Non-technical Summary

This paper analyses the innovative activities of business service firms. For that purpose, we distinguish the so-called “Knowledge Intensive Business Services” (KIBS) and the more ordinary ones called “Other Business Services”. We use data of the Mannheim Innovation Panel in the service sector from 1997 which represents the German part of the second Community Innovation Survey (CIS2) of the European Commission. This leads to a sample of about 1,000 business service firms.

We find that the KIBS are more innovative than ordinary services: They are more on the technology push side, i.e. many KIBS perform R&D continuously, engage in innovation co-operations and have a large share of high skilled employees.

However, there are also differences within the KIBS. We consider Computer Services, Technical Services and Consultancies. The Technical Services are closely interwoven with the manufacturing sector: The good producing firms are their most important client and their most important source of information concerning innovations. The Computer Services and the Consultancies show broader patterns. The Other Business Services are more closely related to their suppliers.

Finally, we use a tobit regression model to investigate the determinants of international market success of services. We find evidence that innovations and R&D activities have a positive impact on the performance of services on international markets. Additionally, the “knowledge content” seems to be an important factor for the geographical market range: The KIBS are more likely to export their services to foreign countries than ordinary services.

Business Services in Germany: Bridges for Innovation

by

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Abstract[1]

During the last 20 years, R&D and innovation activities in the service sector have clearly increased. Especially business services are believed to be one of the main drivers of technical changes and economic progress. Looking at the labour indices calculated over the period from 1982 to 1996 one notices a remarkable increase of over 70 percent for the business services. About 8 percent of total employment in West Germany is in business services. In particular, by taking advantage of information and communication technologies, knowledge-intensive business service firms increasingly play the role of "converters" of technological information within the economy. They are providers, purchasers or partners in the context of innovation. A sound innovation capacity, especially knowledge, creativity, market and management skills let them become bridges for innovation.

Key Words: Business Services, R&D, Innovation, Technical Change, ICT, Knowledge Flows
JEL-Classification: C20, D21, L11, L80, O30

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1 Background and Objectives

It is generally assumed that growth in highly developed economies is based to a large extent on national efforts to increase productivity by innovations. In this context, innovation is an essential precondition for growth, maintaining employment and competitiveness. Innovation is the driving force towards technological and structural changes.

This assumption refers primarily to the innovative activities of manufacturing firms that create the preconditions for new products or production processes together with research and development work (R&D). However, innovations are more widely spread throughout the economy. R&D and innovation activities in the service sector have increased during the last 20 years, and especially business services are believed to be one of the main drivers of technical changes and economic progress. In recent years service firms have become providers, users, originators and intermediary institutions of the transfer of technological and non-technological innovations. Thus, they fulfil a major role in the knowledge based economy.

But transforming knowledge into economically viable products, processes or services is much quite complicated. The innovation process combines several steps, such as analysis of opportunities and threats, research and development, implementation and production, marketing and services. All these activities are closely interwoven and interdependent. In the majority of industries, technologies or services, the phases recur in response to the learning results achieved in the subsequent phases of innovation.[2]

In the end, this transformation process seems to be strongly enhanced by factors like the composition of a country's industries, the presence of leading customers and suppliers, the technological infrastructure, the system of education and vocational training and a number of other specific characteristics, especially the implications of technology transfer and, in this context, the role of technical consultants or business services. Some firms are expanding to take on new roles and integrate new activities into their enterprises and some prefer to outsource some of their activities to specialists outside the firm. The ways of interaction in an economy have been affected with networking, co-operation and the distribution power of knowledge. Recently, these factors were summarised as the “national system of innovation”, in which the transfer and use of information play an important role for the effectiveness of the innovative system and the potential of economic performance.[3]

Adequate support for corporate innovative activities is thus dependent on the effectiveness of the transfer mechanisms. Three aspects are worth discussing:

- First, in view of intensifying (international) competition in technology, and equally intensified technology transfer, the faster utilisation of economically useable knowledge by domestic companies.

[2] For conceptual issues of the innovation process and technology transfer see Bozemann (2000), Bessant and Rush (1995), Kline and Rosenberg (1986), Stoneman (1995), Dodgson and Rothwell (1994), Freeman (1994), Dosi et al. (1988), and Dosi, Pavitt and Soete (1990).

[3] For alternative definitions of innovation systems and innovation approaches see Breschi and Malerba (1997), Carlsson (1994), Carlsson and Stankiewicz (1991), Cooke and Morgan (1994), Edquist (1997), Smith (1995), and the following literature for works mainly related to national systems of innovation: OECD (1996), (1997a) and (1998), Freeman (1988), (1990), Lundvall (1992), Nelson (1993), Nelson and Rosenberg (1993), Porter (1990).

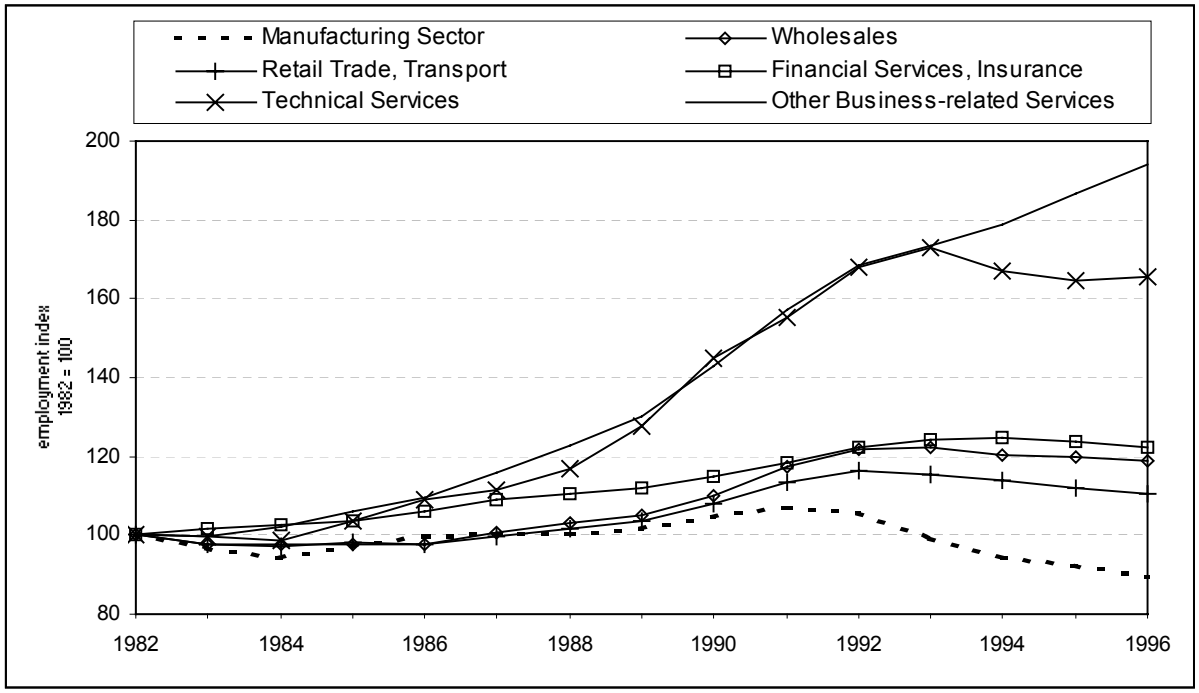
- Second, the ongoing trend away from a traditional division-of-labour approach in public research and the industry towards more networking of public and private-sector research, in the latter with both the manufacturing and the service sector.
- Third, the variety and value of businesses that serve not only as intermediating facilities for transfer activities but also as a means of reducing costs and other obstacles for innovation in other firms, i.e. R&D, knowledge, finance, management, marketing etc.

In conclusion, this debate is aimed at obtaining a better understanding of the overall context behind the generation, diffusion, adaptation and exploitation of new know-how or, as we call it, building “bridges for innovation”.

Trends

Before we study the role of business services in the German national innovation system and the several dimensions of interrelations among business services and other companies in the manufacturing and service sector, it appears meaningful to look at the impact of business services on the labour market.

Figure 1: Development of Employment in West Germany (1982 = 100)



Source: Labour statistics, Bundesanstalt für Arbeit – Beschäftigte in Betrieben, taken from Niggemann (1999)

The importance of business services in Germany is quite considerable. In Figure 1, the labour indices calculated over the period from 1982 to 1996 show a remarkable increase of over 70 percent for business services. In 1997 about 8 percent of total employment in West Germany, i.e. 2.2 million employees, were in business services (technical and other business-related services). A similar picture is revealed for other OECD countries. As shown by the OECD, employment in business services has more than tripled in the 25 years following 1970, corresponding today to around 5-10 percent of total employment (OECD, 1996).

Until the beginning of the 1990s, technical business services and other business services (information and communication technologies (ICT), management consultants etc.) were performing on a high level, whereas services in general (finance, insurance, wholesales etc.)

had only a slight increase in performance. The employment level in the manufacturing sector remained almost unchanged. In the 1990s, the dynamic expansion of technical services came to an end. The figures decreased. This development seems to be comparable to the situation in the manufacturing sector and there might be a link between technical business services and manufacturers in the sense of partners along the value chain. Contrary to this, the labour indices for other business services continued to increase, mainly driven by the development of the ICT-sector and management consultants.

In aggregate terms, investments in information and communication technologies have risen strongly in most OECD countries and have encouraged the development of employment. In OECD countries the share of information and communication technologies (ICT) expenditures on GDP reached 7 percent on average in 1997 (OECD, 2000b). The wide diffusion of ICT forms part of a broader debate as to whether or not it represents a basic technological shift with widespread implications across sectors and long-lasting effects on productivity growth. The so-called "new economy" was applied to the period since 1995. Some authors characterised the new economy as "synonymous with technically advanced in information technology, declined prices in computer hardware, software and telephone services, a growth of computer power and telecommunication capability, and the wildfire speed of development of the internet" (Gordon, 2000).[4] Therefore, information technologies have become increasingly important as a means of innovation in knowledge-based economies. Information technologies process, store, and communicate information. As Schreyer (2000) mentioned "in information technologies (excluding communications) the software market has shown rapid growth and, together with services, dominates the IT market (around 55 percent of the total). Single-user systems, mainly PCs and workstations, have grown strongly but the decline of other hardware categories has meant that hardware's share of the market has fallen. With the rapid growth in the Internet and networks, data communication equipment is likely to continue to be the most dynamic market, but it still has a modest share of around 5 percent of IT markets. Between 1990 and 1997, the OECD IT market grew at 8 percent a year". Ebling et al. (1999) showed the importance of ICT as a means of innovation in serveral German service sectors. Due to the European Information Technology Observatory (EITO, 1999) the market value of IT in Germany is about 211 Million Euro.

Aims of the study and areas of work

In the following sections we will take these first empirical observations into account when we try to answer some questions dedicated to the characteristics, the importance and further developments of business services. The aim is to highlight the following questions:

- What does the term "business services" mean?
- Which role can and do business services play in the economy?
- Who uses these services?
- Are there varying patterns of innovation behaviour in terms of technology transfer, sources of information and R&D-collaboration or network activities among business services?

[4] For the debate about the new economy see e.g. Council of Economic Advisers (2000), Schreyer (2000), Coppel (2000), OECD (2000a), Jorgenson and Stiroh (1999).

- Are business services part of global businesses and involved in international flows of knowledge?

Before we use the data to analyse the topics mentioned above we will provide a short discussion of methodological questions and conceptual considerations. The next part gives some insights into the importance and the roles of business services.

The main part of the study addresses the empirical evidence in business services. That is the "Innovation potential of business services“ and the "linkages and interdependencies” among business services and other companies. This paper examines the role of business services as a means of building bridges for innovation in both the manufacturing and service sectors.

The final section of the empirical part of this paper is related to the results and further steps. In this part we summarise the findings. This is not just meant to give a review but to introduce a concept of how innovation activities in business services could be measured as a driving force for innovation in a global economy.

2 Business-related services: Conceptual considerations

2.1 A classification of business services

In Germany, the most common definition of the tertiary sector of the economy is presumably one that is based on the branches of economic activity. It is the characteristic feature of the differentiation according to sector that the classification of legal (businesses) or local entities (plant or place of work) is based on the activity on which the production or output is concentrated. According to this classification (NACE Rev. 1), the following branches constitute the tertiary sector:[5]

- retail trade, maintenance and repair of motor vehicles, motorcycles, personal and household goods;
- transport, post, and telecommunications;
- financial intermediation, insurance, and pension funding;
- real estate activities, renting of machinery and equipment, renting of personal and household goods, and services provided for companies;
- public administration, defence, and social security;
- education;
- health, veterinary and social work;
- other public or private services.

Certain service businesses are categorised as "production-related services" - a term that is not clearly defined. Apart from "production-related", there are terms, such as "business-related", "knowledge-intensive", "technology-intensive" and "qualified". Alternatively, services are differentiated according to the customers to whom the output is predominantly (in terms of value added) directed. The problem with this method is that it merely considers the exter-

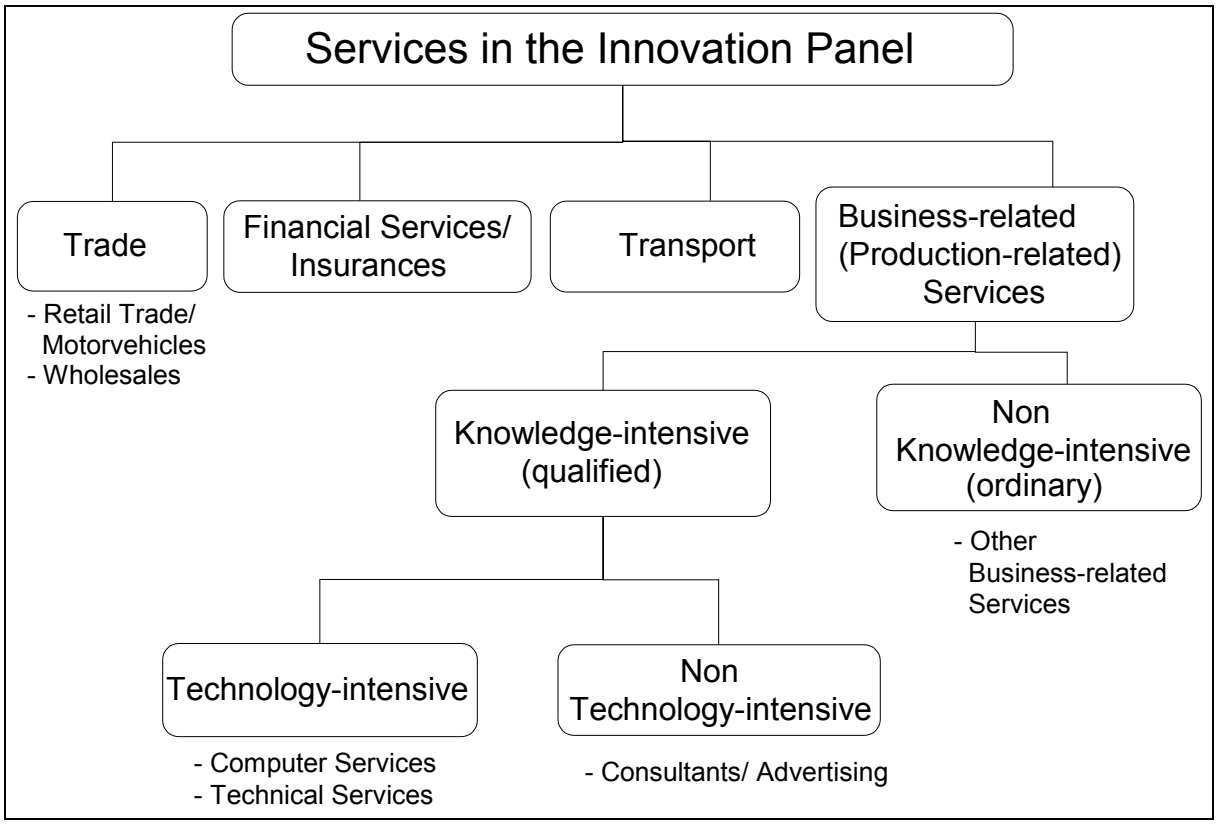
[5] See also Table 9 in the appendix.

nal, but not the internal output. One consequence is, for example, that services generated within a manufacturing firm are not considered in the sectoral classification.

It is because of these inconsistencies, together with the differing availability of data, that there are a number of different ways in which production-related services are defined. One must accept, however, that the criteria for differentiation which form the basis of the respective statistics are hardly coherent, so that the analytical conclusions drawn from the statistics cannot be compared directly either. The official statistic's information deficits make it difficult to carry out a detailed analysis of the structural shifts that takes into account the development within the service sector. Characteristics that are based on the same sub-categories can often not be described. In particular, it is not possible to depict the structure and development of branches influencing economic and technological development to an especially great extent. This applies, e.g. to the computer services business, to telecommunications, or "other business-related service providers". In these cases surveys constitute alternative sources of information (cf. Niggemann, 1999). Apart from the service businesses' selling structure, the "value" of the services serve as distinguishing criteria: The differentiation between qualified and non-qualified services, for example, alludes to the role of knowledge in the production process. Computer services, research and development, and various legal, economic and technical consultants count as qualified services. Therefore, one can differentiate between higher-quality, qualified, or knowledge-intensive services on the one hand and ordinary services on the other.[6]

[6] For a good overview of the different definitions of production-related service providers in the German literature see Engel and Steil (1998), Haß (1995), DIW (1998), Kerst (1997), Strambach (1995), Reissert and Schmid (1990).

Figure 2: Definition of business-related services



To simplify matters, we distinguish two groups: the ordinary standard services and the complex or qualified knowledge-based services.[7] The qualified services can be divided into technology-intensive and non-technology-intensive services (see Figure 2).

- Ordinary standard services are, for example, packaging services, security services, cleaning services, secretarial services, disposal, renting of machinery and equipment, real-estate activities, labour recruitment and provision of personnel. These services are usually purchased locally. There is regular and frequent demand. The minimum size for providers is small and the local market admits several of these.
- More complex and qualified services are information and communication technology services, technical construction planning, civil engineering, legal advisory, tax advisory, financial services and insurance, laboratory services and inspection. These represent services which are requested less frequently (and less regularly) than ordinary standard services, and the intensity of advisory is higher. The geographical catchment area for the purchase of more complex services tends to be somewhat bigger than that of ordinary standard services. The services are demanded less often than ordinary standard services. The minimum size for providers is small and the regional market is big enough for several providers.

Some of these complex or qualified knowledge-based services are more long-run oriented or strategic than others. The knowledge-based services (KIBS) comprise strategic planning,

[7] In a number of studies the term “knowledge-intensive business services” (KIBS) is used for the qualified knowledge-based services, e.g. in Hauknes and Miles (1996), Hauknes (1999), Hipp (2000), Miles (1994), Miles et al. (1995), Smith (1995), Strambach (1994) and (1997).

management, research and development, marketing-related planning, advertising and distribution, software development, technical-scientific training, quality management and certification as well as specific legal advisory.

In general, such knowledge-intensive business services expose a small "density of demand", i.e. there are only few potential customers in one region and they are rarely sought after. On the one hand, it is due to the complexity of the services that the minimum size for providers usually exceeds that of standard services. Accordingly, the market has to be larger. Highly specialised and knowledge-based global services tailored to meet a customer's individual needs are purchased over long distances. On the other hand ICT services, especially E-businesses are means to overcome long distances and bring partners together, wherever they are. These business services often go hand in hand with other knowledge-intensive business services.[8]

2.2 The role of business services

Support for innovation can be implemented through a choice of channels and various actors. In the provision of support for the innovation activities of their customers, the tasks and the time of operation are different for the various branches of the knowledge-based business-related service sector. In general, their function is to generate and develop new ideas. In detail, the analysis of the general set-up for innovations is, for example, the responsibilty of the legal advisor and the tax advisor. Software providers mainly support the implementation of new ideas. Engineers are responsible for the development of prototypes and market researchers as well as opinion researchers start to operate when services are introduced to the market.

A number of factors play an important role in the functioning of an innovation system in a knowledge-based economy. From a general point of view Nelson and Winter (1982) single out four factors which are fundamental for the effectiveness of an innovation system: opportunity conditions, appropriability conditions, accumulation of technical knowledge and the knowledge base. These factors include technological means and human capital, mechanisms to protect revenue generated by innovation activities, know-how and at least its transfer mechanisms.

Looking at the business services and the role they play in the innovation process we have to figure out the long-term interaction among all those involved. For the purpose of our analyses we distinguish three different ways in which business-related services interrelate with the manufacturing industry and other services.[9]

[8] Coppel (2000) stated: "The internet permits the interconnection of new and existing information and communication technologies, and offers businesses and consumers a new and powerful information system and a new form of communication. This makes it possible for buyers and sellers to come together in more efficient ways and is creating new marketplaces and opportunities for the reorganisation of economic processes. It is also changing the way products are customised, distributed and exchanged and how businesses and consumers search and consume products." "Although it may not yet have created many new products, it has opened up many new opportunities. Genetics and biotechnology, mobile phones, online auctions and financial derivatives would all be impossible without low-cost computer processing power" (Economist, 2000).

[9] Another operational definition of KIBS is given by Miles et al. (1995): "Knowledge intensive-business-services rely heavily upon professional knowledge, and either supply products which are themselves primarily sources of information and knowledge to their users, or use their knowledge to produce services which are intermediate inputs to their clients' own knowledge generating and information pro-

- Business-related services purchase knowledge or equipment and investment goods from the manufacturing industry or other services. (Purchaser)
- Business-related services provide services or knowledge for companies in the manufacturing industry/service sector; the services might become part of other companies' products. (Provider)
- Business-related services deliver knowledge or services that are complementary to the manufacturing industry's products or to other services. They have a joint effect for the user, where – together - they generate a value added. (Partner)

The first role of interrelation in the innovation process can be summarised under the term "demand pull". Here, the business service requires an input of knowledge or technology that enables it to do business services and/or to develop new innovative services. The input given by an external company is a precondition for the business service, but the demand for high quality input forces the external supplier to continuously make improvements. For example, IT-services (such as system integration, operation management or support services) and software development depend on powerful and capable IT hardware comprising servers, personal computers, workstations, data communication equipment and peripheral devices.

The second type of interrelation leads to a role, in which the business services give a "knowledge push". Here, the business service is a company that transfers know-how to its customers or at least the results of in-house research and development that are embodied in the services. For instance, the business service generates new efficiencies in manufacturing by reducing procurement costs and improving supply chain management. The knowledge push into the service sector is linked to qualitative aspects of products, such as convenience and customisation, thereby reducing costs and increasing reliability (OECD, 2000b). In this case the high content of knowledge or technology results from the content of the preliminary input. The purchased preliminary goods, services or equipment embody the R&D efforts of the producing company.

Since the knowledge is tied to the services or goods, the acquisition or supply represents two specific types of knowledge transfer. But in many cases a clear linkage of business services to (only) one role is not possible. In the third type of interrelation, the case of partnership or complementarity, the products of the manufacturing industry or service sector and the business services have a joint effect for the customer. Together, they build a system (or partnership). On the market the (joint) system competes with other systems. Both providers depend on the other's efforts to further develop his product in order to stay competitive. The market performance of the system as a whole determines their own success. The R&D or innovation expense for both of them increases the technological content of the system.

For example, due to the implementation of ICT, networking and openness are becoming more important. These technologies make a faster diffusion of codified knowledge and ideas possible and science could be easier linked to business. In times when "the costs and risks of innovation have increased, firms have become more specialised, shifting from an inward to a more outward orientation. Technologies have become more complex, thus companies can no longer cover all relevant disciplines. Many key developments draw on a wide range of

cessing activities, having other businesses as their main clients."

scientific and commercial knowledge, so that the need for co-operation among participants in different fields of expertise has become greater" (OECD, 2000c).

3 Empirical Study and Results

3.1 Outline of the study and data

In the following empirical study we concentrate on business services and we distinguish between ordinary standard business services and qualified knowledge-based or knowledge-intensive business services (KIBS). The research is based on the Mannheim Innovation Panel – Services (MDP). The database is the German part of the Community Innovation Survey (CIS) of the European Commission. The survey was carried out in 1993 and 1997. The survey of 1997 contains observations on 2,200 service firms including the following sectors: wholesale, retail trade, transport, financial services, computer services (computer and related services), technical services, consultants as well as other business services.[10]

Table 1: Business Services in the Mannheim Innovation Panel

Business Services	NACE	Share of Sample
Computer services		8 %
• Hardware consultancy services	• 72.1	
• Software consultancy and supply services	• 72.2	
• Data processing services	• 72.3	
• Database activities	• 72.4	
• Maintenance and repair of office	• 72.5	
• Other computer related activities	• 72.6	
Technical services		27 %
• Research & Development	• 73	
• Architectural and engineering activities and related technical consultancy	• 74.2	
• Technical testing and analysis	• 74.3	
Consultants		20 %
• Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings	• 74.1	
• Advertising	• 74.4	
Other business services[11]	70, 71, 74.5, 74.6, 74.7, 74.8, 90	45 %

Source: Mannheim Innovation Panel 1997, own calculations

Taking into account the differentiation according to sector as described above (see Figure 2), it is possible to outline business-related (production-related) services: computer services

[10] The Mannheim Innovation Panel focuses on services provided by companies, so that public administration and non-profit organisations like political parties and associations are not taken into account. In the following, we draw upon the innovation panel in the service sector by ZEW/FhG-ISI. See Janz and Licht (1999).

[11] See Table 9 in the appendix.

(NACE 72), technical services (NACE 73, 74.2, 74.3), consultants (NACE 74.1, 74.4), and other business services (NACE 70, 71, 74.5, 74.6, 74.7, 74.8, 90). This selection leads to a sample of about 1,000 business-related service firms, mainly (very) small companies: 75 percent with less than 20 employees, and 95 percent with less than 200 employees.

Table 2: Outline of the empirical study

Research topic	Indicators
Step I: Innovation potential of business services	Qualification, innovation and R&D activities
Step II: Bridges for innovation	
- Purchaser	Sources of information
- Provider	Turnovers with different clients
- Partner	Co-operation within innovation projects
- Internationalisation	Export-Sales-Ratio

The innovation panel database represents an opportunity to study various forms of innovation related activities (see Table 2).

- At the beginning, we answer the question whether business services are innovative or not. A sound innovation capacity, especially knowledge, creativity, market and management skills are necessary preconditions to become a bridge for innovation. The assumption here is that if business services have a sufficient in-house innovation potential, then they can build bridges for innovation.
- At the next stage, we figure out how these business services are integrated in the innovation system. This part of the research leads to the specific roles business services play. Are they purchasers, providers, or partners in the context of innovation? Do they push and/or pull the innovation train? In this context we undertake a first step to analyse international flows of knowledge and services.

We investigate these issues with different tools: We carry out descriptive analyses of several variables of interest, i.e. projections on the German firm population with our given sample. Additionally, we use multivariate tests on homogeneity and a tobit regression to examine the firms' innovation performance.

3.2 The innovation potential of business services

3.2.1 Knowledge base

The growing field of know-how-intensive services in particular demands highly skilled workers. The number of highly qualified employees has even risen in the fast-growing area of business, innovation and technology-driven services.[12] This growth is founded on the growing number of intermediate products from the service sector and on increased business

[12] The growing portion of persons with a high level of qualification in German industries is also partly due to the overall increase in the level of education among the general population and the large number of well trained people. With such a labour supply available, companies have workers with various levels of qualification to choose from and often fill positions with highly qualified personnel. This occurs ultimately at the expense of less qualified workers. See BMBF (1998), Technological Performance of Germany 1998.

services such as for R&D, marketing, financing, software, training etc. which are in ever greater demand in industry to augment manufacturing activities. The intensification of services in the manufacturing sector goes hand in hand with shifts toward more highly qualified workers.

The ability of companies to generate knowledge or to gather knowledge from outside the firm and to transfer it successfully into marketable goods or services vitally depends on the human capital of the companies. Scientists and highly skilled employees have key qualifications for innovation. They are also indispensable for putting technical know-how to use in a company.

As an indicator, though not fully sufficient, for the available human capital of a company and consequently for the innovation potential, we analyse the qualification structure of the employees. We distinguish four categories of qualification according to the education level or degree of the employees:

- employees with university degrees
- employees with technical college degrees (master craftsmen, foremen, technicians, etc.)
- employees with vocational training
- other employees

Most notably, Table 3 shows that the share of highly trained employees with at least a university degree or technical college degree is around 60 percent in computer services and technical services. University graduates and persons who have completed non-academic vocational training have the highest participation rates. Today, some 80 to 90 percent of all employees in these fields of business services have completed some form of further education and training. As a consequence, the share of low-skilled workers has shrunk by nearly five to ten percentage points.

Table 3: Knowledge base in business services (1996)

	Employees with university degrees	Employees with technical college degrees (master craftsmen, foremen, technicians, etc.)	Employees with vocational training	Unskilled employees
Computer Services	46%	14%	32%	7%
Technical Services	54%	11%	27%	8%
Consultancy	33%	15%	39%	13%
Other Business Services	10%	9%	43%	38%

Source: Mannheim Innovation Panel 1997, own calculations

Compared with these findings the share of academics is substantially lower in the consultancy business. About 35 percent of the employees have a university degree. Nevertheless, employees with a university degree or technical college degree constitute nearly 50 percent of all employees among the consultants. Moreover, the demand for highly qualified workers in particular is growing. The figures are considerably higher in knowledge-intensive services. The rate is far lower in some other business services.

The trend toward higher levels of qualification is primarily due to the growing demand for highly qualified labour. Modern products and production processes demand increasing amounts of education and know-how in all parts of the economy. Well-trained workers and scientists fuel greater output of know-how and contribute to the rapid dissemination of know-how. For this reason, qualified work and a high level of scientific research constitute the advantages in highly developed economies.

Judging from the level of training in its work force, and from its above-average share of qualified employees, business services offer the conditions necessary to ensure that they will be among the front-runners in the innovation process in the future. “Some services with a strong technology or knowledge component may play a pivotal role as vehicles for diffusion of new technologies throughout the economy. Being major employers of scientists and engineers they will also be a major source of specialist knowledge and for access to advanced networks.“ (Hauknes, 1999)

3.2.2 Innovation profile and R&D activities

In this section we examine the dissemination of innovative and R&D activities among business service companies. The innovativeness at the firm level due to innovation and R&D-activities is a further logical step to evaluate the technological competence of the firm, market opportunities and appropriability conditions. It reflects the likelihood of innovation for a given sector, points to the continuity of innovation, the knowledge base, and at least the suitability to be a “bridge” for innovation.

A first indicator that analyses the innovation activities is the share of innovators in the sectors of interest. Enterprises that have introduced both, any new or improved products or services, onto the market and have changed processes are active contributors to the technological change and the innovation process.[13] In 1996, 79 percent of companies that belong to the computer services sector introduced new or significantly improved products, services or processes. In the technical services or consultancy business the average ratio was 61 and 68 percent. In other business services only 52 percent of the companies reported having developed new products or services. A multivariate test for homogeneity that controls for size, industries and region shows that the larger firms and the computer and technical services are more likely to be innovative (see Table 10, column 1, in the appendix).

Computer services and technical services, measured by the ratio of innovation expenditures and turnovers, devoted a greater percentage of their budget to innovation activities. The innovation expenditure comprises investments in R&D, product design, training activities, market analysis and others. In 1996 the figure was 3.2 percent for computer services and 3.8 percent for technical services.

Furthermore, Table 4 allows one to compare the shares of innovators with R&D. When it comes to R&D activities, the trends are even more pronounced than with innovation activities. Here it becomes clear that R&D requires resources and organisational dimensions be-

[13] The firms were asked whether they have introduced any changed (new or improved) products (goods and services) and processes. This definition of innovators distinguishes between significant and incremental innovations and also takes into consideration imitations as well as an enlargement of the product portfolio. The product or process should be innovative to the enterprise; it does not necessarily have to be new to the market.

yond some sporadic or operative work related to innovation. R&D is a strategic business decision with long-term perspectives. R&D is a continuous source of innovation advantages. With this in mind, R&D is an indicator for an economic environment that is characterised by relevant continuities in specific innovation activities (Breschi and Malerba, 1997). [14]

34 and 29 percent of the innovative firms in computer services and technical services reported to have engaged in R&D. Both the computer services and the technical services exceed the average of the other business services by more than ten and twenty percent respectively. Here, R&D seems to be an important input factor for innovation. Moreover, in comparison with consultants and other business services, computer services and technical services are likely to be more on the "technology-push" side of the innovation process. A multivariate test supports these findings (see Table 10, column 3).

Table 4: Innovation activities and expenditures on innovation in business services in 1996

Business Services	Share of Innovators	Innovation Intensity	Share of Innovators with R&D
Computer Services	79%	3.2%	34%
Technical Services	61%	3.8%	29%
Consultancy (incl. advertising)	68%	1.7%	19%
Other Business Services	52%	1.0%	4%

Source: Mannheim Innovation Panel 1997, own calculations
Note: Innovation intensity: ratio of innovation expenditures and turnovers in %.

In conclusion, the innovation performance capabilities of a company are not solely determined by the R&D activities involved; not less crucial is the ability to launch new or improved products or services on the market, and/or to utilise new or improved processes. This entails costs above and beyond pure and simple R&D, e.g. for market analyses or staff training in connection with new product launches.[15] It is a combination of activities such as research, market investigation, tooling up which are necessary to develop an innovative service, product or production process from the company's point of view. The innovative potential of business services, especially of consultancy will be severely underestimated if one uses only the share of innovators with R&D. There is a high potential of creative ideas that could be used by other companies in the manufacturing sector and in the service sector.

According to the knowledge base (see section 3.2.1.) and the number of firms which are going to develop new products and services, qualified knowledge-based business services are highly innovative. These firms are knowledge-intensive and seem to have the capacity to give impulses to other companies and to transfer innovative products or services into innovation that brings economic success. Detailed analyses will be presented in part 3.3.4.

[14] These thoughts can help to explain why only a small number of smaller firms are able to allocate resources to R&D, whereas almost every big company is active in R&D. Nevertheless, a striking number of small firms introduces new products without any formal R&D activity.

[15] Technological product and process innovation activities are all those scientific, technological, organisational, financial and commercial steps, including investment in new knowledge, which actually, or are intended to, lead to the implementation of technologically new or improved products or processes. Some may be innovative in their own right, others are not novel but are necessary for implementation. See the "Oslo Manual" (OECD, 1997b).

3.3 Bridges for innovation

3.3.1 Sources of information

In many cases, it is not technologies or products that are transferred, but rather information or knowledge, enabling companies to develop market-driven innovations. Apart from the in-house activities, all external information sources can stimulate the innovation ideas and activities at the business services level. Coming in touch with fruitful ideas is a first step and a reasonable way to expand one's own innovative potential. After a while and due to the external inputs, the inspired business service company might deliver ideas or services to other companies and thus switch roles from purchaser to provider.

The possible sources for innovation can be divided into enterprise internal knowledge and enterprise external knowledge. Furthermore, the enterprise external knowledge can be separated into industry internal or industry external. Additionally, one can differentiate the sources of knowledge concerning the interconnection of the enterprises. Thus, it can be determined whether vertical interconnections, i.e. customers or suppliers as sources of knowledge or industry-based horizontal interconnections with other service enterprises exist.

In general, one can identify four different categories of information sources:

- sources within the enterprise or the entrepreneurial group;
- external private enterprises, i.e. customer, supplier, competitor, consulting firm;
- public R&D infrastructure, i.e. universities, professional schools, non-university research, transfer places,
- generally accessible sources, i.e. fairs, exhibitions, publications, patents, data bases, electronic media.

For our purpose it is important to look at the active participants on the market, especially customers, suppliers, competitors and consultants. Table 5 shows that in addition to the internal operational sources, competitors are all important pulse generators in computer services, consultancy, and other business services. Here, competitors are on the top of the ranking list. On the one hand, the importance of competitors can point to a horizontal co-operation. On the other hand, it signifies a large amount of imitation activity in the service sector. In these business services the second important information source for innovation is customers from the service sector. Between 50 and 60 percent of firms indicate this.

Table 5: **Important information sources for innovation activities (1994-1996)**

	Customers of Manufacturing Sector	Customers of Service Sector	Suppliers	Competitors	Consultants	Universities
Computer Services	31%	54%	42%	54%	27%	34%
Technical Services	49%	46%	31%	48%	32%	42%
Consultancy	28%	54%	35%	57%	40%	31%
Other Business Services	46%	59%	46%	63%	34%	20%

Source: Mannheim Innovation Panel 1997, own calculations
Note: Percentage of firms which reported that the specific information source is important or very important. Figures do not add up to 100 due to multiple answers.

The connection to the manufacturing sector is illustrated here by the information source "Customer in the manufacturing sector". This source classifies fewer than 30 per cent of the computer services and consultancy services as important or very important. In contrast, the technical services identified this source as the most important information source. Marginally lower than 50 percent is the share of technical business companies that reported that customers of the manufacturing sector are very important or important stimulators for the innovation process. And again, competitors have a similar influence on the innovation activities in technical services as in other sectors.

Multivariate tests reveal that technical services are closely related to universities. Additionally, we find that the other business services are more related to their suppliers. Thus, innovations in these sectors are mainly due to other firms' activities. There are no significant differences in the importance of customers among industries, regions and size (see Table 10, columns 4 to 9, in the appendix).

It is remarkable that all business service companies identified a variety of information sources of knowledge as very important an above average number of times. There is not only one specific important generator, but also a considerably high number of candidates (keyword: global sourcing). Apparently, further innovation-relevant networks exist with universities, professional schools, vocational academies and public and private research establishments. In the end, all the observations that consider information to be an important input to the innovation process underline a strong probability that business services are a vital actor of the innovation system. It is certainly possible that business services accelerate the impulses they get from outside the company (inter-sector and intra-sector knowledge transfer) and transmit them into fruitful ideas or services.

3.3.2 Turnovers with different clients

The efforts to generate knowledge and translate it into marketable products or services determine the performance of firms. This process can be supported using various distribution channels. These means of knowledge or innovation transfer reflect interaction or activities within the innovation network. For example, firms

- prefer informal contacts such as communication,
- acquire knowledge using licenses,

- purchase equipment or
- share in other companies.

Two channels through which an enterprise gains access to new technologies or know-how seem to be most relevant: On the one hand, there is the transfer of embodied technology through the purchase of equipment. On the other hand, there is the diffusion of disembodied knowledge through both services and communication and knowledge, for example. Selling goods or services as well as knowledge is part of a business and will be clearly evident in the sales figures.

The distribution of turnovers according to different clients is an indicator that examines the (economically-oriented) interaction among business services and other companies. Table 6 gives an overview of the importance of the four customer groups of business services: manufacturing, services, government, and households. The qualified service providers obtain almost the biggest share of their turnovers by sales to the manufacturing sector. Technical services and consultancy cover approximately 50 percent and computer services make up slightly more than 40 percent of selling services and/or knowledge to manufacturing companies. The figures reveal, however, a notable difference among business related service firms. Customers of technical services tend to stem from the production sector and these services have close links to the government, i.e. 20 percent of the turnovers. Computer services and consultancy usually cover a substantially higher share with the service sector.

Table 6: **Turnovers of business service firms with different clients (1996)**

	Manufacturing Sector	Service Sector	Government	Private Households
Computer Services	44%	42%	12%	2%
Technical Services	52%	19%	23%	6%
Consultancy	49%	39%	5%	7%
Other Business Services	30%	26%	12%	32%

Source: Mannheim Innovation Panel 1997, own calculations

The analysis of clients of business services revealed an intuitive pattern of relationships: technical services are predominantly linked to the manufacturing sector, while computer services and consultancy are closely related to the industry and the service sector. Nevertheless, networks connected by different clients are being developed. Service firms are not only important users of new ideas originated in others parts of the economy, they also induce impulses for innovation that returns to the manufacturing firms, for example. Technical and computer service providers supply or sell knowledge and services that lead to new technologies and innovation.

3.3.3 Willingness and partners of co-operation

External know-how, which finds new products, services or production processes for development and improvement, can flow to the enterprises over various channels. Co-operation has not only been able to create knowledge synergy, but also has been able to achieve the goal of sharing goals, costs and risks, while compensating for problems associated with the use of the results. Co-operative research projects usually require permanent activities at the

companies involved. The co-operation partner can always contribute only complementary knowledge.

Co-operation needs a stronger personal commitment and, above all, a stronger cost commitment of all parties involved. R&D co-operation and jointly-executed innovation projects are usually complementary and do not replace in-house activities, even for small enterprises. Therefore, co-operation is only able to make up for certain deficits that the enterprise has. It gives the company the complementary scientific support for its own efforts of innovation.

The proportion of innovative service companies is just as high as in industry, although R&D activities play a subordinate role in the service sector. They take place sporadically, are more project-oriented and are permanently established in only a few sectors, such as computers and technical services. Therefore, it is not surprising that the proportion of co-operation on innovation projects in the service sector is clearly below the ratio of the manufacturing sector. Self-researching service companies have an altogether smaller tendency toward co-operation than R&D-active industrial enterprises. The overall proportion in the service sector is about 15 percent and, thus, clearly below the more than 30 per cent in the manufacturing sector. Only through co-operation with competitors does the service sector achieve the same level as the industrial sector.

Table 7: Co-operation in business services: Willingness and partners

	Computer Services	Technical Services	Consultancy	Other Business Services
Innovators with co-operations	24%	23%	21%	14%
Co-operation partners				
Customers (Manufacturing)	9.4%	14.5%	5.7%	4.8%
Customers (Service Sector)	10.1%	12.2%	8.5%	7.6%
Competitors	16.9%	9.9%	10.9%	7.8%
Suppliers	3.5%	10.1%	7.5%	8.8%
Consultancy	5.5%	2.8%	10.6%	3.5%
Universities	15.4%	9.4%	8.3%	3.6%

Source: Mannheim Innovation Panel 1997, own calculations

The KIBS or qualified service firms (computer and technical services as well as consultants) are more likely to co-operate in innovation projects than other firms of the service sector. More than every fifth innovator is engaged in innovation co-operation (see Table 7). The computer service firms prefer co-operation projects with competitors and universities, which again points out the highly qualified character of service providers in the ICT sector. The technical services are closely related to the manufacturing sector. About 15 percent of innovators joined co-operative innovation projects with customers of the manufacturing sector. The hypothesis of the lower knowledge contribution in other business services is supported again, as those service providers are most likely to co-operate with suppliers. This indicates the supply-dominated character of these mainly ordinary services. Again, multivariate tests support these results (see Table 10, column 2).

R&D co-operation presupposes in-house capabilities and evolves complementary synergies. The foundation of networking is personal experience and mutual trust. The proportion of co-operation in qualified business services is considerably high compared to the average will-

ingness to co-operate in services. Business services do not only use external information sources, they are also active contributors to the innovation process. They are able and willing to co-operate and invest time, financial resources and human capital in joint projects with partners. Similar to the use of different sources of information, it seems to be very likely that if a business service company is willing to co-operate, it may use more than one, in many cases a wide range of partners. A successful horizontal partnership with a competitor goes hand in hand with the use of vertical co-operation with customers in the manufacturing sector. Here, the idea of a network is rather obvious. Business services benefit from external support just as they build bridges for innovation.

3.3.4 Global business at a glance

Thus far, the study shows a rough pattern of links of knowledge transfer and information interchange among business services and other companies, or as we call it, bridges for innovation. This is primarily referenced to activities within a national framework. In order to enrich the focus of the analysis, one can open the field for aspects of international businesses. Various indicators can be used to measure the global performance of a company and to discuss the impact of innovation in this context. In most cases the reason for an engagement in innovation is simple: The motivation is the generation of new economically useful ideas and the implementation of these ideas on the market. Ebling and Janz (1999) showed already that innovative activities stimulate the export behaviour of service firms. Another result of their analysis is that exports do not induce innovations.

Here, as a first step, the export-ratio reflects the competitive edge of the services. The export-ratio of business services is an indicator for market success as well as internationalisation and leads to an analysis of international flows of knowledge and services.

Table 8: Export performance of business services (tobit regression)

Dependent Variable: Export/Sales Ratio (multiplied by 100)	**Coefficient**	**t-value**
Industry Dummies (Basis: Other Business Services)		
Computer Services	16.19 *	4.16
Technical Services	17.35 *	4.44
Consultancies	21.16 *	5.70
Number of employees	.0016	.88
Product innovation dummy	6.04 *	2.27
Innovation co-operation dummy	3.98	1.18
R&D activity dummy	10.24 *	3.27
Share of employees with university degrees	-.02	-.38
East Germany dummy	-15.23 *	-5.04
Diversity of firm's customers (Concentration index)	-.009	-1.09
Part of group dummy	-1.05	-.27
Constant term	-27.40 *	-4.17
Log Likelihood	-992.24	
Number of observations	908	

Note: The tobit was estimated to be heteroscedastically consistent (see Greene, 1997, eq. 20-13 and 20-15). The variables included in the heteroscedasticity term were selected due to the results of Lagrange multiplier tests (see Greene, 1997, p. 969). The estimates of the heteroscedasticity term are not reported.
* reports a 95% significance level.

We use a tobit model because many firms do not export services at all. Thus, the sample distribution of our endogenous variable is left censored at zero. We take this problem into account by using a tobit model. Table 8 displays the estimation results. They can be interpreted as the impact of an exogenous variable on the export activity. The sign and the level of significance contain the information.

It reveals that business services with a more organised or continual innovative behaviour (see product innovation dummy, R&D activity dummy) have significantly higher export activities than firms that do not innovate or undertake R&D in a systematic way. It is also clear that innovative business services such as technical and computer services or consultancy perform better than the average of the other business services. Qualified knowledge based services build international bridges for innovation by selling marketable ideas and services to foreign customers. They establish an international business (and innovation) network.

Although there are a number of differences among qualified business services, the successful business service company shows similar attitudes when it goes global. They "behave" differently from firms in the same service sector. Thus, it seems rather likely that it is not the sector itself (for example computer service) that counts, but first of all the innovation behaviour at the firm level. In internationally oriented business services, knowledge transfer or building bridges for innovation is a strategic function. It is part of the general information management and the co-operation behaviour of the company. Innovation is every-day-business. Being part of the innovation system demands a sound knowledge base and in-house activities. Together they build an absorptive capacity and excellence.

4 Concluding Remarks

Looking at business services[16] and the role they play in the innovation process, the challenge was to figure out the ability to interact and the long-term relationships between business services and other actors in the innovation system. A sound innovation capacity, especially knowledge, creativity, market and management skills are necessary preconditions to become a bridge for innovation. In general, business services have a sufficient innovation potential, thus they can build bridges for innovation.

Looking at the business services and the role they play in the innovation process, we figure out the long-term interaction between all those involved.

- Business-related services purchase knowledge or equipment and investment goods from the manufacturing industry or other services. (Purchaser)
- Business-related services provide services or knowledge for companies in the manufacturing industry/service sector. (Provider)
- Business-related services deliver knowledge or services that are complementary to the manufacturing industry's products or to other services. (Partner)

According to the knowledge base and the number of firms that are going to develop new products and services, qualified knowledge-based business services are highly innovative.

[16] As pointed out, we differentiate between higher-quality, qualified, or knowledge-intensive services on the one hand and ordinary services on the other hand. The former services are computer services, technical services and consultants, the latter are other business services.

These firms have the capacity to give impulses to other companies and to transfer innovative products or services into innovation that brings economic success.

In computer services and technical services some 80 to 90 percent of all employees have completed some form of further education and training. 34 and 29 percent of the innovative firms in computer services and technical services reported to have engaged in R&D. Both sectors exceed the average of the other business services clearly.

There is a considerably high number of candidates, which business services use as information sources. Apparently, further innovation-relevant networks with universities, public and private research establishments exist. The number of sources reveals that they are a vital part of the innovation system.

Selling goods or services as well as knowledge is part of their businesses. The sales figures point to the success of business services. The analysis of clients of business services revealed an intuitive pattern of relationships: technical services are predominantly linked to the manufacturing sector, while computer services and consultancy are closely related to the industry sector and the service sector.

Business services do not only use external information sources, they are also active contributors to the innovation process. They are able and willing to co-operate. The KIBS are more likely to co-operate in innovation projects than other firms of the service sector. More than every fifth innovator engaged in innovation co-operation. A successful horizontal partnership with a competitor goes hand in hand with the usage of vertical co-operation with customers in the manufacturing sector.

Scientific institutions and their links to the business service sector are important for technology diffusion and innovation. Scientific research is the source of many technologies, especially computer services benefit scientific research. Together they transform other companies in other parts of the economy as well as society.

The export-ratio of business services is an indicator for market success as well as internationalisation. The analysis reveals that business services with a more organised or continual innovative behaviour have significantly higher export activities than firms that do not innovate or undertake R&D in a systematic way. The successful business service company shows similar attitudes when it goes global. In internationally oriented business services, knowledge transfer or building bridges for innovation is a strategic function. It is part of the general information management.

The value of ICT and the Internet lies in their capacity to store, analyse and communicate information instantly, anywhere, at negligible cost. Business service firms rely on new information and communication technologies to fulfil the role as a partner of other companies. It is likely that the rate of penetration of new information and communication technologies accelerates the rate of penetration of business services and vice versa.

The role of business services in an innovation system is that of a distributor or transfer agent. There is a high potential of creative ideas that could be used by other companies in the manufacturing sector as well as in the service sector.

5 Appendix

Table 9: Service sectors included in the Mannheim Innovation Panel

WZ 93	Description
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
51	Wholesale trade and commission trade, except for motor vehicles and motorcycles
52	Retail trade, except for motor vehicles and motorcycles: repair of personal and household goods
60	Land transport; transport via pipelines
61	Water transport
62	Air transport
63	Supporting and auxiliary transport activities; activities of travel agencies
64	Post and telecommunications:
64.1	Post and courier activities
64.2	Telecommunications
65	Financial intermediation, except for insurance and pension funding
66	Insurance and pension funding, except for compulsory social security
67	Activities auxiliary to financial intermediation
70	Real estate activities
71	Renting of machinery and equipment without operator and of personal and household goods
72	Computer and related activities
73	Research and development
74	Other business activities:
74.1	Legal, accounting, book-keeping and auditing activities; tax consultancy; market research and public opinion polling; business and management consultancy; holdings
74.2	Architectural and engineering activities and related technical consultancy
74.3	Technical testing and analysis
74.4	Advertising
74.5	Labour recruitment and provision of personnel
74.6	Investigation and security activities
74.7	Industrial cleaning
74.8	Miscellaneous business activities n.e.c.
90	Sewage and refuse disposal, sanitation and similar activities

Multivariate Tests for Homogeneity

In addition to the descriptive analyses, we carried out multivariate tests for homogeneity in some binary choice variables. We test whether there are differences in size, measured as the number of employees (divided by 1000), among industries, i.e. Computer Services, Technical Services, Consultancies and Other Business Services, as well as among the regions of western and eastern Germany. We run logit regressions and perform joint hypothesis tests to determine whether all coefficients are zero (see Table 10).

Furthermore, we test whether the knowledge-intensive business service firms behave different among themselves. For this purpose, we compute test statistics on equal coefficients of the industry dummies (see Table 10).

The innovative activities refer to the different categories of innovative activities. They are binary variables and indicate whether the firm undertakes these activities. The variables of the use of different sources for innovation have the value 1 if the firm indicated this source as important or very important for its innovations. Otherwise, the variables are zero.

Table 10: Tests for Homogeneity (Logit Regressions)

	Endogenous Variables: Innovative Activities (yes/no)			**Endogeneous Variables: Sources of information used for innovations (important or not)**					
	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Exogeneous Variables	Innovation	Co-operation	R&D	Customers of manufacturing sector	Customers of service sector	Suppliers	Competitors	Consultancies	Universities
Employees/1000	1.14 (4.35)[a]	.18 (2.04)	.31 (2.68)	-.007 (-.51)	.17 (1.58)	-.008 (-.60)	-.02 (-.82)	.04 (.72)	.10 (1.53)
Industry Dummies:									
- Computer Services	1.00 (4.85)	.7 (2.44)	1.88 (6.97)	-.07 (-.32)	.26 (1.07)	-.54 (-2.23)	-.34 (-1.47)	-.15 (-.64)	.41 (1.58)
- Technical Services	.61 (3.57)	.8 (2.97)	1.63 (6.31)	-.02 (-.09)	-.21 -(.92)	-.43 (-1.87)	-.66 (-2.92)	-.54 (-2.22)	.67 (2.77)
- Consultancies	.16 (.79)	.73 (2.26)	1.03 (3.32)	-.55 (-1.92)	.12 (.43)	-.88 (-3.02)	-.15 (-.54)	-.04 (-.14)	.49 (1.69)
East Germany Dummy	-.36 (-2.58)	.39 (1.78)	.22 (1.07)	-.18 -(.95)	-.04 (-.23)	-.42 (-2.17)	.27 (1.45)	-.23 (-1.2)	.34 (1.71)
Constant term	-.09 (-.68)	-1.9 (-8.93)	-1.87 (-8.81)	-.29 (-1.93)	.26 (1.63)	-.04 (-.29)	.52 (3.36)	-.40 (-2.57)	-1.35 (-7.47)
Log Likelihood	-641.85	-285.42	-314.04	-373.88	-378.58	-363.88	-375.76	-358.87	-335.75
H_0: Slope Coefficients are jointly zero (distributed $\chi^2(5)$)	75.02 (.0000)[b]	22.52 (.0004)	77.54 (.0000)	4.73 (.4494)	9.20 (.1015)	16.00 (.0069)	11.46 (.0429)	11.22 (.0472)	16.50 (.0056)
Tests on equal coefficients (distributed $\chi^2(1)$)									
Computer Services = Technical Services	2.83 (.0928)[b]	.11 (.7398)	.82 (.3653)	.04 (.8379)	2.96 (.0854)	.15 (.7006)	1.4 (.2359)	1.83 (.1762)	.85 (.3578)
Computer Services = Consultancies	11.57 (.0007)	.01 (.9325)	7.21 (.0073)	2.27 (.1322)	.21 (.6432)	1.13 (.2883)	.43 (.5109)	.15 (.7033)	.07 (.7866)
Technical Services = Consultancies	4.04 (.0445)	.05 (.8318)	3.64 (.0564)	2.82 (.0933)	1.16 (.2807)	1.93 (.1645)	2.92 (.0877)	2.56 (.1095)	.3 (.5815)
Number of observations	993	548	549	563	563	563	563	563	563

Notes: a) The t-values are printed in parentheses.
b) p-values in parentheses.

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