non-innovating peers.

Figure 6: Regularity of science-business cooperation differentiated by research partners and innovation orientation of companies



Source: Own figure, based on survey of firms in Upper Palatinate, April 2011

Figure 7: Current or future lack of Bachelor & Master graduates in all relevant fields



Source: Own figure, based on survey of firms in Upper Palatinate, April 2011

Additionally, nearly 60% of the survey regional firms identified a current or future lack of qualified graduates (figure 7), in particular in the field of engineering that is at the moment mostly covered by the University of Applied Sciences of Regensburg. Apparently, the existing and prospective regional demand for graduates cannot currently be covered. In another question, more than 30% of firms reported additional costs resulting from this situation. Apparently, there is ample potential for regional institutions of the higher education to contribute to the solution of this issue.

The second main purpose of the survey in the context of this study, therefore, is to analyse whether the regional fragmentation of tasks was conceptually predicted in section 2.2 can in the selected case study be identified in practice.

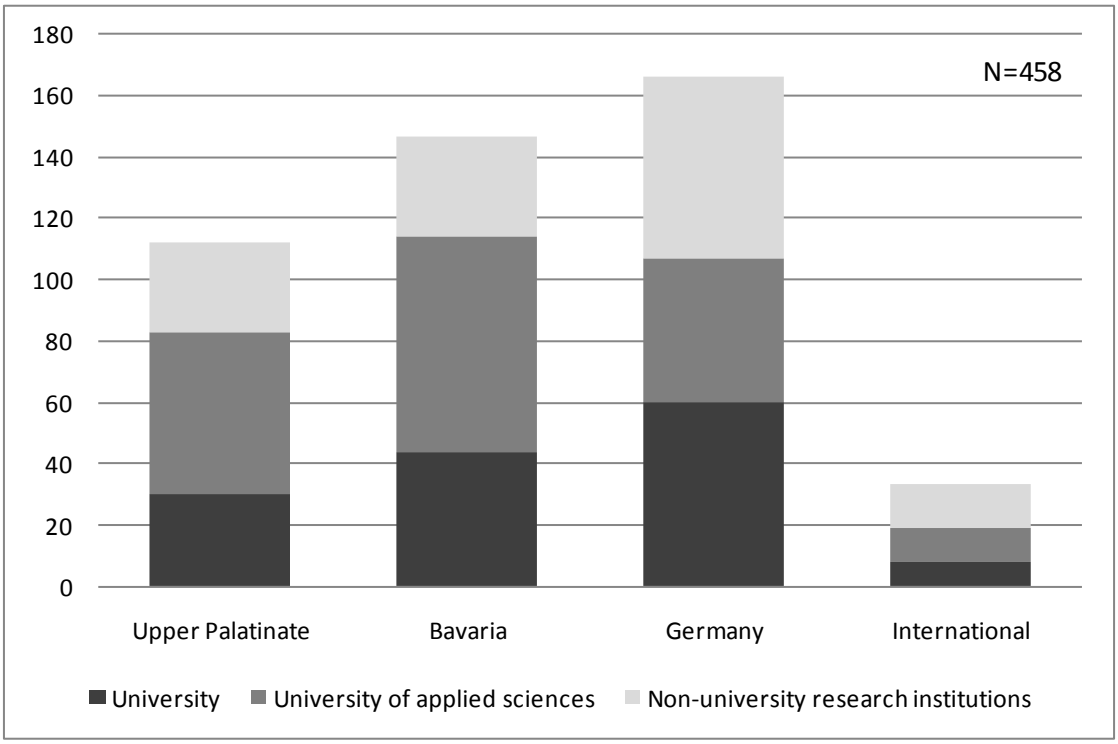
In addition to the intensity of science-business interaction in general, therefore, the local firms were asked about the spatial reach of their co-operation activities with the science sector – and thus their involvement in the regional innovation system of Upper Palatinate. More precisely, the surveyed companies which co-operate regularly or occasionally with public research institutes were asked where their R&D partners were predominantly located.

Figure 8 illustrates that a relevant but by no means dominant number of R&D partners can be found in Upper Palatinate. The most important framework in which partners are found is Germany, followed by Bavaria. In contrast, the international level does not play a significant role. Among the regional level institutions listed as partners, the two universities of applied sciences play the most important role (47% of entries) while it is confirmed that the local university is less relevant as a partner (27% of entries). At federal state level, a similar pattern is found: most co-operations are realised with universities of applied sciences. Across larger distances, on the national level, in contrast, we find that enterprises have a higher propensity to co-operate with universities and non-university research centres. Apparently, long distance co-operation co-operations are either guided by a search for excellence – or affected by the limited interregional visibility of other universities of applied sciences elsewhere.

Additionally, the survey analysed the firms spatial focus of engagement differentiated by the concrete modes of interaction in the process of knowledge and technology transfer (figure 9). In this respect, the survey underlined that the exchange of personnel had a strong tendency to occur on a local basis, followed by the use of laboratories and devices, co-operation agreements, informal contacts and joint R&D projects. It was less common, in contrast, for contract research. Excluding this, it appears remarkable that, between one fifth and one third of all activities is generally conducted at the regional

level and that in nearly all cases more than 60% happens within Bavaria. Apparently, firms have a strong tendency to keep their co-operative activities in the field of knowledge-transfer localised. Again, we find that the degree of localisation is stronger with respect to those forms of co-operation that are often realised with universities of applied science (e.g. exchange of personnel) than with respect to those typically realised with universities (joint R&D projects, contract research). Again, it seems that the situation does not reflect one of sufficient regional availability of those resources that only full universities can provide. Instead, those are more typically looked for at a national, or at least the broader federal state level.

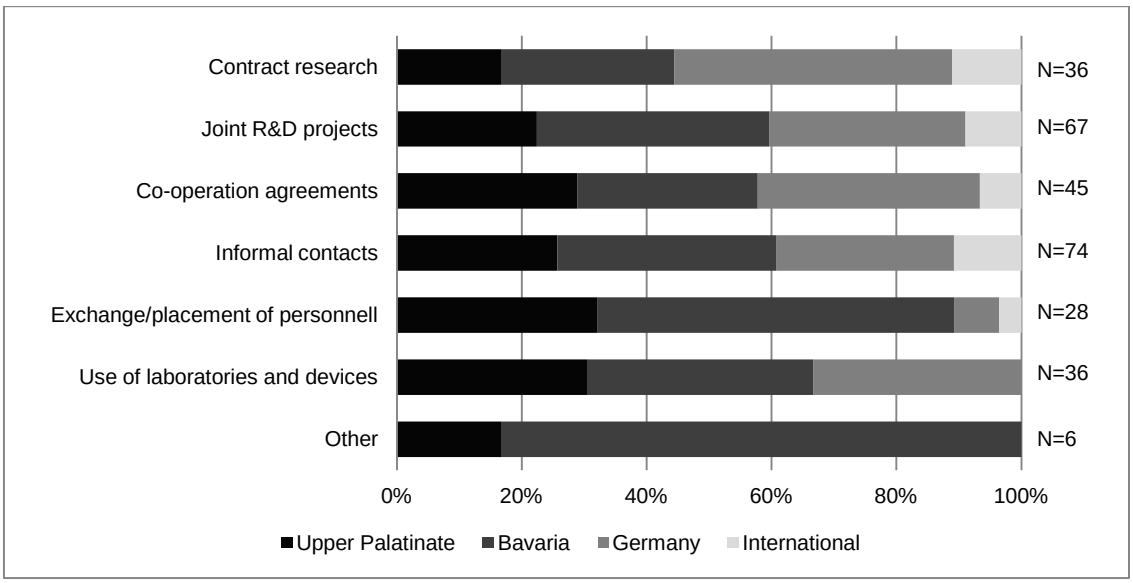
Figure 8: Spatial reach of co-operative relations according to the type of research institute



Source: Own figure, based on survey of firms in Upper Palatinate, April 2011[7]

7 This displays percentages based on the respective number of responses, rather than the overall number of responding firms. Hence, the absolute number of entries indicated in figure 7 exceeds the 37% of companies which co-operate regularly or occasionally (figure 6).

Figure 9: Regional focus of interaction modes in the knowledge transfer process



Source: Own figure, based on survey of firms in Upper Palatinate, April 2011

With a view to Research Question 2.1

In summary, both higher education institutions can currently neither be genuinely satisfied with their role in the regional innovation system, nor is there evidence that the combined regional roles of the regional university and the regional university of applied science suffice to meet the respective demands of the regional enterprise sector. While the University of Applied Sciences can rely on well developed contacts towards the business community and is generally performing well in that respect, the low degree of localisation of contract research and joint R&D projects suggests that it can only partially fulfil the regional firm's need with respect to R&D co-operations. The university, in contrast, cannot be satisfied with its disproportionally low relevance as a regional partner. Even though parts of this effect can be explained by its non-technical profile its higher number of faculty and close to three times larger number of students should make up for this to a larger extent than it does – even if some share of R&D co-operations will always be regionalised. Consequently, the University of Applied Sciences will have to reconsider how it can upgrade its regional operations while the University will have to see how it can establish better contacts to the regional economy.

4.4 Towards the development new approaches to establish a cross-institutional "third role"

Against the background of the abovementioned challenge of an insufficient integration of the regional science system and the regional economic system and, in particular, the

institutional separation of the networking and the research competences within the region's higher education sector the question arises which new institutional approach could be conceived to overcome this situation. As a starting point, the current situation in the region of Upper Palatinate can be described by a concentration of scientific performance at the local University, primarily in the fields of medicine and natural sciences, and a largely unconnected concentration of networks with the regional economy at the University of Applied Sciences. Consequently, substantial potential synergies could be leveraged if a way could be found to bring these to competences together.

Naturally, however, these competences cannot simply be integrated by merging part of the two institutions – as contacts to industry are a personalised asset that cannot simply be transferred across fields. Furthermore, the empirical survey has – in line with the nationwide findings – underlined that although both institutions display a focus on a certain competence this competence is not completely absent in the other one. Figure 8, for example, reveals that the University does co-operate locally while a mere look into the University of Applied Science's website reveals that it has as well some achievements in the field of research.[8]

Nonetheless, both organisations could undoubtedly profit from an integration of some of their main activities – with the aim to could bring their competences together and enable them to learn from each other in a natural way.

One first step in this direction has been taken by developing joint curricula and strengthening them through a mutual recourse on existing competencies and experiences. Currently, this opportunity is explored by engineering courses at the University of Applied Sciences linked with teaching inputs from the University's faculty of medicine (e.g. medical informatics, medicine technologies). The establishment of this kind of co-operative study programmes (e.g. in biomedical engineering) does not only improve the mutual understand of each other's specific capabilities but also provides an opportunity to generate valuable first experiences on the basis of which future co-operate strategies can be build.

In a second step, novel institutional models are being considered with the aim to systemize the co-operation between the two organisations. Before this can happen, however, both institutions underline that similar activities need to be bundled on both sides to create a sort of interface at which the activities of both partners can sustainably be matched.

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8 http://www.hs-regensburg.de/einrichtungen/forschung-und-transfer-iafw.html

In a first phase, activities at both institutions would have to be co-ordinated to develop a joint area of strength in those fields in which a regional demand is documented. For the University of Applied Sciences this would imply the targeted expansion of existing R&D capacities; for the university, it would involve a strengthening of cross-disciplinary co-operation with the long term perspective of bundling some of its dispersed MINT resources in a newly set-up faculty in the defined area of co-operation – and ambitious project both with respect to the internal consensus and the resources needed. Currently, a first tentative step in the direction of interdisciplinary co-operation has already been taken with the establishment of new courses in the field of media informatics, computational science and computational physics.

In parallel, additional steps could be taken with the definition of self-standing co-operation projects in the field of research with clearly defined strategies to bring together and complement each others areas of strength to increase trust between both partners and mutual knowledge about each other – and thus in the long run prepare more ambitious steps.

With a view to Research Question 2.2

The brief overview of possible options has shown that it is challenging to conceive suitable and institutionally realistic approaches to integrate the long-time fragmented competences within the regional higher education system – which continue to hamper the development of a stronger third role of the regional higher education sector. Evidently, both institutions have a long institutional history and particular profiles so that any attempt to bring together competences by simple mergers, even if partial, would reveal a misunderstanding of the situation – and likely be futile. Nonetheless, the recent years have seen an increased openness of both institutions to consider each others activities in their respective strategic planning. First steps to match the regional industry's demands

have been made by the University of Applied Science's acceptance of external teaching input in more conceptual fields and the University's efforts to design interdisciplinary courses with a view to increase the application orientation of its curricula. Undoubtedly, the way forward will be one of a gradually intensifying joint practice in teaching and research – with the ambition to in the long run reconcile a convergence in missions with a convergence in practice.

5 Summary

In Germany, professors at both universities and universities of applied sciences have actively lived the "third role" for many years, although at times without consciously recognising that they did. The results of the Germany-wide survey illustrate that beyond information events and further education the most frequent activities in this regard are the placement of students as well as contributions to local communities and social involvement. Additionally, our survey underlines that regional engagement is mostly motivated by reasons like increasing reputation and visibility, augmenting the higher education institution's attractiveness for students and the development of practically oriented curricula.

On closer examination, differences in attitude can still be documented between professors at universities and those at universities of applied sciences. In general, professors at universities of applied sciences are more often involved in hands-on consulting activities, as well as teaching-oriented activities, whereas university professors have a higher propensity to engage in pre-competitive research projects with regional partners.

While, on direct request, most academics stated that few centralised incentives were given to extend or facilitate their activities in this field, universities of applied sciences appeared to be a bit more open in this respect than others – in line with their regional mission.

The case study of the Upper Palatinate region in Bavaria with its capital Regensburg has corroborated that the predicted fragmentation resulting from the clear differentiation of tasks between universities and universities of applied sciences is real. In Upper Palatinate, both the regional university and the regional university of applied sciences aim to collaborate with and to supply graduates to the strong regional manufacturing sector. This process, however, is hindered by the particular characteristics of the local higher education institutions in different ways. While the local university lacks a sufficient focus on engineering and regional networks the local university of applied sciences is unable to provide the research capacities and higher level graduates that

some larger firms are looking for. Consequently, the development of a strong "third role" is hampered by a fact that competences are split between the two main players in the regional higher education sector. Recognizing this situation, both higher education institutions have started to engage in co-operations complement each others key competences. A process, however, that will be gradual, lengthy and open ended.

In summary, our paper has aimed at and succeeded in demonstrating that the development of a "third role" of higher education is not homogeneous but a regionally contingent process with many facets. Due to the differences in endowments and requirements of the main actors in regional innovation systems there is no new, single optimum that will be reached as the consequence of the development of a "third role". Instead, the engagement, involvement and mutual adaptation of regional players will continue in a transformed, but path-dependent way. While many universities still seem to be struggling to implement their new strategies to an extent that would be broadly acknowledge by individual professors, this study has collected different types of evidence that underline that regional missions put in practice are a common characteristic of many universities of applied sciences.

In the future, further research is needed in order to shed light on the perception of business and society towards these changes – aiming at an understanding of whether the process of mutual engagement will continue to intensify or at some point be reversed. Moreover, the case presented in this paper underlines that the way in which higher education institutions aim at playing their "third role" and the institutional models that they develop to do so are highly idiosyncratic. In this context, it remains to be seen to what extent different institutions in one region will actually be willing to learn from each other – or if they continue to follow their own institutionally specific pathways of learning. Consequently, it would be interesting to conduct similar studies in other regions, or even countries, and see if they come to the same basic conclusions.

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