The changing role of universities in the German research system: engagement in regional networks, clusters and beyond

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1 Introduction

The German research system is well developed and consists of a manifold of different organisations for both basic and applied research and industrial development (Frietsch and Kroll 2010). Within the research system, the universities are the largest public organisation which carries our research and development (R&D). Of the total German R&D expenditures of 61.5 billion Euro in 2007, universities represent a share of 16.1 %, while the second largest research organisation, the Helmholtz Association, reaches 4.4 %. Nevertheless, with a share of 69.9 % most R&D is performed in the industrial sector (BMBF 2010, p. 41).

Technology transfer at universities started as early as the 1970s with the operation of the first transfer offices, still following the linear innovation paradigm (Krücken and Meier 2005). With advances in innovation economics research during the 1970s and 1980s, the understanding about the complexity and interactivity of innovation processes changed drastically. Especially with the increasing popularity of the system of innovation approach (Lundvall 1992; Edquist 2005) regional innovation networking within and between the industrial and the research sector gained more and more importance during the 1990s. The 'network paradigm', as Cooke and Morgan (1993) put it, became the starting point for policy measures by which the effectiveness and the efficiency of distributed innovation activities was promoted.

In Germany, but in other countries as well, a trend towards a regionalisation in technology and innovation policy is clearly evident. In 1995, the German Federal Ministry for Education and Research initiated the BioRegio contest which aimed at the strengthening of biotechnological research and increased international competitiveness in this field by supporting firms, universities and other research institutes collaborating in close spatial proximity (Dohse 2000). Together with an amendment of the German higher education framework law by which knowledge and technology transfer was introduced as third main objective of universities (besides research and

teaching), other national programmes started in 1997 which explicitly promoted the role of universities in regional networks (e.g. the EXIST firm formation from universities programme). During the first decade of the new millennium, the freedom of universities was further strengthened by:

- the introduction of self-governance instruments and thus the increasing independence of universities from formerly strong public governance (Liefner 2001),
- the abolition of the professor's principle in patenting of university inventions and the creation of university patenting and licensing offices,
- the Bologna process which put strong pressure on the universities to reform their curricula,
- the excellence initiative of the national government for the selection of 'elite universities',
- the formulation of the high-tech strategy as the comprehensive German technology and innovation policy platform, addressing the universities as strategic research partner for enterprises.

These developments trigger the expectation towards universities that they should establish regional ties and networks in order to exploit the advantages of spatial proximity to other research institutes, to industry and to policy and regional administration, e.g. within a cluster or through other collaboration activities. In Germany, it is expected today that universities are excellent in research and provide all necessary resources for good teaching, both on a national and international competitive level, that they have a high patent output and sufficient licensing returns, that they provide incubation facilities for spin-off activities, and that they act as knowledge hub in their respective regional innovation system. It is the objective of this paper to analyse the role of universities in their region as driving force for the development of new modes of collaboration both with industry and with other research organisations. Starting from the literature on universities and their regional ties, future prospects in the appearance of new forms of boundary spanning roles of universities (Youtie and Shapira 2008) in distributed research and innovation processes will be discussed.[1]

2 Universities in the context of regional research and innovation policy

The strategic orientation of universities in their regional environment has become subject of economic and social science research from different perspectives (Bleaney et al. 1992; Cooke 2002; Gunasekara 2006; Keane and Allison 1999; Kitagawa 2004; Thanki 1999). Since around 15 years a strong interest in the increasing autonomy of universities can be observed in the growing field of higher education research. This development is based on the changing and

1 We thank our colleagues Miriam Hufnagl and Henning Kroll for their valuable contributions to this paper.

thus decreasing role of the government in the governance of universities. An important finding of university research is the observation that in most European countries an orientation toward external targets has gained priority (Teichler 1998). Research topics include control over evaluation systems (Gläser et al. 2008), the setting of new incentive structures (Liefner 2001; Schröder 2003) and greater control of resource flows (Teichler 1998, Teichler 2002).

Less studied, however, are the effects of non-research policy instruments in the strict sense, which nevertheless have effects on the strategic orientation of universities. These include public programmes in the context of new innovation policies and measures which try to activate universities and other research institutes as a regional or even national knowledge anchor. German examples of this kind of policies are the excellence initiative, the high-tech strategy (here in particular the leading-edge cluster competition), support programmes such as EXIST (business start-ups from the science sector; cf. Kulicke 2006), the various activities of the programme family 'UnternehmenRegion' in eastern Germany (cf. Eickelpasch and Fritsch 2005), and the various cluster programmes at the federal states level (cf. Kiese 2008). Such measures are increasingly combining regional networking with strong competition among the actors. This reflects a growing trend in emphasising regional policy measures which also have an effect on universities, especially in times when they have to acquire additional public and private funding.

It can be expected that this development opens options for strategic actions of universities, especially in the range of their increasing autonomy. Universities become actively acting strategic actors by themselves (Krücken at al. 2009; Krücken and Meier 2006; Nickel 2004), whereas they were only control object before. In science and innovation research the emergence of "entrepreneurial universities" (Clark 1998; Gibbs 2001; Etzkowitz et al. 2008), the "boundary spanning roles" of new university units (Youtie and Shapira 2008) and the special role of universities in the transfer of tacit knowledge in a regional context (ibid.) are discussed in this context. These role models and the associated significance in local knowledge transfer (Abramson et al. 1997; Charles 2003; Gunasekara 2004; Premus et al. 2003) are relatively new for German universities - compared to the activity profiles of American, British or Australian universities (e.g. Beckmeier and Neusel 1994). The forms of coordination and control which emerge are strongly influenced by the regional integration and the structure of scientific disciplines, resulting in an increasing differentiation in the higher education system (Gibbons et al. 1994). It is assumed here that the initiated measures lead to the emergence of different types of universities with different degrees of regional orientation. So far there is little empirical evidence in this field.

Research in economic geography and regional science deals since the mid 1990s with the role of universities in regions as well as with network relations of research institutes in terms of content and spatial perspective. Three main lines of research can be distinguished.

Especially during the 1990s, studies dealt with the regional economic effects of universities and technical colleges (cf. Voss 2004 for an overview). The focus was on the economic impacts of these organisations, especially as a regional employer and as buyer of products and services, but also with regard to demand aspects of university employees and students (cf. Bleaney et al. 1992 for a case in England). These studies have demonstrated that universities exercise significant employment and income effects on their region, and that some of them are even the largest regional public employer.

A second line of research emerged since the late 1990s from the increasing variety of tasks of higher education, the orientation at the US American transfer model and the resulting development of the Triple Helix model (Abramson et al. 1997; Etzkowitz and Leydesdorff 1995). The "Entrepreneurial University" which is outlined there has not only the task to act entrepreneurially in terms of attracting excellent academics and to generate licensing revenues from the transfer of university research results (Etzkowitz et al. 2008), but also to promote the idea of entrepreneurship among employees and students with the aim of creating new businesses through spin-offs (Franzoni and Lissoni 2009). In this context academic spin-offs which locate in spatial proximity to their incubator organisation play an important role (Koschatzky and Hemer 2009; Rabe 2007; Stahlecker 2006). In recent years, the research focus is on analyses which deal with fluidity of research organisations and research systems and the emergence of new modes of organising research for which the proximity between different partners is important (Kaufmann and Tödtling 2001; Kuhlmann et al. 2003). Among these modes are temporary forms of strategic research cooperation between universities and firms in which scientists from both organisations jointly work on new topics as part of a public-private partnership (Frank et al. 2007; Koschatzky and Stahlecker 2010). Other forms are cooperation agreements within the science sector. A prominent example in Germany is the merger of the University of Karlsruhe and the Research Center Karlsruhe (as part of the Helmholtz Association) as Karlsruhe Institute of Technology (KIT) in 2009. This merger was part of the concept of the University Karlsruhe to become a university of excellence.

A third line of research can be identified in the analyses of regional innovation systems (e.g. Asheim and Gertler 2005; Cooke 1992; Cooke 2002), which particularly address the role of the research sector. Based on primary statistical surveys using standardised questionnaires in different German and European regions (cf. Koschatzky and Sternberg 2000; Sternberg 2000) and by additionally drawing on other German and European innovation surveys (e.g. Beise and Stahl 1999; Mohnen and Hoareau 2003) it could be shown that universities intensively cooperate with various partners, but regional cooperation relations particularly exist with firms (Fritsch and Schwirten 1998). On the other hand, networks with other universities have a significantly greater degree of national and international orientation (Sondermann et al. 2008). It could also be shown that within this general cooperation pattern technical colleges (universities of applied science) focus much more on their close geographical environment than universities (Beise and

Stahl 1999). Other studies in the following years analysed specific aspects of the regional embeddedness of universities. Fritsch et al. (2007) found out that the intensity and quality of research conducted at universities has a significant effect on regional innovation performance. Broström et al. (2009) dealt with the question of whether the regional knowledge spillovers of universities are so large as to encourage the settlement of branch plants of multinational companies. Thune (2007) analysed whether the embedding in previous networks between universities and firms influences the emergence of joint research projects and the perception of the success of these projects. Also the role of universities in regional innovation systems is continuously addressed (Fritsch et al. 2007).

The growing interest in the interactions of universities with their regional environment is related to the increasing importance of the region in supranational and national science, research and technology policy. At least since the late 1990s in Germany (but also in many other countries) the formation and development of regional networks, regional centers of excellence and knowledge- and technology clusters is actively promoted by the European Commission and the national and regional governments. It is the objective of these measures to increase national competitiveness and to develop regional and local knowledge and creativity poles (Dohse 2007; Koschatzky 2005). As a result, both the national and the regional-local policy levels expects universities to play a more active role in regional capacity-building and profile development, even if this expectation is not always explicitly formulated. Beyond the traditional management tools and the current funding programmes a more fundamental political pressure is put on universities in the way that they should expand their regional ties and increase their regional impact.

Based on these reflections we formulate our central research question:

- Which strategies and modes of organisation do universities develop for a stronger integration in regional networks, the regional economy and regional politics?

We have to assess whether and how the new political demands trigger the emergence of new strategies dealing with the expectations to engage regionally. It can be expected that especially large research universities cannot only focus on their regional environment, but have the task to offer a nationally and internationally competitive research portfolio. It is therefore necessary for them to combine different, sometimes conflictive, tasks in order to meet all political demands. We will therefore analyse the strategies of those universities which do not exhibit a strong regional integration per se (as for example the technical colleges have), i.e. larger universities with a high scientific reputation.

3. Regional networking strategies of universities

Since we have to identify strategies and modes of organisation we cannot use a broad statistical dataset, but have to apply a comparative case study approach. In this paper, we will exemplarily analyse two technical and one general universities which all are highly linked to international scientific networks: the technical universities of Karlsruhe and Aachen and the University of Heidelberg. All three were awarded with the title "elite university" as winners of the excellence initiative of the German federal government (BMBF 2010, p. 25).[2] The selection of these three cases reflects different strategies of collaboration with regional partners.

3.1 University of Karlsruhe

Founded in 1825, Karlsruhe University is the oldest technical university in Germany and one of the nine universities in Baden-Württemberg. Its profile is determined by technical and natural sciences and engineering. Architecture, humanities, cultural sciences and economics are also present, but interlinked with thee three other major fields. The University Karlsruhe has more than 18,000 students and around 4,300 employees, making it an important employer in the region. Of these employees, 266 are professors and 350 foreign scientists. The university budget is 299 million Euro. In 2006, the university has won in the excellence initiative of the German government together with the University Munich and the Technical University Munich. In physics and information science, Karlsruhe is in the top group of German universities (Karlsruhe Institute of Technology 2009).

Karlsruhe University is an important actor in the so-called "TechnologyRegion Karlsruhe". This region is identical with the administrative district Karlsruhe and includes the districts (Landkreis) Germersheim and Südliche Weinstrasse, which belong to the neighbouring federal state of Rhineland-Palatinate. The region has 1.12 million inhabitants and GDP per capita is around 32,500 Euro and thus similar to the average of Baden-Württemberg. The objective of the TechnologyRegion Karlsruhe is to join forces in economic promotion by representing and promoting the diversity of the economy and the individual cities and counties under a single roof. A unique feature of the region is the form of regional cooperation based on principles of voluntarism and interdisciplinarity. One of the strength of the region is its research potential. Both in technology output (patents) and in scientific output (publications), Karlsruhe (including the TechnologyRegion) is among the European top performing regions. With regard to filings at the European Patent Office, Karlsruhe reaches the 4th rank among 167 European regions (520.4 filings per million inhabitants in 2004 and 353.2 in 2005) (TechnologieRegion Karlsruhe 2006).

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In this context, the university and its representatives play an active role in the region and are engaged in different activities since many years. Close scientific working relationships exist with the Research Center Karlsruhe (FZK) since many decades. In 2008, 18 of the 31 directors of the different FZK institutes had a chair at Karlsruhe University. The research center was founded in 1956 as the Nuclear Research Center Karlsruhe and employs 3,700 people of whom 63 are professors; its budget amounts to 408 million Euro.

The reason why the University Karlsruhe received the status "elite university" was the plan outlined in its proposal to the excellence initiative to merge the university (as an entity of the federal state of Baden-Württemberg) with the Research Center Karlsruhe (as a national entity) in order to establish a new organisation called Karlsruhe Institute of Technology (KIT). This proposal was only possible with the strong support of the organisational bodies of the research institutes, namely the federal state of Baden-Württemberg and the Helmholtz Association, and also of the city of Karlsruhe. Especially the regional support reflects the important role the university plays for the city and the region. It is not only institutionally well embedded in the region, but the region itself expects from a merger an increased reputation of Karlsruhe as a technology and science city. After the university received this elite award in October 2006, official negotiations started between the two organisations on the one hand, and between the government of Baden-Württemberg and the Federal Ministry of Education and Research as responsible political actors on the other hand. While the institutional cooperation under the KIT umbrella started in July 2007, at the end of July 2009 an agreement between Baden-Württemberg and the Federal Government was signed which serves as a framework for the merging process of both organisation to form the KIT (BMBF 2009). This merger created a new organisation operating along the three strategic fields of research, teaching, and innovation. With about 8,000 employees and an annual budget of about 700 million Euro, the KIT becomes one of the largest research and teaching organisations worldwide (Karlsruhe Institute of Technology 2010a). By its size and reputation the KIT serves as a knowledge creating und distributing hub for the region and for whole Germany.

The KIT is not only geographically rooted in the region through its south campus, which is located within the city of Karlsruhe, and the north campus which has its location north of the city in the district (Landkreis) of the same name, but also engaged in several regional initiatives. It is one of the major drivers of the cross-border metropolitan region Upper Rhine Valley in which universities and research institutes from the western part of Baden-Württemberg, Alsace and the north-western part of Switzerland will create a platform for research networking, e.g. in the life sciences, and mutual exchange of students and research staff (Deutsch-Französisch-Schweizerische Oberrheinkonferenz 2010). Besides, KIT is involved in two of the German leading-edge clusters, funded by the Federal Ministry of education and Research within the high-tech strategy. On the one hand, KIT participates in the software cluster "Software Innovations for the Digital Enterprise". It is the only software cluster in Germany and covers the centers of

Darmstadt, Kaiserslautern, Karlsruhe, Saarbrücken, and Walldorf. In the MicroTEC Southwest cluster which focuses on the use of microsystems technology in various sectors KIT is one of the prominent partners. The cluster based in Baden-Württemberg is aimed at linking research, industry, and in particular small and medium-sized enterprises and crossing the boundaries of branches (Karlsruhe Institute of Technology 2010b).

The formation of KIT is a new development in the German research system and demonstrates that the borders between formerly separated organisations become weaker and interactions get stronger. KIT is an example for a new mode of research-research collaboration in the way that the competencies of two formerly different organisations complement each other. Nevertheless, this model is not free of conflicts. The conflicts are less pronounced with regard to its regional role, but are stronger regarding the internal governance structures. It will take quite a long time until formerly different payment schemes, carrier paths and incentive systems will be matched as to form one externally and internally coherent organisation.

3.2 University of Heidelberg

The University of Heidelberg is one of the classical European research universities with a long tradition and an outstanding reputation. It was founded in 1386 and had for centuries four faculties, i.e. theology, laws, medicine and philosophy. Only in 1890 the natural sciences complemented its disciplinary structure. Today it has 12 faculties both from the social and natural sciences and a university clinical center. On the average of different university rankings, Heidelberg is one of the highest ranked German universities and among the leading European universities. Regarding Nobel prizes, Heidelberg is fourth in Europe and 13th globally. In October 2007, it received the status 'elite university' for its future concept "Heidelberg: Realising the Potential of a Comprehensive University". It has around 27,600 students and employs 12,191 people (including the medical facilities). In the university alone 3,498 have their working place. Of these are 240 professors. The budget of the university (including medical facilities) reached 548.31 million Euro in 2008, of which the university alone represents 283.48 million Euro (University Heidelberg 2010).

The city of Heidelberg is a science city and hosts many internationally well known research institutes. Besides the university, the German Cancer Research Center, the European Laboratory for Molecular Biology, four Max-Planck Institutes and many others are located in the city. Heidelberg and its respective research institutes were also part of the BioRegio Rhine-Neckar triangle which was funded by BMBF as one of three model regions from 1997-2005.

Due to its long tradition, the University of Heidelberg is deeply rooted in its regions and an interesting partner for research collaborations. As well as for Karlsruhe, the excellence initiative served as an impetus for developing new forms of collaboration, in this case between the uni-

versity and industry. The impetus was thus indirectly in the way that in the first phase of proposal writing a strategy paper was drafted which underlined that the technology transfer between the university and industry did not function in a satisfactory manner. The idea was to develop something new and based on already well functioning relationships with industry to demonstrate that the university regards knowledge and technology transfer as one of its key priorities. Together with the chemical company BASF, the idea for a Catalysis Research Laboratory (CaRLa) was borne. This laboratory should be similar to the university-industry research centers in the USA (Koschatzky and Stahlecker 2010). Within the university's application to the "excellence initiative" the plan took on more concrete shape in the year 2006.

Right from the beginning, no specific institute status was planned as the university wanted to profit directly from the work in the lab. A contract regulating the establishment and operation of CaRLa between BASF and the University of Heidelberg exists; however the lab does not possess an own legal form. The University has rented premises for CaRLa in the near technology park. A cost division on a 50:50 basis was agreed between the partners, whereby the university and the state of Baden-Württemberg share the 50 per cent university share. The savings bank of Heidelberg (Sparkasse) as owner of the technology park is also a partner in this public private partnership. The facility was opened in November 2006.

In the beginning of its activities, CaRLa had a total of 13 staff members, six of whom are international post-docs from the University and six BASF scientists as well as the head of the laboratory, who comes from BASF. The latter is assisted by a scientific head from the university. In addition, one visiting scientist per year is planned. Within the lab itself no division is made between university and BASF. The work contracts are admittedly different, but the employee salaries are uniform. CaRLa's target is the systematic research into how catalysts work and to find new ways for catalyst development (catalyst design). Due to the collaboration with the special research area "Molecular Catalysts: Structure and Functional Design" of Heidelberg University, CaRLa is presently basic-research-oriented; contract research is however possible at a later date. Five years were agreed on as the initial time limit, whereby an evaluation should be carried out after the third year. If this is positive, the running time of CaRLa can be extended. A flexible solution was important for both partners which does not build upon existing structures so that the cooperation can be terminated without high follow-up costs (Koschatzky et al. 2008).

3.3 Technical University of Aachen - RWTH Aachen

With 260 institutes in nine faculties, RWTH Aachen is one of Europe’s leading institutions for science and research. Currently around 31,400 students are enrolled of which over 5,000 are international students hailing from 120 different countries. The university's innovative force is reflected in the high number of start-ups in the area: Over the past twenty years, about 1,250 spin-off businesses were founded and created around 30,000 jobs in the greater Aachen region.

RWTH Aachen University was founded as a polytechnic institute (Polytechnikum) in 1870 by an industrial initiative, in a then fringe area of the Prussian heavy industry. As early as 1899, it was granted the right to award doctoral degrees. Re-established after World War II as the Institute of Technology of North Rhine-Westphalia (Rheinisch-Westfälische Technische Hochschule Aachen), it soon obtained the status of a university. Today, the profile of RWTH Aachen is determined by engineering and the natural sciences (RWTH Aachen 2009). Like the university of Karlsruhe, RWTH Aachen was selected as one of nine German universities with the most promising concept for the future (however, unlike Karlsruhe university RWTH Aachen was awarded not before the second competition round for government funding in 2007). The nationwide competition resulted in grants provided by the national government totalling 180 million Euro over a five year period of time.

Partly due to its research profile, but also due to a strategy that can be described as “entrepreneurial” and business-oriented, the work conducted in the research centres at RWTH Aachen is strongly oriented towards the current needs of industry, commerce, and the professions. This has led to numerous innovations, patents, and licenses. Contract research and "third party funding" are of significant importance for the RWTH as a whole and for single institutes in particular. The so-called "An-Institutes" of the RWTH for instance (i.e. institutes associated to the RWTH and closely cooperating with industry) have 500 employees and more than 35 million Euro expenditures per year and thus accomplish an important contribution to the technological development of the region. The strong research performance of the RWTH in terms of basic and applied research (with a strong orientation towards the technological needs of the business sector) was a crucial factor in motivating multinational corporations such as Philips, Microsoft, and Ford to locate research facilities in the Aachen region. Against this background, it comes as no surprise that RWTH Aachen consistently ranks as one of the German universities with the most external funding.

In line with the already well established regional networks of the RWTH with technology oriented enterprises that make use of spatial proximity in order to have access both to technologies and qualified graduates, two recent initiatives deserve a deeper analysis to understand the strategy of the RWTH Aachen with a view to regional integration:

- The RWTH industry research campus
- Jülich-Aachen Research Alliance (JARA).

The two initiatives constitute "two sides of the same coin": by strengthening and intensifying the links between RWTH Aachen and the Research Centre Jülich (like the Research Centre Karlsruhe, a non-university research centre primarily carrying out basic research and financed by the federal government as one of its "Helmholtz Centres"), the insularity of university and non-university research and teaching should be overcome. The RWTH industry research cam-

pus on the other hand will be a new organizational mode in the German research system aiming at closing the gap between university-based research and business research.

The completion of RWTH's new *industry research campus* will make the University one of Europe's largest hubs of research. Over the next few years, RWTH and its business partners will invest around 1 billion Euro in the project, creating a fully equipped site for interdisciplinary top-flight research with an array of research institutes, laboratories and offices. More than 100 high-tech companies from Germany and the rest of the world will take up residence there for the medium term to work directly with University institutes. A total of 15 RWTH "clusters of excellence" will be created to focus on specific research topics and closely align the academic interests of the university with the needs of industry. Major research topics include bio-medical engineering, integrative production technologies and sustainable energy.

One of the largest and most visible current projects of the industry research campus is surely the E.ON Energy Research Centre (E.ON ERC) which was initiated by a major R&D donation of E.ON AG to RWTH Aachen in 2006. The donation was used to form a public private partnership for a duration of 10 years. At this time, this partnership is the largest research cooperation between a company and a university in the European Union: two "big players" are working together here as equal partners. The core of the research center consists of five Chairs for which E.ON is financing a total of 40 million Euro over a period of ten years. Furthermore, the management of E.ON ERC and the involved scientists want to enlist considerable funds for additional research projects not only from public research funding programmes but also through cooperations with other companies. The volume of this third-party funding after approximately five years is expected to correspond to about the annual contribution of E.ON AG. Co-applicants and other clients are expressly welcomed to cooperate through contracts and collaborations in the studies on securing our future energy supply (E.On Energy Research Centre 2008, 2009; RWTH Aachen 2009).

RWTH Aachen is responsible for constructing the E.ON ERC building. Moreover, RWTH Aachen has explicitly declared that it will continue to support this research center beyond the initial financially guaranteed period of ten years. Under these prerequisites, not only does the E.ON Energy Research Center have every opportunity and right to soon become an indispensable institution in energy research, but it also has every opportunity and right to maintain this position on a long-term basis and to continuously develop it further in the future.

The main objective of the *Jülich-Aachen Research Alliance* (JARA) is to establish a scientific environment that is in the top international league and is attractive to the best researchers. At the same time, research opportunities are opened up and projects realized that would not be possible for one partner alone. Over and above pure research, the collaboration in JARA also encompasses the fields of education, facilities, innovation and services. These fields create the

necessary conditions for research and the applications arising from this research. JARA currently comprises four research areas: (1) sustainable energy (JARA-ENERGY), (2) brain research (JARA-BRAIN), (3) information technologies of the future (JARA-FIT) and (4) high performance computing (JARA-HPC). The two partners, RWTH Aachen University and Forschungszentrum Jülich, thus selectively link research fields in which they have complementary expertise. In this model of integrative partnership, scientific policy strategies are defined and coordinated. Research goals are jointly defined, investments made and academic staff appointed and trained. JARA has a staff of approx. 3,800 with a financial budget of about 350 million Euro. In 2009, the volume of investments amounted to around 40 million Euro (Forschungszentrum Jülich and RWTH Aachen 2007).

4. Conclusions and research outlook

Regarding our three case studies, we come to the following conclusions:

- The foundation of KIT was not a response to the increasing expectations for a stronger regional integration, but result of a new programme (the excellence initiative) of the federal government which offered financial incentives for those universities which developed new and creative future-oriented research and teaching concepts. Regional, national and international cooperation with leading research partners is one of the central elements of this programme. The excellence initiative is a good example for research and innovation policy which adds new forms of competition based financial support to the classical division of labour between the federal government and the federal states governments in which the latter are mainly responsible for university funding. The merger between the university and the Research Center Karlsruhe would not have been possible without previous close collaborative ties between the two organisations. Regional networking and integration, combined by joint research interests, mattered in this case. Since these regional ties existed, the excellence initiative with its demand for regional cooperation created an impetus for the plan to merge the university with the research center. In this respect, the political expectation to create something new out of a regional research network was implemented. The KIT as new large organisation has a much stronger weight in the regional political governance than the two former organisations alone. As a consequence, it is a strong economic and scientific actor and coordinates both formerly independent regional network relations in one unit. Its scientific strength and its role in regional networking is reflected in its participation in the cross-border metropolitan region Upper Rhine Valley and in the fact that it is member of two nationally leading clusters from Baden-Württemberg and neighbouring federal states.

- CaRLa at the University of Heidelberg is an example for a regional engagement of the University of Heidelberg in the form of a joint research lab with an industrial company, organised as public-private partnership. A major reason for the foundation and an important advantage

in the operation is the spatial and cultural proximity between the two actors. Trust, personal exchange and close distances are seen as the most relevant requirements. CaRLa stands for a new mode of collaboration by which the university demonstrates its regional embeddedness and signals its openness for future-oriented transfer activities.

- The RWTH Aachen is currently in a process of a realignment of its regional networks with the aim to integrate university research (and teaching) with non-university research and at the same time pursues the objective of strengthening the links with research and technology-oriented firms in the region and beyond. The two recent initiatives - JARA and the industry research campus - are the most ambitious strategic manoeuvres until now. From an organisational point-of-view JARA means no formal integration of RWTH Aachen and the Jülich Research Centre and therefore is not as far reaching as the KIT example in Karlsruhe; however, KIT may serve as a role model for JARA in terms of a mid-term perspective. The research-industry campus on the other side is a consistent further step towards a public-private partnership based model with the aim to create an organisational frame for new strategic research partnerships. Both initiatives are supported, but not initiated by policy. The strategies were primarily developed by the different organisations involved, i.e. the RWTH Aachen, the Jülich Research Centre and the different companies which are already active in the campus or intended to do so. The construction of the industry campus will partly be financed by the federal state of Northrhine-Westphalia.

With regard to our research question, which asked for the strategies and modes of organisation universities develop to reply to political expectations regarding their role they could play for regional development, we can concluded for our case studies that German universities developed a great creativity in establishing new modes of research governance and created new forms of collaborations with different partners, be it companies or other research institutes. The universities we analysed changed their roles from classical research universities to entrepreneurial universities in the way that they not only became autonomous in their decisions (and are no longer dependent on ministerial governance as they were in the past), but also in they way that they developed and implemented new research and transfer relationships within their respective regions, often in the form of public-private partnerships.

This kind of 'regionalisation' reflects the new freedom the universities have in organising their structure, their transfer interfaces and their budget, but is also the result of new policy measures which directly (e.g. through local or regional clusters) or indirectly (e.g. through the excellence initiative) aimed at a stronger integration of universities into their respective regional environments. By participating in respective public programmes and activities, but also by developing own initiatives, our case study universities increased their regional involvement substantially. This involvement is not only a reply to the political expectations as to play a stronger 'regional role', but also an approach to combine regional potentials both from industry and the science

sector in order to increase their attractiveness as a research and transfer partner and their scientific competitiveness at a global scale. In this respect, universities become much more proactive and dynamic organisations in regional and national innovation systems and are thus able to strengthen their role as a knowledge generating and knowledge diffusing interface in innovation processes. This new role is not emerging without conflicts, because the traditional research incentives (e.g. with regard to publications) are still important and sometimes conflictive to incentives which reward collaboration and transfer with industry (e.g. with regard to non-disclosure of research results). Nevertheless, the examples we analysed show that these conflicts are not insolvable, especially when new options for research, teaching and transfer activities develop.

Although we shed some light on the new modes of organising research collaborations between universities and other partners in a regional context, our three case studies do not allow a deeper insight into the opportunities and threats universities face with regard to the political expectation to play a stronger role in regional innovation systems. Here, more research is needed in order to identify different types of collaborative behaviour and their implications on coordination and governance processes within universities. As already mentioned, it could not be expected that all universities and their faculties react in the same manner, but that different strategies emerge as response to the explicit and implicit expectations of a more active regional engagement of universities. Next steps of our research will deal with this challenging question.

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