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Title: Knowledge Economic Specialisation of Regions as development Potentials

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1 Introduction

Different terms are used to describe the key drivers of the economic structural change: knowledge economy, knowledge-based economy, and new economy are just a few. Knowledge becomes the most commonly used term associated with globalisation as it is connected with a growing quantitative and qualitative extension of knowledge work. Traditional production factors such as natural resources, labour and capital are accompanied by a new one: knowledge. Knowledge becomes a tradable commodity transferred through personal exchange as well as in form of (more or less standardised) products. This fact has been reflected in spatial economic debates on the impact of the knowledge economy.

Scholars of different disciplines seem to agree upon the fact that knowledge work is usually very interactive and takes place in networks and collaborations. Therefore, knowledge intensive firms built up interaction networks in order to gain access to knowledge, to collaboratively generate new knowledge as the base for organisational and individual learning, as well as to share costs and risks in knowledge intensive work. In that understanding, the knowledge economy forms the link between global and local knowledge resources: Regions successfully participating in the knowledge economy have to fulfil the function of being a hub between local and global knowledge sources. Firms embedded in certain regions have to be able to combine different kinds of knowledge –such as for instance scientific knowledge, technological knowledge, and entrepreneurial knowledge (Karlsson und Johansson 2004)– originating not only from very different sources but also from different regions.

Looking at the spatial distribution of economic activities, two trends seem to be overlapping each other: Because of the necessity to hold up national and international contacts, needs to access high-quality infrastructures (such as air-connections, fast speed rail connections, high-speed and secure telecommunication infrastructures) as well as options to access person-bound –tacit– knowledge through locally bound informal networks and milieus are dominating location decisions. Therefore scholars observe an increasing concentration of knowledge intensive economic activities in very few central places, such as large metropolitan agglomerations (Sassen 1991; Häußermann und Siebel 1995; Blotevogel 1998; Kujath 2005a; Schmidt 2005; Krätke 2007). On the other hand, because of modern infrastructures, knowledge intensive work may take place everywhere. The "death of distance"-thesis (Cairncross 1998) has heated the debate on the spatial impact of the information society (Castells 1991) and the fear of the decreasing power and economic stability of metropolitan regions. Combining those two contradictory theses, debates on the interplay between global development trends and local resources and potentials came up (e.g. Swyngedouw 2000; Castells 2002).

Recently, the concentration thesis seems to be supported. Although accompanied by an increasing importance of metropolitan regions, the concentration argument also puts forward the observation of highly specialised knowledge in few non-metropolitan regions, finding theirs imprint in clusters and regional innovation systems. Malmberg and Maskell (2006) argue that this spatial concentration may not only be explained by localisation advantages as external effects (often used in cluster debates), but rather by the capability of firms to organise learning routines and interaction networks to gain access to different knowledge sources. Such activities are not only supported by "hard" and relatively ubiquitous locations factors, but rather by region-specific conditions provided through region-bound knowledge as well as a supportive institutional environment: „*All that it says is that location patterns will never be determined by ubiquities, but that firms locate and build their competitive advantages in interaction with localized capabilities. These might be chiefly associated with a region's natural resource endowments, infrastructure, and built environment, but it is more likely today that it is the available knowledge base and institutional setup that matter.*" (ibid.: 3).

It is therefore probably more likely that simultaneous concentration as well as de-concentration characterise spatial implications of the knowledge economy. Even though the arguments put forward by Malmberg and Maskell help to explain observed different spatial processes, a clear understanding of the factors determining knowledge economic activities and their spatial imprints is still lacking. Furthermore, an understanding of explanatory factors for spatial disparities with regard to economic performance is still underdeveloped. One reason for this is a quite diffuse understanding of what actually is "the" knowledge economy.

With this paper we would like to introduce a differentiated look at the spatial impacts of the knowledge economy. Based on theoretical considerations rooted in the new institution economy we introduce a differentiation of the knowledge economy that addresses different functional specialisations rather than specialisations based on economic sectors or branches. This enables us to argue, that spatial processes may be explained by the modalities of knowledge work, not by specific products. It is the need to interact with different parties and to organise such interaction that determines location decisions. Because of the advantageous provision with modern ICT and long-distance transport infrastructures, metropolitan regions seem to be favoured regions for those firms that have a high demand of frequent and intense interaction with different actors. However, based on the modes of knowledge that determines the main activities of firms in the knowledge economy, non-metropolitan regions may fulfil such hub-functions as well.

The paper builds on empirical evidence of different studies carried out at the Leibniz-Institute for Regional Development and Structural Planning in Erkner (IRS)[1]. Throughout different surveys we addressed knowledge intensive services in the metropolitan regions of Berlin and Munich. Through these surveys we are able to analyse the spatial-functional networks of the polled services as well as determining factors for their location decisions. Figures presented here are based on statistical calculations of the survey data base.

2 Knowledge Economy – Towards a Definition

In 1996 the OECD defined the knowledge-based economy as a composition of high-tech industries as well as other economic sector with a ratio of highly qualified labour clearly above the average (OECD 1996). This has been the output of a rapidly changing institutional environment, not only on local or regional, but also on global scale. Continuous technical change and modernisation has lead to an increasing globalisation of economic activities. Information and communication technologies (ICT) supported, simplified, and –most importantly– accelerated data, information and knowledge processing and distribution and became the backbone of global communication and trade. While the OECD mostly addressed the qualitative change in industrial sectors, the economic structural change includes a drastically changing and rapidly growing service industry too. The number of employees working in business services has increased drastically since the mid- 1970ies indicating, that pure knowledge work could generate economic growth. Business services were no longer considered as co-existent to industrial enterprises (Albach 1989), but became an independent economic sector dealing with the production, processing and distributing of information and knowledge (Dunning 1993; Häußermann und Siebel 1995; Illeris 1996; Millard 2002). Once knowledge is codified and therefore transferable, it can easily take on characteristics of public goods (Paci und Usai 2000: 3). This, however, reduces the marketability of knowledge goods. Therefore, the protection of knowledge goods was a necessary pre-condition for trading non-physical, knowledge intensive goods (Kujath und Schmidt 2007). Property rights regulations, patents and licenses are such institutions that –to a certain extent– secure global trade with codified knowledge.

[1] www.irs-net.de

A definition of the knowledge economy based on high-tech industries and highly qualified labour, consequently, seems not sufficient enough to grasp the fundamental structural changes not only within economic sectors, but also across sectors and space. What differs in comparison to earlier times are modalities of knowledge production, the distribution and processing of knowledge as well as a concerted commercialisation of knowledge products. Park (2000) defined the knowledge-based economy as an economy consisting of two major columns: knowledge industries and knowledge-based industries. „*Knowledge industries are those whose output is knowledge such as patents, inventions, and new products, as well as services that are mainly knowledge, while knowledge-based industries are those whose main product or service is dependent on technology or knowledge. Knowledge industries and knowledge-based industries are interdependent since knowledge is output from the former and input to the latter, and they are together making the knowledge-based economy*” (ibid.: p 2). With this logic, knowledge industries purposefully develop new knowledge (e.g. in form of products or process innovations), while knowledge-based industries have to be organised in such a way that they are able to apply this new knowledge. Parks differentiation shows that the term knowledge economy does not address selected industrial branches or services. Rather, is seems that knowledge as a production and process influencing factor effects many if not all economic activities, even though to different extends and with different intensities. Van Winden (2005) therefore pointed out two perspectives on the knowledge economy: One perspective regards the knowledge economy as a section of the economy, mainly comprising activities in research and development, technology and innovation. Such point of view has a rather technological understanding of knowledge, because knowledge-based economic activities are considered to lead to new products, production methods, and productivity growth. While this view takes on a somewhat narrow perspective, the other view regards knowledge economy as “one in which knowledge is becoming a more dominant factor throughout the economy.” (van Winden 2006: 3) This perspective is quite broad as it describes the structural change that affects all economic sectors (though in different ways).

Van Winden’s considerations illustrate the dilemma that researchers have to face when conducting empirical studies on the knowledge economy. There is no commonly excepted definition of what actually *is* the knowledge economy and each study produces new definitions and classifications. Especially when conducting quantitative research, the differentiation of the knowledge economy becomes linked to official statistical classifications such as NACE[2]. The IRS approach to define the knowledge economy lies between van Winden’s two perspectives. The approach considers the knowledge economy as an economy where knowledge is a production factor, a process influencing factor as well as a

[2] **N**omenclature statistique des **a**ctivités économiques dans la **C**ommunauté **e**uropéenne

product of the economy. Enterprises in the knowledge economy hence centre on transforming knowledge from one form into another, build on more or less extensive networks for generating new knowledge, and distribute their knowledge intensive products (might it be physical products or services) across different regions or even on global markets. The need to innovate (in a broader understanding as something new) becomes part of daily economic activities and leads to transforming working environments and working organisations. Transforming and producing knowledge, of course, requires a high education level as well as continuous learning of individuals and organisations. The IRS therefore refers to economic activities listed by ISI[3]/ NIW[4] (Legler et al. 2004) for its delimitation of the knowledge economy. The ISI and NIW differentiate between knowledge intensive industrial activities as well as knowledge intensive service activities. Knowledge intensive industrial sectors focus their main activities on research and development intensive goods. For delimitating activities in this category, expenditures in research and development were related to the turnover of enterprises. If this ration reached 3.5% or more, enterprises were classified as knowledge intensive. The classification of knowledge intensive services was based on the intensity or potential of enterprises to innovate. The ration of highly qualified employees or employees mainly working in fields of planning, construction, design etc. was used for measuring innovation intensity or innovation potential. The IRS accounts knowledge intensive industrial sectors as well as knowledge intensive services as the two constituting bases of the knowledge economy in its empirical studies.

Spatial Development Trends of the Knowledge Economy

As mentioned above, both, concentration and de-concentration theses, put forward major arguments for spatial implications of the knowledge economy. On European level, for instance, the concentration thesis seems to be supported. Looking at maps of the ESPON programme, the major concentration of financial and business services can be found in large central European agglomerations (London, Paris, Brussels, agglomerations located along the Rhine river, Zurich Rome). There are only few exceptions to this traditionally called– “blue banana”, such as Oslo, Stockholm, Hamburg, Berlin, or Vienna (BBR 2006: 22). Though controversially discussed, patent activities are used to map the spatial distribution of innovative activities. On European level, regions in Scandinavia, Ireland, southern UK, Germany, Austria, Northern Ireland, and France seem to be most active in filing patents. The highest share of total patent applications, however, comes from the pentagon area (London-Paris-Milan-Munich-Hamburg) (BBR 2006: 26; Hanell und Neubauer 2006: 25). While R&D

[3] Fraunhofer Institut für System- und Innovationsforschung – Fraunhofer Institute for Systems and Innovation Research

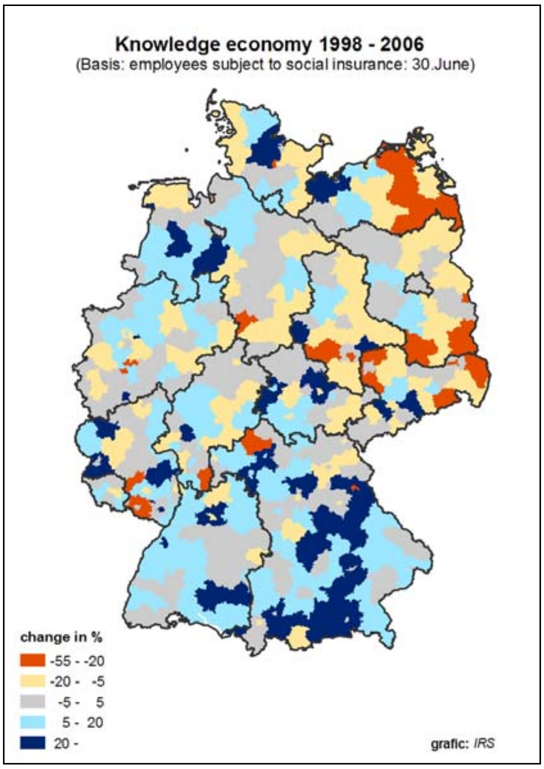
[4] Niedersächsisches Institut für Wirtschaftsforschung – Lower Saxon Institute for Economic Research

expenditures, financial and business services and patent activities illustrate knowledge activities; human capital (measured in proportion of a population with tertiary education) is used to illustrate the potential of regions for participating in the knowledge economy (BBR 2006: 19). Especially in Eastern European countries as well as countries at the European fringe, human capital concentrates in the nation’s capital regions. Even though Western European as well as Nordic countries generally show a higher average, only few countries have a high educational level throughout all their regions. In Germany, for instance, high ratios can be proven for south-eastern regions, in France in southern and western regions.

GDP or employees subject to social insurance contributions are indicators for depicting the actual regional economic performance. In the Germany case, the latter show quite differing spatial development trends. Figure 1 below illustrates the percentaged changing pattern of employees subject to social insurance contributions in the knowledge economy between 1998 and 2006. Data selections for employees in the knowledge economy are based on the above described lists provided by ISI and NIW (Legler et al. 2004; Legler und Frietsch 2006).

Though lacking a clear centre-periphery picture, an increasing ratio of employees in the knowledge economy might be related to few regions only. First of all, there are still clear differences between Eastern and Western Germany. In Eastern Germany, regions with a decreasing proportion of knowledge economy employees dominate. Regions that border to Western Germany (e.g. Thuringia, Western Mecklenburg-Western Pomerania and Western Saxony-Anhalt) as well as few exceptions in Saxony and Brandenburg show positive developments. Other regions have had either neutral or negative developments. In contrast, positive developments are to be seen in southern Western German regions –especially Bavaria and the federal state of Baden-Wuerttemberg– as well as in a belt between the Rhine-Rhur region – Hamburg – Northern Schleswig-Holstein. While negative development dominates the Eastern German regions, neutral development and selected positive developments do so in Western German regions.

Figure 1: Spatial Disparities in the Knowledge Economy



Source: IRS 2008

3 FUNCTIONAL SPECIALISATIONS IN THE KNOWLEDGE ECONOMY AND ITS SPATIAL IMPRINTS

It is the thesis of this paper that this picture will significantly shift if we differentiate between forms of functional specialisation in the knowledge economy. So far, the knowledge economy consists of industrial sectors and services sectors. In our opinion, comparing services and industrial branches can no longer do a differentiation. This becomes especially apparent as the role of services as formerly being of support for industrial processes has shifted towards an economic sector that to a large extend develops independently from industry-based sectors.

While the classic differentiation of economic activities bases on the understanding a division of labour along value added chains, new approaches rather suggest differentiations based on a *functional* division of labour. Duranton and Puga (2003), for instance, recognise a new global functional division of labour that manifests itself in an increasing specialisation of certain locations as well as leads to economic clusters across economic sectors. Therefore, large agglomerations are not just (global) services locations, but rather locations specialised in innovative activities for a global economy. In line with this logic, Stein (2002; 2003) argues that the metropolitan economy might best be described based on the functions enterprises fulfil, such as transaction activities, research and development, production and transformation, or public services.

Based on Stein, Duranton, Puga and other scholars and adding considerations of functional specialisations, learning and innovation (Lundvall 1992; Lundvall und Johnson 1994; Lundvall 2002; Tödtling et al. 2006), the IRS developed a differentiation of the knowledge economy based on the knowledge involved in economic activities as well as functions fulfilled by knowledge intensive firms. This differentiation proved to be very important for discussing spatial implications of the knowledge economy as the below described types have quite different spatial impacts (Kujath und Schmidt 2007).

- *High-tech* industries are technology intensive firms that are able to integrate high shares of new knowledge in their products in order to improve their global competitiveness and thus create (temporary) comparative advantage. In contrast to standardised mass production, high-tech industries produce highly specialised products, often customer-specific instead of for an anonymous mass market. The term high-tech indicates beyond the state of the art technologies or very advanced technologies at the cutting edge between state of the art and completely new technologies. Therefore, high-tech firms have to be able to implement product and process innovations into their production flows, but they do not necessarily create new knowledge. Due to their comparatively hierarchical organisation (with the aim to realise economies of scale) they are probably not flexible enough to explicitly generate new knowledge (Jansen 2004). However, this does not imply a disability to generate learning processes (as an organisation or at individual level). Quite contrary, high-tech industries must be able to recognise new knowledge and its applicability within the firm’s context. Furthermore, they need to have the know-how to adjust existing routines to the application of new knowledge, which then implies a continuous changing production chain. The knowledge flows of high-tech industries may best be described as internalising knowledge that was formulated and codified elsewhere as well as continuous organisational learning based on combining existing knowledge (Nonaka und Takeuchi 1995). In other words, high-tech firms need to have combinative capabilities (Caspers und Kreis-Hoyler 2004: 35) in order to develop new (standardised) applications based on already existing knowledge components. Firms manufacturing highly specialised devises for medical purposes or industrial control equipment, optical or pharmaceutical industries are just a few examples of high-tech industries (see Annex 1).
- *Transformation oriented services* are very closely linked to their customers as their major business segment lies on transforming existing knowledge in combination with their own knowledge base to customer specific solutions. In contrast to high-tech industries they develop highly individualised services. To a certain extent, they are integrated into their customer’s processes or products. Furthermore, it is also quite conceivable, that the costumer’s production chain depends on the provided service as it is a separate module within the production process (Burlefinger et al. 2006: 5). From the customer’s point of view, this decreases his/her own direct labour and accelerates operational procedures

because the customer can focus on his/ her core competencies, while the service provider may provide externally realisable procedures and working stages. Even so, this division cannot be interpreted as typical division of labour as both, customer and service provider, are closely linked and interdependent. The provided service is not a separate working step, but rather an integrated module. The focus of transformation oriented services lies on combining externally generated knowledge and adjust it to the needs and expectations of their clients. The aim of transformation oriented services is to provide process- or product innovations or enhancements for existing product and processes. This also includes conducting research and development or specialised tests on behalf of their customers. Even though such services are initially customer specific, research and development findings, for instance, may in the end also be of inter-sectoral value as other companies might profit from the knowledge services once they are articulated and published. Companies conducting research and development in natural and social sciences, in engineering and in humanities, technical testing and analyses, architectural and engineering activities are famous example for this type of functional specialisation (compare also Annex 1)

- *Transaction oriented services* are involved in the organisation and management of economic transactions. Compared to transformation oriented services, transaction oriented service providers are not directly involved in their customer's production processes. Rather, they provide services that help to manage and organise the customer's internal and external transactions (e.g. financial and insurance companies, advertising, real estate activities, for more examples see Annex 1). The institutional environment for companies has become very complex, due to increasing global trade and competition. Therefore, negotiating contracts and transactions has become very complex as well. While transformation oriented services may be used as antenna for global product specific expertise, transaction oriented services are specialised in brokering between different institutional environments.[5] Doing so, transaction oriented services reduce their customer's transaction costs by fulfilling search and information task, negotiating and bargaining activities. The majority of transaction oriented firms hence execute different kinds of counselling and consultancy; activities where they need to be able to act within different (institutional) environments and have to be capable to handle very different institution[6]. The knowledge competencies of such service providers might be described as

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[5] The terminology emanates from the new institutional economics (NIE). For further discussion on institutional environment see for instance (North 1990; Williamson 1994; Furubotn und Richter 1997; Williamson 2000; North 2001; Richter 2005).

[6] Institutions in the understanding of the NIE: "Institutions include any form of constraint that human beings devise to shape human interaction." (North 1990: 4) "Institutions provide the basic structures by which human beings create order and attempt to reduce uncertainty in exchange." (ibid.: 238)

"know-how" and "know whom" (Nordhause-Janz und Widmaier 1999) and is probably very implicit, because such knowledge very often is not codified and person-bound.

- The *information and media industries* consist of industrial as well as service sectors. Enterprises of the information and media industries are characterised by the strong influence of modern information and communication technologies and an intensive use of these technologies. In information and media industries, two groups are present: One group consists of what commonly is describes as creative industries, where (often very individual) knowledge and competencies are digitalised with ICT and made publicly available to a very large group of consumers: radio, television, and other entertainment activities, publishing, and motion picture activities are famous examples. The other group centres on software and computer hardware applications, e.g. by software consultancy and supply, data processing, data base activities and such. This group primarily develops customer specific solution by using and recombining existing ICT (software as well as hardware) as well as operates in the field of advancing existing solutions or creating new technology and/ or software intensive solution. To a very large extent, both groups are strongly interlinked, which can be observed in media-clusters. While the first group transforms knowledge into standardised immaterial knowledge products (through externalisation), which are traded worldwide particularly through different media, the second group transforms codified knowledge into individual customer solutions. The intensity of modern technologies is very high in both groups, which is why they are both put together in one form of functional specialisation. What combines both is the high degree of combining person bound skills with technology. Famous examples of information and media industries are publishing and software companies and database and other computer related activities (for more example see Annex 1).

Each of the four groups is very knowledge intensive, however, they differ in their modalities of knowledge production and knowledge processing. The specific role of knowledge becomes apparent not only in manifold externalised forms, but also in the impact of implicit knowledge on production processes.

Differentiated Spatial Development Trends of the Knowledge Economy

When considering these four introduced forms of functional specialisation, the formerly mapped spatial picture of the knowledge economy in Germany (see Figure 1) shifts considerably. Figure 2 displays the calculated location quotient for employees subject to social insurances in Germany. Based on the location quotient, it is possible to distinguish what functional specialisations are over-represented in regions. Of course, once a region is identified as having a functional specialisation in one of the four types of specialisation, other types are present as well. Rather, an over-representation indicates an above average ration compared to general average in German regions. There seems to be a trend towards concentration, but this trend differs clearly between the functional knowledge economic specialisations.

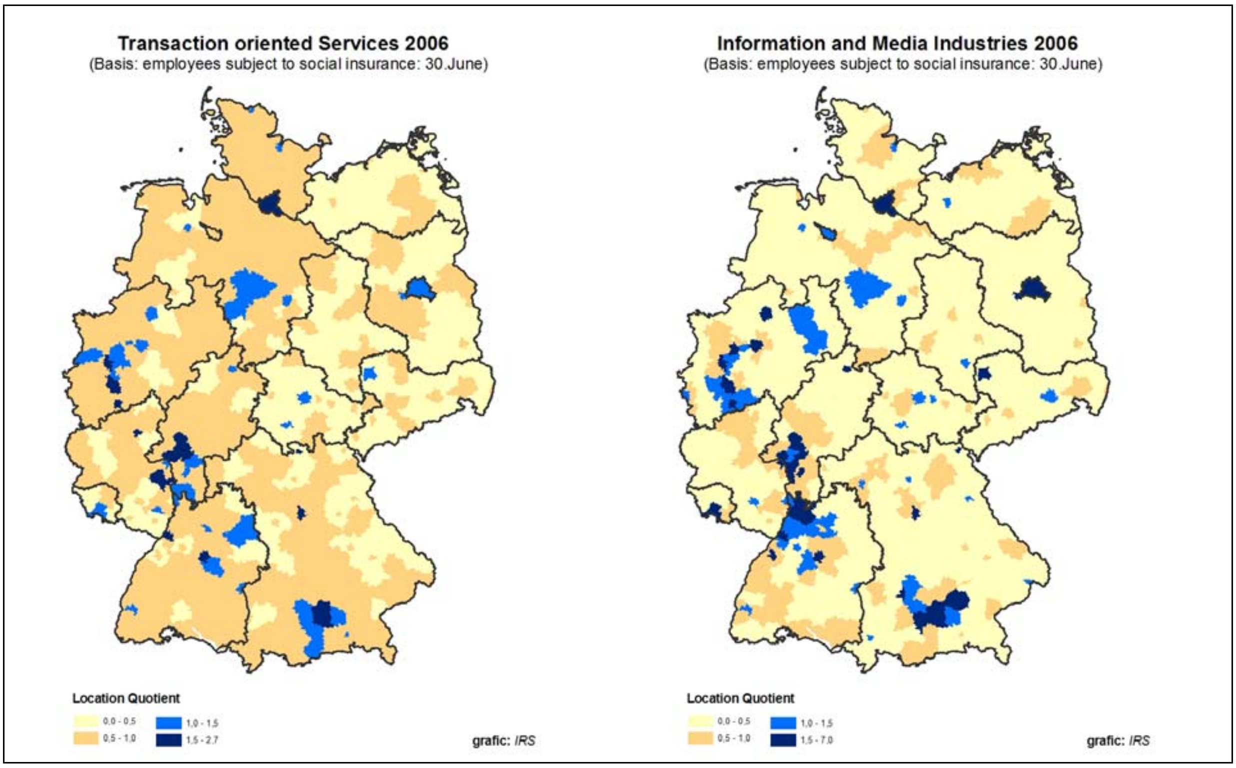
The spatial concentration of transaction oriented services clearly underlines previous findings on concentration processes in metropolitan regions. Hamburg, Berlin, Stuttgart, Munich as well as Rhine / Ruhr and Rhine / Main metropolitan regions show an above average specialisation in transaction functions, due to the high concentration of financial services as well as different kinds of business consultancies. Information and media industries show similar location quotients. Florida (2004) points out that not only human capital measured in qualification levels determine economic progress, but the “creative class” has a decisive influence on economic development as well. Job occupations within cultural and media branches form a major part in information and media industries and hence include highly creative occupations. People working in creative industries prefer urban surroundings, due to an open and tolerant atmosphere within such regions (ibid.). Fritsch and Stützer (2006) support this thesis with empirical findings for German regions. In line with our empirical findings they argue, that creative potential is not exclusively concentrated in large German metropolitan regions, but also in smaller ones, e.g. selected Eastern German cities (Schwerin, Dresden, Leipzig, Halle, Erfurt or Weimar). Still, only few non-urban region show above average ratios in information and media industries and in many cases they are part of a larger region connected with a metropolitan centre (e.g. in the greater Munich area, regions between Stuttgart and Frankfurt/ Main, Rhine / Ruhr region with Cologne as focal point).

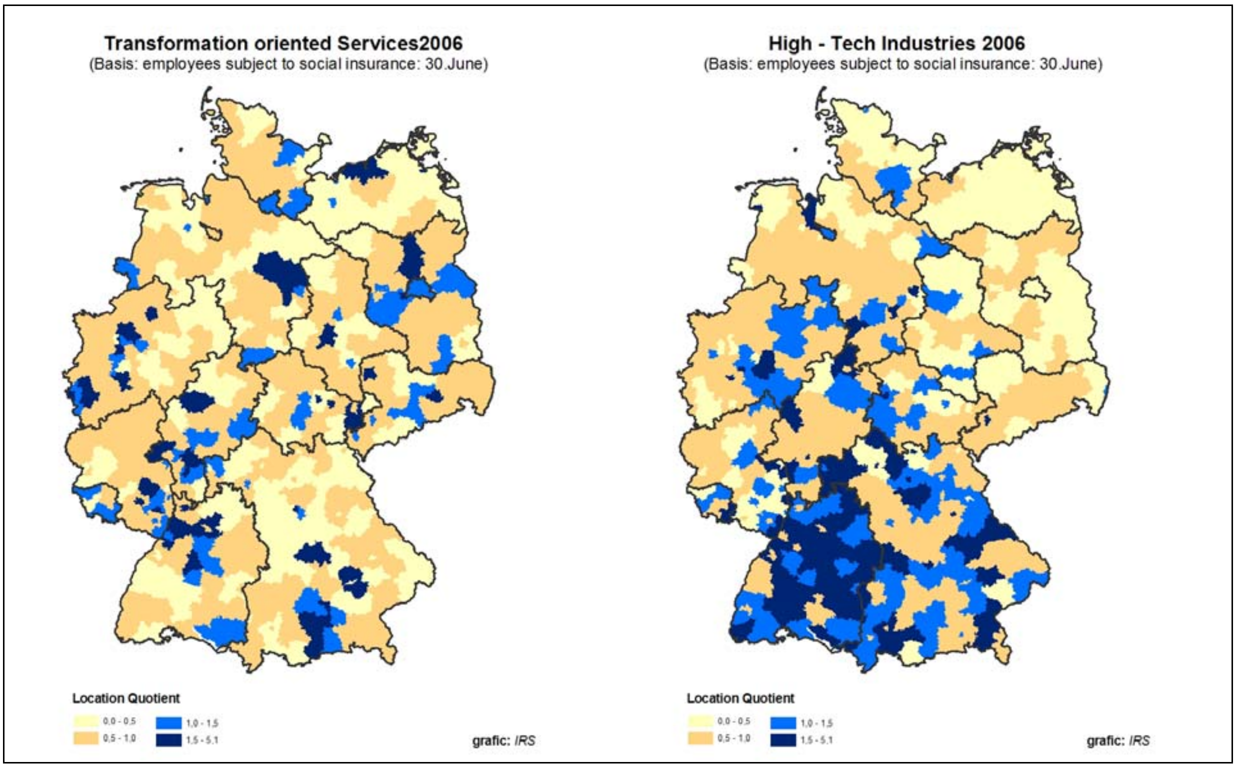
Though with an above average presentation in German urban centres, transformation oriented services are not as spatially concentrated as transaction oriented services or information and media industries. In many cases, transformation oriented services show an over-representation in regions close to metropolitan regions or larger city regions. Transformation oriented services are described as research intensive as well as closely linked to the production processes of their customers. Therefore, many regions with above average location quotients of transformation oriented services also host universities or other public research institutions (e.g. Aachen, Heidelberg/ Karlsruhe region, wider Goettingen region or Rostock). In other cases, transformation oriented services are over-represented in important high-tech clusters, such as region close to Wolfsburg (VW-production site), biotechnology clusters in southern Bavaria, life-sciences cluster north of Berlin or within automotive clusters in Saxony and Baden-Wuerttemberg.

Finally, high-tech industries are located most disperse compared to the other three types of functional specialisation. Though spatially concentrated, it is a concentration outside of metropolitan regions. Especially southern German regions (Baden-Wuerttemberg and Bavaria) are specialised in high-tech industries, mostly based on the automobile and related industry. Those are regions with a long industrial tradition, indicating a certain path dependency. The disparities between Eastern and Western German regions results from the quite clear break in the early 1990. Germany's re-unification led to a considerable breakdown of Eastern Germany's industrial production sites. Until today, new companies of the industrial sectors face a very tight and competitive market where entry barriers are very high. Because other German as well as global firms have already been established and competitive in the increasingly global market, new firms have to be able to define market niches for their own products.

Despite obvious differences between Eastern and Western German regions, but the spatial picture remains to be the same. Though at a lower level, larger cities like Rostock, Schwerin, Cottbus, Leipzig, Dresden, Halle, Chemnitz, Erfurt and so forth show a slightly over-representation in transaction oriented services as well as information and media industries. An over-representation of transformation oriented services as well as high-tech industries shows slight concentration tendencies as well, but –as in Western Germany– outside larger agglomerations.

Figure 2: Spatial Specialisation in the Knowledge Economy





Source: IRS 2008

4 EXPLANATIONS FOR SPATIAL FUNCTIONAL SPECIALISATION

Of course, the question arises of how such different spatial patterns might be explained. It is our thesis, that the observed spatial differences result from differing spatial interactions, divers functional interdependencies between different actors, and the organisational structures of the service providers themselves. The following chapter focuses on empirical findings gained through a quantitative survey undertaken in 2002[7] by the IRS. Though aiming at functional interrelationships, the survey offers the opportunity to differentiate between three of the above described forms of functional differentiation. The survey aimed at analysing the spatial-functional networks of business services in the metropolitan regions of Berlin and Munich. Therefore, the standardised survey addressed business services of the transaction and transformation oriented service sector as well as information and media industries. Enterprises of the high-tech sector were not included in the survey as well as industrial companies of the information and media sector. Consequently, significant differences will be discussed on a three-fold differentiation only: transformation oriented service, transaction oriented services, and services in information and media

[7] The goal of the survey was to analyse the spatial dimension of business relevant networks of knowledge based business services in the metropolitan regions of Berlin and Munich. Additionally, the results were also used to analyse the special role of metropolitan regions. For more detailed results see for instance (Schmidt und Wolke 2004; Jähnke und Wolke 2005; Kujath 2005b; 2005c)

industries. Even though located in metropolitan regions, quite interesting differences with regard to interrelationships and organisational structures can be observed.

4.1 Customer Relations

The shift from industrial mass production towards an individualised production of goods as well as a quantitatively and qualitatively strengthening of business services is a central feature of the economic structural change[8]. Services have always been described as customer specific, which is why customers are integrated in the process of service provision. In contrast to industrial mass production, customers are not anonymous and fulfil a role that might be described as value chain partners or co-designers (Reichwald und Piller 2002). They become co-actors within the service production, where different level of integration might be distinguished: customers as recipients, observation objects, informants, co-designers or even partners (Schneider und Scheer 2003: 10). Such strong interactions imply extensive communication and interaction between service providers and customers. Depending on the nature of such communication as well as the knowledge exchanged though communication, personal contacts might be of varying importance. The very important role of interacting with customers and other actors is often used to explain the need for spatial concentration due to the need of spatial proximity to different actors.

The *importance* of face-to-face contacts with their customers can be supported by our survey. Throughout all stages of the service provision (up to ordering date, during service processing, and during customer care), clearly over 85% of all polled enterprises value personal contacts to customers as very important or at least important. This is true for service enterprises throughout the transformation and transaction oriented services as well as information and media industries. However, there are significant differences as to *where those meetings take place*. Meetings at the customer's site are the preferred mode for personal meetings. This is especially true for enterprises of information and media industries as well as transformation oriented services. In contrast, transaction oriented services also see their customers at their own offices. Explanations at this stage can only be formulated in form of hypotheses. The main emphasis of transaction oriented service activities lies in organising transactions for other companies, more or less independently of their customer's economic focus. In order to do so, the service provider does not need detailed knowledge on how the customer's enterprise functions, what processes are involved, what materials are used etc. In other words, the service provider does not need to know in depth the inner-organisational contexts or fields of expertise of the customer. Rather, transaction service

[8] At this point the authors do not intend to widely debate the topic of a changing service sector. For more debates see for instance (Hepworth 1989; Illeris 1989; Daniels 1993; Dunning 1993; Illeris 1996; Kulke 2000; Tomlinson 2001; Stein 2002)

providers need to have knowledge of the institutional contexts and respective institutional environments involved in the foreseen transactions of their customers. To illustrate these thoughts, please see following simple example: An accountant has to prepare the VAT return for his customer. He needs to have knowledge of his customer's financial flows as well as expert knowledge of the formal regulations for preparing the VAT. He needs to know whom to address for specific questions and where to send to filled report. This knowledge he does not acquire from his customer, but rather through his academic background, contacts to respective administrations, formal advanced trainings and qualifications as well as from his own implicit knowledge and competencies, mostly gained through experiences made in former settled transactions. The process of developing the VAT report can then follow rather standardised routines, with costumer specific adoptions within institutionalised barriers. What is happening within the customer's enterprises' regarding product- and process development or the organisation of day-to-day activities is not important for the accountant. Therefore, it is possible for him to have less direct contact at the costumer's enterprises in comparison to transformation oriented services or the information and media industries.

On the contrary, transformation oriented services transform product- or process related, scientific, technical or factual knowledge for the needs of their customers. The service focuses on collecting, filtering, systematising manifold expert information for developing realisable application concepts and problem solutions. To do so, the service provider has to connect the knowledge of his customers with external knowledge in order to develop the optimal solution. Again, an example may visualise this consideration: A company hires an architect because it wants to enlarge its production site. Thought the first contact to the architect may be realised through meeting at the architect's office, for more concrete planning the architect has to visit the customer's production site. He needs to know how the customer organises the production processes, what space is available for the enlargement, what space is actually needed for the foreseen enlargement etc. Together with the customer, the architect clarifies utilisation demands, construction quality and –depending on the kind of contract between the two of them– plans, organises and coordinates all necessary activities. He integrates and coordinates suppliers, such as electricians, structural designers, bricklayers etc. These tasks also ask for a regular appearance at the customer's site. The architect then needs knowledge of the organisational contexts and foreseen goals of his customers. He needs to connect the articulated customer's demands with available resources and suppliers. Hence, the architect functions as a knowledge hub with high and detailed technical knowledge combined with planning and organisational competencies.

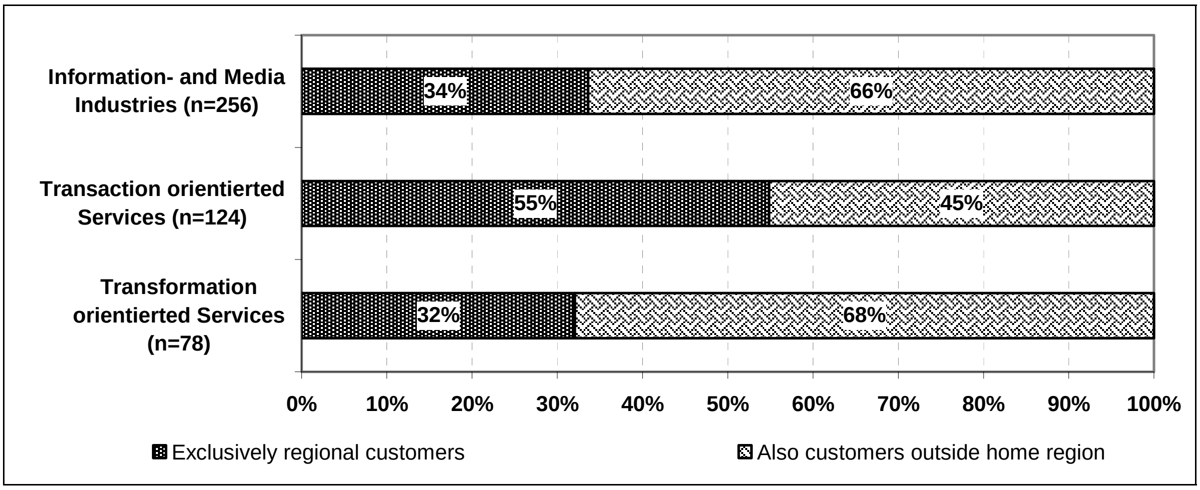
Looking at information and media industries, the need of knowing the customer and being present at the customer's becomes apparent as well. Once again, let's have a look at an example: A company wants to implement a database as a knowledge management device. It hires a data base expert for fulfilling this task. Being personally present at the customer's company seems inevitable (see e.g. Reuter 2001: 25). The data base expert has to know, what kinds of information are digitally available within the firm, where and how the information are stored, who has access to what kind of firm-internal knowledge and the customer's objectives with the database. Even though certain data base modules may be developed and programmed at the service provider's office, for filling the database with information, connecting the modules with different servers or other software components, installing the needed software at different computers etc. the service provider needs to be personally present at the client's. Summing up, the service provider has to have very high technical knowledge with respect to databases and computer programming. In combination with his personal experiences he also has to be able to use his specific knowledge and skills in order to develop software for his client. Even though he may use software components developed elsewhere, he needs to develop the final product in cooperation *with* the client and *at* the client's. This cooperation does not only imply the usage of the client's technical infrastructure (as in the above example), but also it is only the customer who really knows the ideal contents of the e.g. a database. In other words, the service provider profits from the implicit client's knowledge.

Bearing theses observation in mind, one could argue that a spatial differentiation between the customer's locations might be expected as well. One central argument for debates on the knowledge economy addresses the spatial diffusion of knowledge work: The need for close interaction with customers, partners and suppliers have been put forward as major arguments for a spatial concentration. In contrast, supported by information and communication technology, the spatial dispersion of codified knowledge increased considerably. Hence, if codified knowledge is to be transferred or exchanged, physical space does not act as a barrier for the knowledge transfer. In contrast, if implicit/ person-bound knowledge –often very difficulty to be put into codes– is transferred, physical space does matter as a physical barrier. In order to exchange such knowledge, people have to invest time and money to overcome this barrier. Even though modern transportation infrastructures have enlarged the distance one can travel within a two-hour timeframe (assumed to be the time most people are comfortable with investing in one day trips), this need to meet in person supports a spatial concentration of economic activities.

Looking at above described costumer-interactions of the three functional specialisations in the knowledge economy, one would assume that these enterprises tend to *locate* in spatial proximity to their customers. At least, one could assume that most of their customers are located within a close range to their own location. However, these considerations could not be approved by our study. The enterprises were asked to assess different location factors, with spatial proximity to their customers being among them. For over 50% of all polled enterprises, spatial proximity to their customers was of moderate or even little importance. The same is true for spatial proximity to other knowledge economic actors such as partners, suppliers or information resources. Though spatial proximity is considered by the enterprises, the need to locate close to their interaction partners is obviously not of central importance. Instead, enterprises articulate a clear need to have infrastructures for interacting with others (such as telecommunication infrastructures) as well as a rich labour market at their own locations.

The importance of spatial proximity to customers is furthermore put into a different perspective when looking at the actual location of the service provider's customers. With the exception of transaction oriented services, clearly over 50% of the transformation oriented services as well as of firms in the information and media industry have customer located outside their own region (in many cases they have both, customers within and outsider their won region). This means, over 50% of the enterprises develop knowledge intensive services that can be exported to other regions and contribute to an inter-regional knowledge exchange. In that sense they are *knowledge brokers* or even *knowledge hubs*, because they use their own knowledge combined with their customer's, partner's, and supplier's knowledge, as well as information resources to generate new knowledge and services that are widely distributed in space. In contrast, transaction oriented services serve a rather regional market. 55% of all polled transaction oriented services declare to have exclusively regional customers (compare Figure 3).

Figure 3: Location of Clients from the Service Provider's Perspective



Source: IRS 2008

This seems to be an astounding observation as we described the interaction with clients of transaction oriented services as less bound to the client's location, because transaction services meet their client's at their own office more often compared to the other functional specialisations. Maybe transaction services need to be conveniently accessible for their clients, so that they locate close to their markets. They depend on the spatial proximity to their clients not because they need to be able to reach their clients in person but rather because their <u>clients</u> need to be able to personally reach them whenever they need. In contrast, transformation oriented services as well as service providers in information and media industries coordinate and organise the service provision regarding their own service provision processes. Though the contact to the customer is important as well as their present at the customer's location, the timing of those face-to-face meeting depends on the process of service provision and how the service provider organises the service provision. The meetings are therefore organised and timed based on the service provider's timing and activities, while transaction services depend on the timing of the clients. If this is true, transaction oriented services need to be physical available and easily accessible, which is why they co-locate to their clients. Information and media industries and transformation oriented services may be able to temporarily send staff to their customer's, while obtaining a central location elsewhere.

Furthermore, the three types of functional specialisation probably differ regarding the knowledge-character provided by their customers as well as the modes of knowledge transfer between customers and service providers. Korell (2002: 23) differentiates between following knowledge characters provided by customer:

- basic customer knowledge,
- knowledge on customer's requirements/ needs/ problems and processes,
- changes and developments of the customer or the customer's environment, as well as
- customer's behaviour and decision making processes.

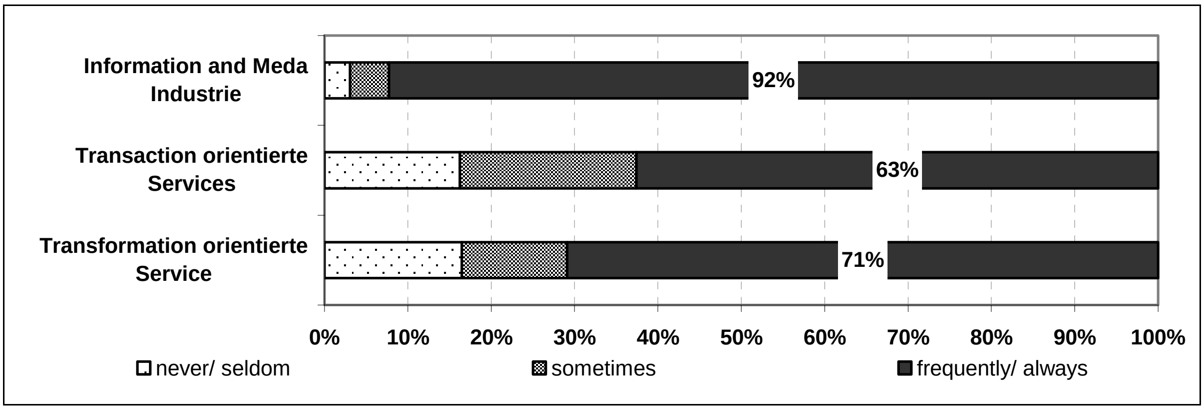
Of course, all service providers need a basic understanding of their costumer's needs and requirements. But, as the above examples demonstrate, there are differences with respect of the knowledge transfer between customers and service provider. Transaction oriented services (which consist to a large extent of consultancies and financial services) provide support to the operational procedures of their customers. Therefore, knowledge on business strategies or strategic decisions, an understanding of reasons for certain decision made by customers or awareness of the influence of norms, traditions cultures etc. on customer's choice is essential for providing a high quality service that fits the customer's expectations. Customers usually do not codify such knowledge. It is bound to decision makers within companies and therefore of implicit nature. Codifying such knowledge constitutes a risk from the customer's viewpoint, because competitors could make use of it for own strategic decisions if such knowledge spills over. Therefore, face-to-face meetings between service providers and customers focus on the transfer of rather confidential knowledge and cannot be substituted by other means of communication. Furthermore, the interaction between the two parties pervades the entire process of service provision.

In comparison, the knowledge transfer between transformation oriented services and their customers addresses more subject related knowledge and expertise. Though confidential due to competitive advantages too, the interaction with the customer might be structured in different ways. Intensive meetings are inevitable, but when subject related knowledge –such as the nature of the customer's product, used materials or resources etc.–

can be formulated. By reducing the effort for personal meetings to the exchange of knowledge that can not be formulated/ codified, service providers are able to realise some kind of interaction standardisation (Schmidt 2005; 2006). Furthermore, the customer's knowledge regards formulating a problem or a task to be solved by the service provider. Transformation oriented services, for instance, then have to activate their own knowledge resources in order to generate knowledge for the ordered problem solution. Hence, there are phases of intensive and less intensive interactions between customers and service providers.

Services provided by information and media industries are quite technology intensive. Such services either use technological options of ICT-s or develop software for ICT-s. They develop knowledge intensive services that by nature consist of externalised/ codified knowledge. Like transformation oriented services, interactions with customers are reduced to the exchange of knowledge that is hard to formulate in shared codes. More than the other two types of functional specialisation, information and media industries profit from an increasing protection of intellectual property. The more a knowledge product has a clear form, such as software, a database, a movie etc, the easier the protection through licenses, patents, property rights. Such forms of protection were a central precondition for a strengthening knowledge economy, because as soon as knowledge is published it might easily take on public good characteristics. The transferability increases as well, which is why large parts of interacting with customers can be established by means of virtual communication (see Figure 4). Despite already established protection mechanisms, control costs for unprotected distribution of knowledge goods still remain high.

Figure 4: Frequency of ICT Usage for Communication with Customers



Source: IRS 2008

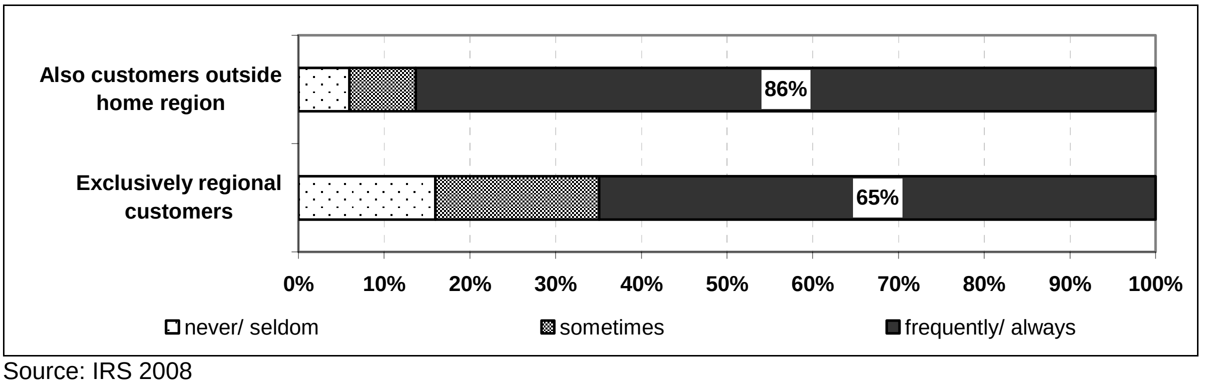
Integrating customers does not only lead to an increasing quality of services. Each interaction is connected with additional costs arising e.g. from coordination and management tasks. The more customers are integrated, the higher transaction costs, due to communication intensity, reconciliation and organisation efforts and expenses. Additionally, if service providers depend on the customer's information or other kinds supply, the provider also runs a risk of increasing costs, because of uncertainties as to the quality of supply or time delays in providing the supply (Enke und Poznanski 2005). Therefore, service providers will seek for ways to rationalise the interaction with customers as much as possible.

4.2 Rationalising Knowledge Work

Interaction Standardisation

One way to do so is through "*interaction standardisation*" (Schmidt 2005: pp 304). Interaction standardisation describes a quite simple observation between ICT usages related to the customer's locations. Information and communication technologies help to rationalise personal meetings because information can be exchanged in preparation and post-processing of personal contacts. Personal meetings are then quite intense as they focus on non-explicable knowledge, reconciliations, adjustments, or actual service implementation. ICT-s hence do not substitute personal contacts, but rather intensify such contacts. Empirical findings of the IRS survey support these considerations. Those services with customers located within their own region use information and communication technologies to a highly significant less extent as those service providers that serve customers in other regions.

Figure 5: Interaction Standardisation of knowledge intensive Services



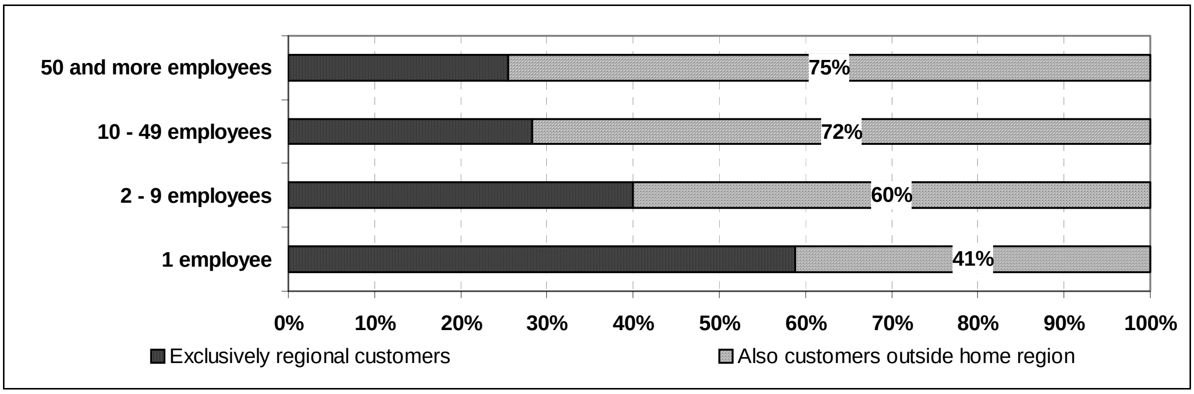
Source: IRS 2008

Of course, this has its consequences on location demands. The intensive use of IC-technologies as a knowledge transfer tool finds its imprint in the need to have access to telecommunication infrastructures. Above all other sampled location factors, access to respective infrastructures was valued as most important by all polled enterprises. This does not only mirror the need to be constantly in touch with diverse actors. Instead, the expressed high demand reflects the perception of ICT-s as knowledge exchange tools. Especially in the knowledge economy, knowledge takes on an economic dimension and is not always bound to physical carrier media, such as printed books or incorporated in knowledge intensive products. Software components, creative products such as music or films, research results, etc. may be distributed by using ICT-s. Due to security reasons as well as file sizes, a basic provision with telecommunication infrastructures will not be sufficient enough for exchanging those –speaking in terms of bits and bytes– very large knowledge components. Therefore, interaction standardisation not only addresses simplifying communicating over large geographical distances, but also exchanging products or product components between communicating actors. It rationalises knowledge work as interim working results or even final products may be transferred.

Process Standardisation

While interaction standardisation addresses external interactions of enterprises, process standardisation focuses on rather internal rationalisation processes of knowledge work. Grabher (2002) richly illustrated these considerations with his studies of advertising enterprises, where groups of different employees are involved in different fixed and/ or temporary networks. The employees' tasks are divided based on functions they fulfil within enterprises (e.g. internal and external project management, planning, creative work, technical work). Only a small part of the workforce is personally in contact with the customer. Depending on the kind of service, other employees are involved in quite different networks (e.g. with partners, suppliers or information sources). In order to implement process standardisation, enterprises have to have several employees. Though usually much smaller than industrial enterprises service providers will be able to implement a certain division of tasks and functions as well. This becomes quite visible as only those enterprises that have a larger workforce are able to provide services for customers located elsewhere, independently of the type of functional specialisation.

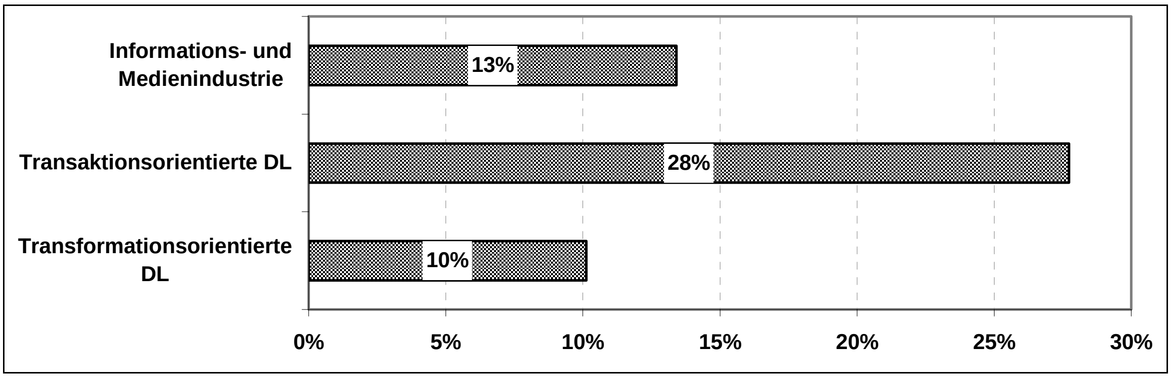
Figure 6: Process Standardisation



Source: Schmidt (2005: 310)

Process standardisation furthermore includes some kind of standardised knowledge sharing and knowledge flow within companies or corporate associations. Depending on types of function service enterprises fulfil, they have different modes of internal knowledge distribution. Service companies may not grow endlessly with regard to the number of employees because the internal coordination efforts for numerous employees leads to growing internal transaction costs as well. In order to use knowledge externalities from a larger workforce, companies may avoid growing internal costs by forming corporate associations. Such associations may form around a more or less standardised service, with associates that focus on specific adoptions of the common service. Furthermore, association allow a diversification of key products. Insurance companies or financial services are very good examples for this. An insurance company may have been initially founded with a major business area in enterprise insurances. With the intention to enlarge its range of products, it decided to offer different kinds of insurances that may be mixed depending on the customer's needs, e.g. legal costs insurances, theft insurances, loss-of-information insurances, and casualty insurances. In order to minimise financial risks, the different insurance components where outsourced, but to ensure a central control the outsourced units were bundled by founding a corporate association. Besides risk minimisation as well as central control, this also allows a standardised information exchange within the association. Through the different units the association has quite a broad base e.g. for observing markets and competitors, which is quite an advantage compared to smaller companies that do not posses such potential and may have to use external consultancies for such tasks. Again, this line of thinking may be observed based on our empirical findings. The enterprises where asked whether they belong to a corporate association. Indeed, to a highly significant extend a higher ration of transaction oriented services tended to be part of an associations compared to transformation oriented services or information and media industries (compare Figure 1).

Figure 7: Corporate Associations in the Knowledge Economy



Source: IRS 2008

Though all enterprises are able to use some kind of process standardisation essentially based on a division of tasks within the company, information and media industries as well as transformation oriented services probably make use of other strategies too for processing knowledge.

4.3 Functional Networks of the Knowledge Economy

Institutionalising interactions with other economic actors may be regarded as widening the knowledge base of companies. Institutionalising interactions e.g. in form of partnerships or close interactions with suppliers bears the advantage of reducing risks of unintended knowledge spillover because the interaction is judicially regulated through different contract forms. Institutionalisation includes a judicial regulation of the rights and obligations of each involved actor. Partnerships, for instance, can be regarded as a horizontal relationship between two or more enterprises that share a certain goal, such as a research project, a joint movie or a construction project. Partners are usually treated equally and –depending on the kind of partnership contract– oblige to certain tasks and may participate in decision making processes. Within partnerships, knowledge is brought together and shared. Though a partnership is usually generated with a specific aim and is therefore often temporary, each partner may use the jointly generated knowledge for within his/ her own contexts. There are several options for institutionalising partnerships, ranging from very low levels (e.g. oral agreements) to quite fixed levels of institutionalising (e.g. fixed contracts). Based on Theling and Loos (2004), partnerships may be differentiated based on actor constellations (e.g. among partners of the same or different branches), time aspects (e.g. sporadic-permanent, short term-long term) as well as contract agreements. As argued earlier, sharing knowledge is connected with risks, especially the risk of uncontrolled knowledge diffusion. Within partnerships, new knowledge is generated, but partnership agreements also regulated how this knowledge is to be treated and how the partnership members may use it.

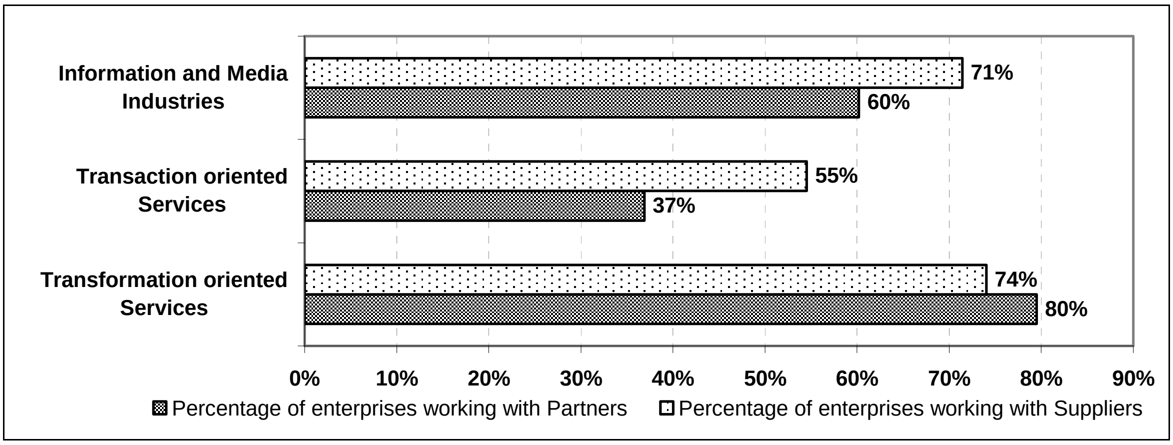
Enterprises of the knowledge economy are usually quite limited in size. Most of the companies are rather small, but highly specialised. Knowledge products, like service, are very complex and in order to ensure a high service quality, highly specialised companies need to cooperatively work together. Partnerships provide a convenient platform for doing so, because specialists cooperate by joining complementary knowledge parts, while sharing (financial) risks. In contrast to supplier relationships, a partnership reduces control costs (Kräkel 2004: pp 347), because there a less uncertainty as to what module or contribution can be expected from partners.

Suppliers, in contrast, provide a rather defined product or service. Purchasers and suppliers have an institutionalised bound in form of sales agreements. In comparison to partnerships, supplier relations are less transparent. While partners have a good knowledge on the know-how and competencies of each other, suppliers are less familiar. The quality of supply, not the supplier himself, is important for purchaser. Enterprises that purchase a supply, do not need to know how the supplier develops the requested good or service. Finally, partnerships aim at developing a new product or service cooperatively, but suppliers are “only” a component of a whole process. The supply in itself is nothing new, but already known and purchased because the purchaser knows what to expect.

Following the argument that information and media industries as well as transformation oriented services develop alternative ways to rationalise knowledge flows as well as widen the knowledge base for their services, both functional specialisation should have different partner and supplier relations compared to transaction oriented services. Using our empirical evidence, there are indeed highly significant differences in this respect (compare Figure 8).

Most polled transformation oriented services do work with partners, information and media industries to a less extend. Compared to them, relatively few transaction oriented services do so. With regard to suppliers, the picture shifts a little, but the pattern remains: Comparatively less transaction oriented services need suppliers for providing their services when contrasted with the other two types of functional specialisation.

Figure 8: Partner and Supplier Relationships of different Types of functional Specialisation



Source: IRS 2008

When having a closer look at partners and suppliers, it seems appropriate to assume rather horizontal relations. Most of the partner as well as suppliers are other service companies (the same is true for customers as well). Furthermore, enterprises of the information and media industry have mostly partners and suppliers in other media sectors; transaction oriented services mostly in financial sectors, which indicates a spatial clustering or concentration of certain transaction functions. In contrast, Transformation oriented services are closely linked to the industrial production, which confirms that those services transform subject and occupation related knowledge on behalf of their customers. Transformation oriented services are probably still an important part of their clients value chain or support product specification or diversification of their customers.

Only very few companies have partnerships with public administrations or political organisations. With the exception of transformation oriented services, public administrations are also an important customer neither. Even though about 50% of all polled enterprises asses the functioning of public administrations as an important location factors, administration are obviously not directly involved in knowledge generating processes, but instead are part of the important and supportive institutional environment.

5 SUMMARY

The presented paper introduces a functional differentiation in the knowledge economy with the aim to

1. illustrate different location patterns that result in differing regional disparities.

2. explain the observed spatial structures based on knowledge flows, customer relations and functional networks of knowledge intensive services.

Since there is still no shared understanding of what actually *is* or *constitutes* the knowledge economy, the IRS developed an approach that distinguishes between four functional specialisations: high-tech industries, transformation oriented services, transaction oriented services, and information and media industries. Based on that differentiation, the authors were able to demonstrate quite distinguished spatial implications in the knowledge economy. While all types tend towards a spatial concentration in certain region, such regions differ based on the functional specialisation. Information and Media industries as well as transaction oriented service show quite a strong concentration in large urban agglomeration, favouring metropolitan regions. High-tech industries built on existing industrial bases and concentrate in traditional industrial regions. Finally, transformation oriented services are over-represented in region that are located close to metropolitan regions, regions that either have scientific clusters (locations of large universities or other research and development facilities) and/ or a high-tech base.

The paper builds on the assumption that those differing spatial structures might be explained by the service provider’s interactions. For testing this assumption, the authors used existing empirical data of an IRS survey conducted in 2002. The statistical tests focus on customer relations, but also –to a bit less extend– on partner and supplier relations. Even though the mentioned survey was conducted in metropolitan regions, the tests do allow first explanations for the observed spatial patterns, because spatial interaction structures seem not to differ based on branches, but on functions, service provider fulfil.

Service providers in the knowledge economy develop very customer-specific knowledge services. For that reason, customers are closely involved in the service providing process. Firms generate new knowledge by interaction with and learning from their customers. Empirical evidence hints towards different natures of customer integration. While information and media industries as well as transformation oriented services are able to rationalise customer interactions by temporary, but intense, staff presence at the customer’s site, transaction oriented service need to be permanently present near their customers. While the former two organise and manage customer relations by themselves, the latter seems to depend on the timing and demand of their customers. In order to reduce costs for managing, organising and supervising customer relations, transaction oriented services tend to develop a multi-site location system, which is indicated by their involvement in corporate associations. In contrast, information and media industries as well as transformation oriented services use interaction as well as process standardisation for rationalising interactions with customers. These standardisation alternatives furthermore lead to a decreasing importance of spatial proximity to customers in location decisions.

Location decisions additionally seem to be influenced by the mode of knowledge processing, knowledge work, and knowledge exchange between service providers, customers, and other actors. The services providers act like a *knowledge hub* that connects own knowledge resource with external ones (Reuter 2001: 20). Service firm generate internal and external learning processes with and at their customer's, which leads to knowledge flows into the home region of the service provider. Through interacting and inter-regional service distribution, service providers contribute to an inter-regional knowledge dissemination. Combined with modes of customer relations, the knowledge hub function leads to specific spatial demands and impacts:

1. *Transaction oriented Services*: are strongly involved in their customer's transactions. They support management and strategic decision-making processes. Information of such knowledge are usually of tacit nature and therefore best exchanged by personal interaction. The knowledge hub function of theses service providers consists of observing and interpreting the institutional environment of their customer. Metropolitan regions offer a supportive environment for their activities, because important intermediaries or administrations that might support their hub function are concentrated there as well. If the service provider are a member of corporate associations, central location that are connected support association internal knowledge flows due to supportive high-quality inter-regional infrastructures.
2. *Transformation oriented services*: collect and combine knowledge related to their customer's economic activities. Though such expertise is formulated and codified already, it is the specific service provider's competence to combine and transform such knowledge into their customer's contexts (Haase 2004: 77). Instead of traditional agglomeration advantages that support transaction oriented services, transformation oriented services need locations with supportive technological knowledge. That is, localities that support organising, controlling and combining subject related expertises (e.g. Antonelli und Quéré 2002). Due to the temporary nature of customer contacts and the ability to furthermore use already codified knowledge, transformation oriented services are less restricted in their location decision. They chose locations that best support access to external subject related knowledge, such locations densely equipped with universities and other research facilities or specific industries.
3. *Information and Media Industries* connect creativity and technology for their customer's need. Employees working in creative industries very often prefer large agglomeration for inspiration, which is why information and media industries tend to concentrate in metropolitan regions as well. Information and communication technologies are not only a central tool in the process of developing their services, but also in transferring service modules between different actors, located in quite different region. Metropolitan region offer central infrastructures, be it telecommunication or high-speed transportation ones.

Firm with this functional specialisation often temporarily work at their customer's location, which is why they need such divers infrastructures.

4. *High-tech industries:* could not be analysed based on the existing empirical data. If they are indeed path dependent on traditional industries that chose location where they can realise economies of scale, high-tech industries also locate outside of expensive (costs e.g. for industrial real estates) and dense urban agglomerations. In a recent study, the IRS conducts a survey that includes high-tech industries as well. In upcoming publication research result will be published on the gap that comes up here.

As Howells (2002: 874) pointed out: "Distance, proximity and geography all count here, although the importance of this geography will vary depending on what type of knowledge and the context of its generation and transfer." Regions need to be supported in constituting a supportive institutional environment for their economic base, but this also includes a clear understanding of what role companies play within a global competition.

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Annex 1: Functional Specialisation in the Knowledge Economy - Definitions based on NACE

NACE	Description	IRS Classification
11.1	Extraction of crude petroleum and natural gas	High-Tech Industries
14.3	Mining of chemical and fertilizer minerals	
22.3	Reproduction of recorded media	
23.2	Manufacture of refined petroleum products	
23.3	Processing of nuclear fuel	
24.1	Manufacture of basic chemicals	
24.2	Manufacture of pesticides and other agro-chemical products	
24.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	
24.4	Manufacture of pharmaceuticals, medicinal chemicals and botanical products	
24.6	Manufacture of other chemical products	
24.7	Manufacture of man-made fibres	
26.8	Manufacture of other non-metallic mineral products	
29.1	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines	
29.2	Manufacture of other general purpose machinery	
29.3	Manufacture of agricultural and forestry machinery	
29.4	Manufacture of machine tools	
29.5	Manufacture of other special purpose machinery	
29.6	Manufacture of weapons and ammunition	
29.7	Manufacture of domestic appliances n.e.c.	
30.0	Manufacture of office machinery and computers	
31.1	Manufacture of electric motors, generators and transformers	
31.2	Manufacture of electricity distribution and control apparatus	
31.4	Manufacture of accumulators, primary cells and primary batteries	
31.5	Manufacture of lighting equipment and electric lamps	
31.6	Manufacture of electrical equipment n.e.c.	
32.1	Manufacture of electronic valves and tubes and other electronic components	
32.2	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	
32.3	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	
33.1	Manufacture of medical and surgical equipment and orthopaedic appliances	
33.2	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	
33.3	Manufacture of industrial process control equipment	
33.4	Manufacture of optical instruments and photographic equipment	
34.1	Manufacture of motor vehicles	
34.3	Manufacture of parts and accessories for motor vehicles and their engines	
35.1	Building and repairing of ships and boats	
35.2	Manufacture of railway and tramway locomotives and rolling stock	
35.3	Manufacture of aircraft and spacecraft	
22.1	Publishing	Information and Media Industries
72.2	Software consultancy and supply	
72.3	Data processing	
72.4	Database activities	
72.6	Other computer related activities	
92.1	Motion picture and video activities	
92.2	Radio and television activities	
92.3	Other entertainment activities	
92.4	News agency activities	

NACE	Description	IRS Classification
51.1	Wholesale on a fee or contract basis	Transaction oriented Services
51.8	Wholesale of machinery, equipment and supplies	
60.3	Transport via pipelines	
62.3	Space transport	
64.2	Telecommunications	
65.1	Monetary intermediation	
65.2	Other financial intermediation	
66.0	Insurance and pension funding, except compulsory social security	
70.1	Real estate activities with own property	
70.2	Letting of own property	
70.3	Real estate activities on a fee or contract basis	
71.3	Renting of other machinery and equipment	
72.1	Hardware consultancy	
74..1	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings	
74.4	Advertising	
11.2	Service activities incidental to oil and gas extraction, excluding surveying	Transformation oriented services
45.1	Site preparation	
72.5	Maintenance and repair of office, accounting and computing machinery	
73.1	Research and experimental development on natural sciences and engineering	
73.2	Research and experimental development on social sciences and humanities	
74.2	Architectural and engineering activities and related technical consultancy	
74.3	Technical testing and analysis	