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Innovation in the service sector: The demand for service-specific innovation measurement concepts and typologies

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Abstract

There is evidence that the notion of innovation, well established in the manufacturing sector, cannot simply be transposed to the service sector. This article deals critically with existing measurement concepts derived from manufacturing, and introduces a new typology with a view to obtaining a better understanding of innovation in services. Selected results from the German innovation survey are analysed in order to support the conceptual findings and to identify potential improvements. Special attention is directed towards the inclusion of knowledge-intensive business services that are of particular importance for innovation processes.

JEL classification: O 33; L 80

Keywords: Service sector; Typology of services; Innovation in services

1. Introduction and starting hypothesis

During the past years efforts have increasingly been made to push the service sector and its peculiarities concerning innovation into the centre of economic policy research.[1] The roles of innovation, technology and know-how in the context of economic development and technological change are here – in addition to macro- and meso-economic questions on employment or external trade – of growing interest. This paper also examines the wide-ranging topic of services from the innovation research point of view.

Two reservations have to be made, however. On the one hand, this paper mainly focuses on the corporate

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[1] See, e.g. van Ark et al. (1997), Atella and Rosati (1995), Barras (1986), Collier (1983), Djellal and Gallouj (2001), Djellal et al. (2003), Evangelista and Sirilli (1995), Fuchs (1968), Gershuny (1978), Hauknes (1998), Martin and Horne (1993), Miles (1994), Quinn (1986), Sundbo (1997), Tidd and Hull (2003).

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level. It is assumed that business enterprises with their various combinations of abilities and strategies can be regarded as the key actors of technological change (Chandler, 1994, p. 3). This change is the result of innovation and learning within organisations as well as between the organisations and their environment. Also Dosi (1988b) describes business enterprises as the central promoters of structural change. New technologies and know-how are, therefore, generated through the interaction of companies and their environment and are developed further internally.

On the other hand, the understanding of the innovation process (according to Nelson and Winter, 1982) is focused on here rather than its formalisation, i.e. the theoretical deliberations are conceptual or scoping in nature, and not mathematical. This caveat has to be noted because there are insufficient theoretical studies in this area, with the result that formal theoretical analyses cannot be made yet.

However, from the existing, continuously growing number of available publications four starting hypotheses can be derived, which are summarised below. They reflect the current "common sense" nature of the scientific discussion.[2] In the course of this work they will be discussed individually and in detail, and then developed further with the help of our own conceptual thoughts and empirical methods.

- More and more service companies contribute substantially to macroeconomic and social development. The trend towards a *knowledge-intensive economy* supports structures in which human capital and knowledge-intensive business service companies, in particular, play an important role as knowledge brokers and intermediaries.
- However, the *character of innovation activities* and their organisation and implementation differ substantially from those of the industrial sector. This is valid for the type of newly developed products (incremental versus radical, product versus process), the character of services (process orientation, intangibility), the customer integration and the respective provision processes, as well as for the organisational aspects and the co-ordination of activities to develop new services.
- *Internal innovation activities* in companies are the major stimulating force of (company) growth and change also in the service sector. Service businesses, contrary to the widespread assumption, do produce innovation originally, and do not depend only on industrial innovations. However, the character of R&D activities as well as the role of technology have to be analysed in detail. Consequences for empirical research on innovation activities in the service sector are manifold, and new forms of indicators are needed.
- The heterogeneity of the economy and the lack of adequate theoretical and empirical scientific analyses require first of all a reduction of the complexity. One possibility is the creation of an *innovation typology* for services.

In the following paper, we deal with the knowledge-intensive economy in general, and the specific role of human capital and innovation in the service sector (Section 2). The empirical study of innovation activities in the German service sector is displayed in Section 3. From the empirical observations we derive a typology of services in general (Section 4), and of knowledge-intensive services, in particular (Section 5). At the end of this article, we attempt to illuminate prospects for future research (Section 6).

2. The knowledge-intensive economy: human capital and innovation in the service sector

Data, information, and knowledge are intangible goods that are produced and traded especially by the service sector (Miozzo and Miles, 2003). David and Foray (1995) emphasise, for example, that the efficient distribution and utilisation of knowledge is not an automatic procedure but requires supporting functions. Knowledge-intensive services,[3] in particular, are responsible for the combination of knowledge from different sources, and for the distribution of knowledge itself.[4]

[2] Cf., e.g. Coombs and Miles (2000, pp. 92–94).

[3] In an English-speaking environment they are also referred to as knowledge intensive business services (KIBS).

[4] Den Hertog and Bilderbeek (1997, p. 13) "expect these KIBS to be both highly innovative in itself and facilitating innovation in other economic sectors."

The discussion regarding scientific-technological change and its consequences for employment has a long tradition in economics, but the theoretical models have remained relatively simple (Grupp, 1997, p. 1). Bell already assumed in 1976 that the development of the service industry is matched with a rise in white-collar employment, and that training in these areas needed to be intensified. This trend can be seen within Germany (Licht et al., 1997); when compared internationally, particularly, with the US—it still has growth potential. Within the scope of the innovation survey in the service sector, Ebling et al. (1998) showed that Germany lacked skilled personnel in electronic data processing. The authors conclude that the move towards the service society is accompanied by a considerable increase in jobs for skilled and highly qualified personnel.

In the framework of the annual German reporting on technological competitiveness the 15 European union economies are regularly analysed from the perspective of knowledge intensification in great detail. From this data the percentage of professionals with a senior technical college or university degree was determined. The results show that the percentage of professionals in the knowledge-intensive services and the R&D-intensive industry had grown from 1995 to 2000 annually by 5.4 and 3.5%, whilst the annual change in the total number of employees was only 1.3% (Grupp et al., 2002, pp. 26–29). The results indicate a trend towards the increasing employment of university graduates when compared to the labour market for lower levels of education and, therefore, also indicates a trend towards knowledge intensification in industries and services. However, the level of employment as well as annual salary increases for the highly qualified staff members, and is higher in services (without government) than in manufacturing in the most EU countries. Comprehensive lists of industries that contain a high share of university-educated employees can be found in Grupp et al. (2000). According to these lists, the service sector employs an above-average number of highly qualified personnel in scientific libraries and universities, publishing houses, hospitals, news offices, architectural practices, etc.

The increase of highly qualified staff within the service sector, particularly within business services, is a clear indicator of the increasing interdependence of economic activities from different sectors (Miles et al., 1994, p. 11). Companies concentrate on their core competencies, which leads to specialisation, new organisational structures, and an increasing utilisation of information technologies. As a result, more companies require more external knowledge, and are aware of the generation and implementation of knowledge, which raises the demand, particularly, for knowledge-intensive service providers. These companies, in turn, play a central role in the innovation processes and networks.[5]

The structural change from a technology-based economy created by industrial production to a service society that regards knowledge as a central resource is reflected in a change of the innovation processes. In essence, the innovation process is viewed as a learning process that generates or acquires new knowledge, and allows its economic utilisation (Witt, 1993, p. 2). In addition to scientific and technological processes, organisational and social aspects are increasingly being considered. Lundvall (1992) studied the innovation process from the perspective of accumulation and application of knowledge and competencies, but placing the manufacturing sector at the centre of his attention and not referring explicitly to the service sector.[6]

Whilst continuing the analysis of the service sector data the question arose, which differentiation criteria help distinguish between services and manufacturing innovation processes. The aim is not to find an unequivocal separation of the two sectors;[7] rather the goal is to identify typical service characteristics that influence the way innovations and the innovation process per se are dealt with, and which may initiate a service-specific innovation dynamism (DIW, 1998, p. 519).

- *The human factor*: Based on the above considerations relating to human capital in the service sector, the definition of innovation needs to be expanded

[5] See also Hipp (1999).

[6] Drejer (2004, p. 561) advises against just focusing on learning in the definition of innovation without taking into consideration new products, processes, markets, or organisational structures. There is a danger of neglecting the Schumpeterian approach and definition of innovation. “The extreme consequences of this are that the innovation concept becomes detached from the original meaning as an economically successful introduction of something new, thereby being a contrast to acting within the boundaries of routine systems.”

[7] Cf. Coombs and Miles (2000, pp. 96–99). For a similar approach based on Lancaster’s definition of the product (in both manufacturing and services) as a set of service characteristics, see Gallouj and Weinstein (1997).

and separated from purely technical innovations. The contribution of organisational knowledge and non-technological elements in the innovation process should be acknowledged (Hipp et al., 1996; Hauknes, 1998). Other forms of personal skills such as experience or extensive customer contact now become appropriate when describing the efficiency of a service company.

- *Organization of the innovation process*: Many innovations in the service sector use technological developments merely as a means of creating new and improving existing products and processes rather than just offering pure technological progress. Equally important are adequate methods in selling and marketing. The organisation of the innovation process concentrates not only on the R&D departments known from the manufacturing companies but also covers a number of functional units of the company. This is, additionally, reflected in the low internal R&D intensity of service companies from the traditional R&D statistics' point of view.[8]
- *Innovation output typologies*: Preissl (1997) questions the use of categorisation into basic and incremental innovations; and doubts the relevance of this differentiation for the tertiary sector. Sundbo (1997) discusses this point in detail and concludes that, because service innovations are easily copied, a continuous innovation process is necessary. In turn this constant innovation process impacts on the initiation of radical innovations. There are additional characteristics that influence innovation activities within service companies and affect their empirical measurement. Evangelista and Savona (1998) note, for example, that simultaneous production and consumption of services impedes the separation of product and process innovations. Miles (1995), therefore, introduced the concept of delivery innovation as one solution to the problem. The term refers to innovations in the area of delivery and covers process- and product-oriented issues; an example of this is the automatic teller machine and other self-service equipment. For innovation management, this implies that it has to take away the process (internal) and product (external) dimensions.[9] The implementation risks increase, as the customers have not only to accept the new service product but also accept the new delivery process; occasionally they may have to learn from scratch how to use the new service. Benkenstein (1998) concludes that new forms of delivery will either lower the innovation intensity or have a particularly high desire for innovation.
- *Intangibility*: Information and communication technologies play – thanks to their data process orientation and the resulting information intensity – a central role in the innovation process of service companies. Other technologies are of relatively minor importance. At the same time, service products can often not be displayed in advance because they are intangible; hence, their qualities are not easily explained to the customer. The same reason hinders efforts towards standardisation.[10] The protection of intangible services – or rather the lack thereof – becomes important in this respect as there is no way of creating a temporary monopoly with the help of some sort of patent protection to redeem the innovation annuities. This lack of protection possibilities may reduce the incentive for innovation activities.[11]
- *Customer integration*: Services are characterised either by very close customer contacts or by the integration of external factors in the production process. Especially the process orientation of most services requires close contact to customers and can be seen as a success factor for service companies. The customer integration is based on simultaneous production and consumption, and is a major characteristic of services. However, information technologies help to remove the synchronisation of time and location between service provider and customer.[12]

[8] Cf. Hipp et al. (2003).

[9] It has also to be noted that in the manufacturing sector customers increasingly have the chance to observe the production processes of suppliers and producers. This is to meet the increased expectations on quality and open up the chances to distinguish themselves (e.g. the "glass" factory of Volkswagen at Wolfsburg).

[10] Tether et al. (2001, p. 1125), however found in the German service sector that the proportion of "standardized services" (no customer-specific changes are required) is substantial at 24%. Forty-two percent of the answering firms stated that at least two-thirds of their sales were a result of standardized services, while only 17% attributed less than one-third of their sales to standardized services.

[11] Blind et al. (2003) deeply analyse the issues of patents, intellectual property rights and service innovation. See also Miles et al. (2000).

[12] And according to the findings of Hipp et al. (2003, pp. 182–186) on the significance and the amount of standardized services the

- *Structure of the service sector*: Additional characteristics of the service sector arise from the fact that most of the companies are small. The DIW (1998, p. 525) assumes that, for example, obstacles to innovation depend on the size of the company, not which sector it belongs to. Empirical analysis that only concentrates on companies with more than 20 employees creates a problem as it leaves out the majority of relevant companies and may cause biased results. (Preissl, 1997, p. 15).
- *Regulatory issues*: Legal and professional regulation is at the core of many service industries. This extends from demonstrability issues, quality aspects and consumer protection (handicraft, personal services), to a national strategy to defend some services from international competition and to ensure society-wide provision (telecommunication, television). Current trends have led to de- and re-regulation, which in turn have been followed by new dynamic innovation activities within the affected service firms.

It is not easy to combine the various characteristics into one definition. It can be said that there are general characteristics that may induce innovation activities within services. However, it is not common sense to insist on one generally accepted definition of services or to generate a certain number of service criteria. What is required is a typology concept that represents this heterogeneity, capable of presenting the various aspects to be considered in a systematic manner.[13]

3. Innovation activities in the German service sector

3.1. German innovation survey—data, sector and size distribution

In the following descriptive statistical findings, insights and a general overview of the innovation activities within the German service sector are given. An innovation survey of the service sector has been carried out since 1995 (Licht et al., 1997; Janz and Licht, 2003)—which became part of the community innovation survey (CIS) in 1997. The sample is taken from the database of the *Verein für Kreditreform* (VVC), an organisation that gathers data on the credit history and credit ratings of the firms. The service industries included in the survey are presented in Table 1 together with their classification numbers according to the German index of industries ("Verzeichnis der Wirtschaftszweige"—abbreviated to: WZ 93).

Table 1
Industry classification of services in the German innovation survey 2000

Industry	WZ 93
Wholesale trade	51
Retail trade	50, 52
Transport	60–64, without 64.2
Banking/insurance companies	65–67
EDP/telecommunication	72, 64.2
Technical services	73, 74.2, 74.3
Other business services (e.g. consultants)	74.1, 74.4
Other services	70, 71, 74.5–74.8, 90

From Table 1, one can conclude that health care, tourism, education, public administration and personal services are excluded from the survey. Fig. 1 gives an overview of the distribution of each service industry within the sample showing a dominance of trade, transport, banking and insurance firms.

The sample includes a range of company sizes; however small companies are dominant (cf. Fig. 2). Over half of all responses came from companies with less than 50 employees. Slightly more than 20% of the participating service firms are medium-sized whilst 20% have 250 or more employees. A similar picture can be drawn for the surveyed manufacturing companies; however, the distribution is less extreme towards small companies than in the services sector.

One of the first innovation surveys to enquire explicitly about the organisational strategic change in the service sector was conducted by a work group from the official statistical office of Canada (Statistics Canada, 1995). This study assumed that linguistic modifications to a questionnaire from the manufacturing sector did not adequately take into account the innovation behaviour of service companies. The content of questions

question is raised if the importance of customer integration is really dominant for all services. More research is needed to get a better understanding of the role of the customer in production and delivery, the use of information and communication technologies as well as the innovation process itself.

[13] Drejer (2004, p. 560) concludes that many of the claimed peculiarities of services innovation do also apply for the manufacturing. She argues that, for example, the traditional technology approach to innovation is also too narrow for manufacturing. She recommends a synthesis approach.

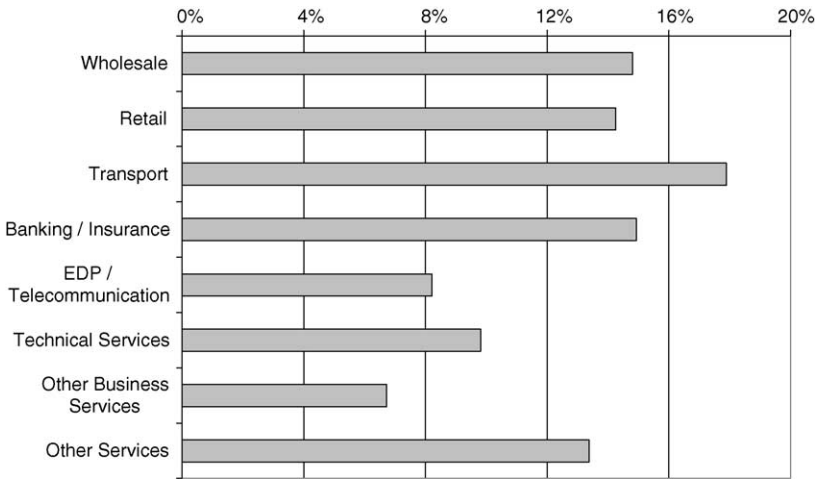

Fig. 1. Distribution of industries in the service sample of the German innovation survey. *Source*: Mannheim Innovation Panel—Services, 2000 survey, authors' computations, $N = 1621$ (without real estate).

needed to be adapted to suit specific service characteristics. The CIS-questionnaire, which is also used in the German innovation survey attempts to take a middle course by combining traditional questions for the manufacturing sector (e.g. patent activities) together with new, service-specific answer choices, e.g. for the organisation of innovation activities.

Empirical findings are highlighted in the following subsections supporting the hypothesis that service companies can show different innovation patterns compared to manufacturing firms and, therefore, a specific approach (empirically and conceptual) is required. As

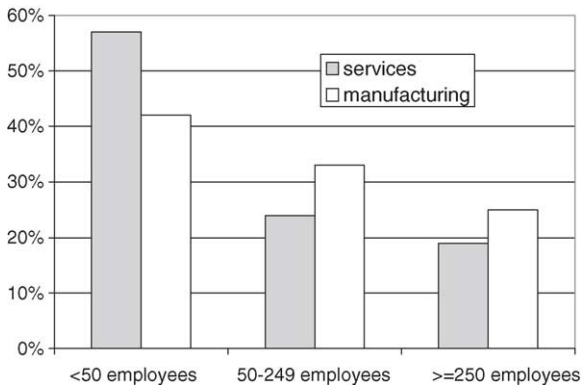

Fig. 2. Distribution of firm size in services and manufacturing. *Source*: Mannheim Innovation Panel—Services and Manufacturing, 2000 survey, authors' computations, $N = 1621$ (services, without real estate), $N = 1669$ (manufacturing).

the questionnaires differ significantly from year to year, different datasets have to be used in this chapter. The responses to the 1995, 1997, 1999 and 2000 survey were taken into the analysis—depending on the research question under consideration.

3.2. Input to the service innovation process

The service industry differences discussed above become evident, for example, in the often less than systematic organisation of the innovation process.[14] Closely connected to the unsystematic approach is the fact that service companies usually do not pursue "classical" R&D. For this reason, in the service industry there are usually more departments and project teams engaged in the innovation process than in the manufacturing sector. Innovation is not the result of a scientific research process (Dosi, 1988b) and, therefore, has to be handled differently.[15]

These considerations can be confirmed empirically. In Fig. 3, around 30% of all the innovative service companies were engaged in internal R&D, with only one-fifth of them applying this on a continual basis. A study of individual industries shows that the reported levels of

[14] Cf. also Martin and Horne (1993, p. 51).

[15] Cf. also Le Floc'H et al. (1993). Benkenstein (1998), e.g. suggests planning of new service processes with the help of network diagrams and blueprints.

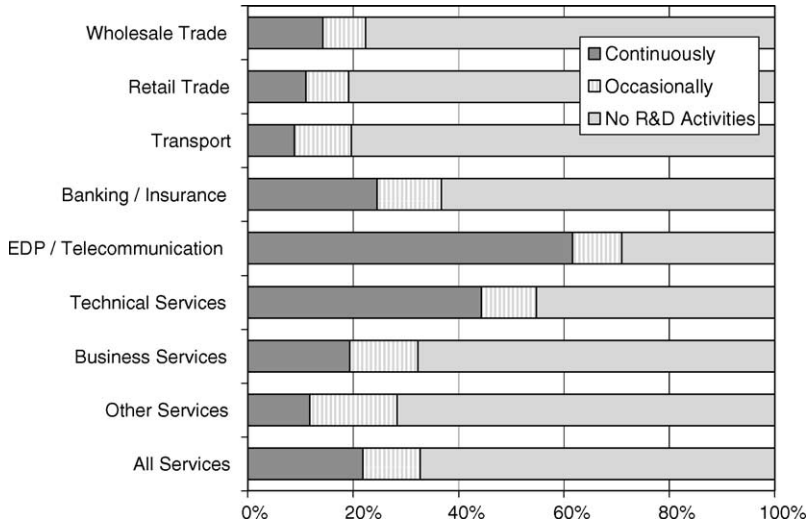

Fig. 3. Internal R&D in service companies between 1996 and 1998. *Source*: Mannheim Innovation Panel—Services, 2000 survey, authors' computations, $N = 921$.

their R&D activity differ considerably. Whilst there is little R&D in trade or transport and therefore hardly any contribution to the acceleration of classic technological change, the more technology-oriented industries such as technical service providers and EDP (electronic data processing)/telecommunication companies are much more active in R&D. These technology-oriented industries are comparable to the manufacturing sector when reviewing their R&D activities (interestingly, this is also true for the tradability and exportability of their services).[16]

It can be summarized that internal science and technology-based R&D play only a minor role in services compared to manufacturing; the service firms have to focus on other forms of knowledge generation.[17] It is hard to understand how such occasional R&D is organised in service companies, and how the generated internal (tacit) knowledge is passed on. The question is which other route is taken to generate innovations.

The innovation survey shows that the structure of expenditure in service companies differs considerably from that of manufacturing firms. About 17% of all innovation expenditure is spent on internal and outsourced R&D (cf. Fig. 4). Product launches, conception of new services, and patents and software make up more than a third of all expenditure. Almost a fifth is spent on employee's qualifications (confirming the legitimacy of the human capital approach in Section 2). The highest expenditure, however, is investment in machines and physical resources, requiring on average about one quarter of all the innovation expenditure, indicating the concurrent of technology provider

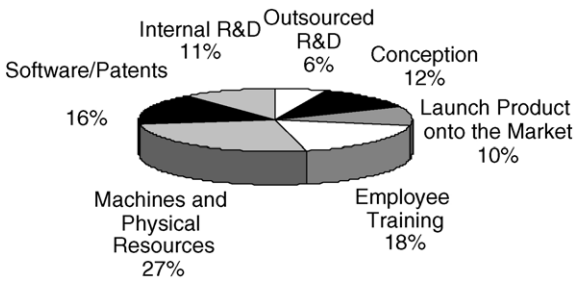

Fig. 4. Structure of innovation expenditures in service companies in 1996. *Source*: Mannheim Innovation Panel—Services, 1997 survey, computations by ZEW/FhG-ISI.

[16] For a European-wide analysis and comparison of innovation activities in the service sector, see Tether et al. (2000).

[17] The Mannheim innovation panel on manufacturing shows for 2000 that 38% of all the innovating manufacturing companies conduct their own R&D activities on a continuous base. In addition, 17% of the manufacturing firms possess R&D activities on an occasional base. *Source*: Mannheim Innovation Panel—Manufacturing, 2000 survey, authors' computations, $N = 1601$.

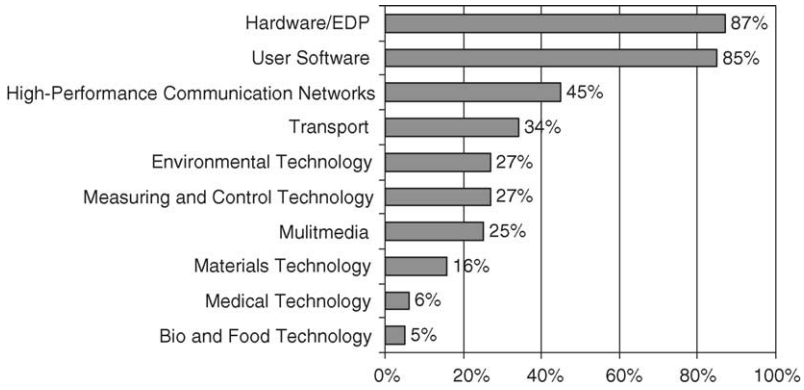

Fig. 5. Descriptive findings on utilised technology in service companies in 1994. *Source*: Mannheim Innovation Panel—Services, 1995 survey, authors' computations, $N = 1656$.

and technology receiver relations in the service sector.[18]

The high innovation expenditure on investments points to the most important channel of innovative acquisition for the innovation efforts of service companies. The question is what type of technology is employed in this fashion. According to Fig. 5, 87% of all innovative service companies use computers and other hardware in their businesses. The current approach of viewing the modern service society basically as an information-, intangibility- and knowledge-based society is correct (especially when considering the high number of software users). However, only 45% of all the innovative service providers are connected to high-performance communication networks (e.g. broadband networks with digital, optical or electronic transmission). The difference between hardware and network users indicates that network applications do not necessarily predominate in all service companies, although the intangibility of most of the services is reflected in a specific use of technologies.[19]

Approximately, one-third of the service innovators surveyed in Germany utilise transport technology as well as measuring and control technology, or automation and environmental technology. The difference between multimedia utilisation and (simple) computer applications demonstrates again the preference of many service providers for insular solutions with regard to information technology. New materials, medical and biotechnology are still of lesser importance for service companies. However, when an application is considered such as broader administration of genetic tests this picture might soon change.

3.3. Role of patents in the service innovation process

Another non-technological component of innovation activity can be derived from intangibility. The innovation process does not necessarily aim to acquire or generate technical know-how. Technologies and all other related processes (e.g. patent application) are not the centre of the innovation process in services. Literature, in particular, points out that patent protection and theoretical concept of patent competition in the service sector is only of minor importance. In almost every empirical study on service innovation, the protection of innovation activities is seen to be extremely difficult

[18] For manufacturing firms a different picture can be shown: 55% internal and outsourced R&D, 15% product design and market launch, 2% training of employees, 28% investment in machines and other equipments. *Source*: Mannheim Innovation Panel—Manufacturing, 1995 survey.

[19] In 1993, the American service sector spent 80% of its expenditures on technology in the area of information and communication (Leech et al., 1998). In the United Kingdom about 75% of all the investment expenditures on information and communication technologies are made by the service sector (Miles, 1996). American experts regard electronic commerce, cryptographic standards, surveillance and control of large information and communication networks, electronic signatures, video servers, wireless communication, easier and cheaper internet access, and firewalls as key technologies for the service sector. The future of these technologies derives from existing technological problems with regard to security and curbing of abuse.

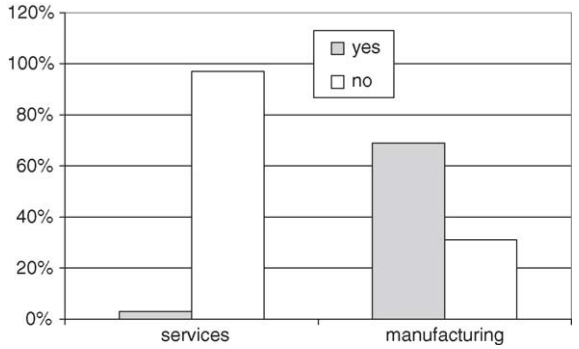

Fig. 6. Application of patents between 1996 and 1998. *Source*: Mannheim Innovation Panel—Services and Manufacturing, 1999 survey, authors' computations, $N = 2147$ (services), $N = 2030$ (manufacturing).

whilst the majority of innovations in the manufacturing sector are protected by some kind of intellectual property rights.[20]

The data in Fig. 6 is taken from the 1999 survey (services and manufacturing) to highlight that less than 5% of all the German service companies surveyed applied for one or more patent. Amongst the top 100 applicants at the European patent office, less than five are "pure" service companies. The result is a small share of 3% of all patent applications (Blind et al., 2003, p. 15). Furthermore, the study of Blind et al. (2003) illustrates that patenting comes particularly from R&D and telecommunication services.

3.4. Innovative output of the service sector

The German innovation survey does not provide much information about the outputs of service innovations. This is due to the fact that the intangibility and the close connection between products and processes make it difficult to measure the output. In addition, and due to the close interaction between service providers and service customers, a certain amount of innovation activities are oriented to the adaptation of the services to the user's needs, which might be classified as innovative. But is this really an innovation? The same question is raised when analysing the economic effects of new products and processes. It is assumed that firms have difficulties making a difference between "real" innovations and incremental customer adoptions.

Table 2
Degree of novelty of innovations in services and manufacturing

Innovation new to the market	Services (%)	Manufacturing (%)
Share of firms launching innovations which are new to the market	16	34
Share of firms launching innovations which are only new to the firm	77	57
Unknown	7	9
Total	100	100

Source: Mannheim Innovation Panel—Services and Manufacturing, 1999 survey, authors' computations, $N = 1080$ (services), $N = 1405$ (manufacturing).

However, the distinction between product and process innovation is considered to be very relevant, particularly, with reference to the role of innovation in the creation of new markets and the impact on productivity and employment.[21] The German survey details new products and processes launched within the last 3 years. Fifty-five percent of all surveyed service firms and more than two-third of the surveyed manufacturing companies had undertaken product innovations between 1997 and 1999. A similar picture could be drawn for process innovations. Whilst 60% of all the manufacturing firms implemented process innovations, only 50% of all the service companies did so.[22] No process dominance of service innovations can be observed from the German data.

The incremental nature of product innovation in services can be measured in terms of degree of novelty. Table 2 shows that 16% of all the service innovators launched products between 1996 and 1998, which were new to the marketplace, compared to 34% in manufacturing. Three quarters of service innovators imitated already existing services. This finding supports the hypothesis and the empirical findings of Djellal and

[20] Cf. Blind et al. (2003, p. 26 onwards), Djellal and Gallouj (2001, p. 66). For a classification of intellectual property rights see Andersen and Howells (2000).

[21] The Italian survey (Sirilli and Evangelista (1998), p. 887) shows that one-fifth of all service companies have difficulties separating product and process innovations. The two authors conclude that overall, the distinction between product and process innovation is possible at the firm's level, and that reliable data can be collected.

[22] *Source*: Mannheim Innovation Panel—Services and Manufacturing, 2000 survey, authors' computations, $N = 1756$ (services), $N = 1671$ (manufacturing).

Gallouj (2001, pp. 63–65). The authors comment that the process of innovation in services is very rapid, and arises mainly from the fact that innovation in services have an incremental nature, and often result from intra- or extra-sector imitation.

To summarise, it can be said that German service companies are less innovative than German manufacturing companies. Product innovations are dominating services and manufacturing, process innovations play only a minor role. Incremental innovations (only new to the firm, not new to the market) are dominant in services to a much greater extent than in manufacturing. A big difference between innovation patterns in manufacturing and services using innovation output indicators can be accepted.

One can conclude that new indicators are needed to develop both an overview and more detailed insight into the innovation activities of the service sector (see the following subsection). To gain a better understanding of the service sector a new service-specific conceptual framework is needed (see Section 4).

3.5. Trademarks as a new empirical measurement concept for service innovations

The problem of measuring innovation activities stem from their complexity, in addition to their interdependencies with other economic, social, technological and organisational developments, making the pinpointing of effects and relevance often very difficult (OECD, 1992). Freeman (1995, pp. 9–10) illustrates in a historical perspective, how, in the light of the linear innovation model, R&D could be established as *the* source of innovation in the debate, supported by the relatively simply constructed measurement concept. The Frascati manual, developed in its first version in 1980, standardised and harmonised this R&D-based approach.[23] Although it is acknowledged that technological change is not exclusively based on R&D activities, this monetary input indicator is often – because of lack of alternatives – employed as the single variable for measuring innovation activities, allowing statistical bias to influence the analysis.

The R&D measurement concept has proven especially disadvantageous for the service sector. As the sector's share in the official R&D statistics is small, it has been concluded that the service sector is hardly innovative at all—without considering the specific characteristics of their innovation processes. As a result, innovation activities in the tertiary sector have been systematically overlooked. Scientific research in measurement methods and indicator creation describing service innovations and their effects on the economic, technological, and social environment has only just started. International databases on this subject are equally just being created.

The specific problems arising from the assessment of innovation activities in the service sector should not be underestimated (Voss et al., 1992). As already indicated above, classical measurement concepts used for the manufacturing sector provide little informative value. It has to be noted, that the differentiation of innovation activities and other processes (e.g. organisational learning) is – due to many incremental innovations – often not unequivocally possible (Preissl, 1998, 525; Preissl, 1997, p. 15). The German innovation survey of service sector companies underlines the insufficient qualities of traditional input, throughput and output concepts as indicators. Therefore, other measurement mechanisms and indicators are needed.[24]

A rather new empirical approach is possible—via the statistics of trademarks (brands). This includes dealer's brands, trademarks and service marks. It can be assumed that brands are registered just shortly before the launch of the product or service on the market, so they indicate a later phase as patents in the innovation process. It can, further, be assumed that products and services related to brands will indeed be launched, and that there will not be any significant selection process, in contrast to patents. In a survey on patents in the service sector, trademarks were ranked highest in the importance of various protection instruments (Blind et al., 2003, p. 17). On the other hand, even services containing no or only low levels of innovation can be brand protected. This limits the trademarks statistics' value as an innovation indicator.

There is a relatively rough database classification for the trademarks of 45 categories, 11 of which are reserved for services. An overview of recent year's data shows that the number of national trademark applications in Germany has increased massively—more than

[23] Cf. OECD (1993).

[24] See also Brouwer and Kleinknecht (1995 and 1997).

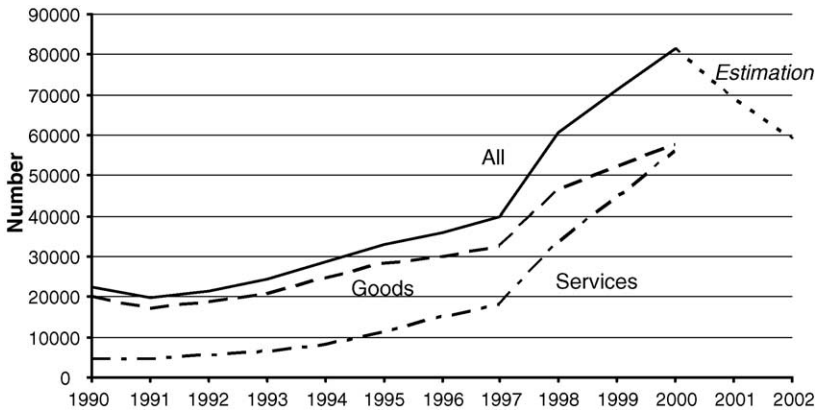

Fig. 7. Applications of trademarks in Germany in the manufacturing and service sector. *Source*: Schmoch, 2003, unpublished updates by the authors, FhG-ISI.

80,000 in 2000 (Schmoch, 2003; Mendonca, in press). This figure is even higher than the number of patent applications in the comparative year. The quantitative difference between patent and trademark applications is, particularly, due to the fact that about 50,000 applications for service trademarks have been accepted that may not be registered as patents. The number of trademark applications rose mainly because of the strong growth of service brands (Fig. 7). Fig. 7 does not reach the conclusion that the service sector has overtaken the manufacturing sector, with respect to the introduction of new products, because the respective shares of value-added are not known.

The results of a detailed analysis are remarkable, however, as they show that a considerable number of trademark applications for new services have been filed by manufacturing companies. The chemical firm Bayer, for example, has filed between 500 and 600 trademark applications per year with a rising share of service trademarks over recent decades. This points to general characteristics of new endeavours protected by trademarks. The distinction between products and services is becoming unclear. Fig. 8 demonstrates that the trademarks combining a product with a service (for instance, repair services) are growing considerably. The latter trademarks are defined by a co-classification in a product and a service category (or more than one; Schmoch, 2003). This enormous change reflects the growing relevance of product-related after sales services and blurs the definition of the service sector.

From this data, we conclude that the use of trademark statistics may be helpful to investigate innovation in services, but it needs to be remembered that trademarks are often not directly linked to an innovation (cf. Blind et al., 2003, p. 9). Instead, increasing visibility or a reflection of competitive strategies might be the main motivation. Djellal and Gallouj (2001, p. 66) illustrate that over 40% of the French service firms most frequently cite ‘brand image’ as being effective. So, an indirect link between innovation activities and protection mechanisms via image building can be assumed. But we also need to consider other ways to understand innovation in service firms.

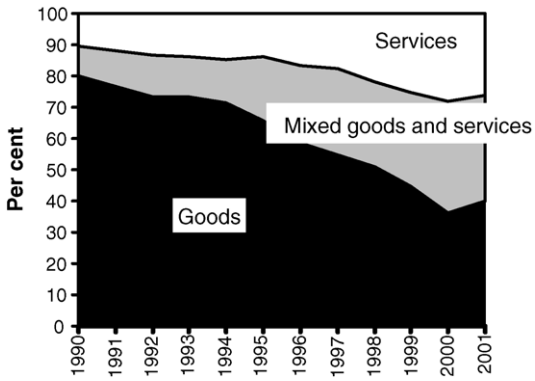

Fig. 8. Applications of trademarks in Germany considering simultaneous co-classifications in manufacturing and service categories. *Source*: Schmoch, 2003, unpublished updates by the authors, FhG-ISI.

4. Typology of services

The analysis so far has emphasised the role of services in the knowledge-intensive economy. The different character of services and the implications for the innovation process as well as the innovation process of the service sector itself are based on some partly developed indicators. In evolutionary economics when considering manufacturing a typology has proved useful for reducing the complexity of the innovation issue. The Freeman–Pavitt–Dosi model is particularly well established in the relevant literature (Pavitt, 1984; Freeman and Soete, 1997; Dosi, 1988a) differentiating between scale-intensive, supplier-dominated and knowledge-intensive industries as well as specialist manufacturers.

This classification can be transferred to the service sector.[25] The innovation typology for the service sector introduced by Soete and Miozzo (1989) is derived from Pavitt's taxonomy, and was developed conceptually but – to the best of our knowledge – never tested empirically. For the current work, this typology represents an approach of innovation behaviours in service companies. As Hipp (2000a, pp. 115–134) concludes, these types are well supported by additional analyses and can also be operationalised by the German innovation survey. In summary, the following approach was developed.[26]

4.1. Knowledge intensity

These companies named customers (from the service and the manufacturing sector) and universities or other research institutes as important or very important sources of external knowledge. The companies have been selected as having exhibited close customer relations and tight links with the scientific base. This definition takes into account knowledge-intensive business service firms as intermediaries between knowledge-producers and knowledge-users.

4.2. Network basis

The technology-based network type is hard to grasp. Soete and Miozzo (1989) were the first to attempt a description of interactive network companies from an innovation perspective[27]. The authors identify banks, insurance companies, and telecommunications as network-intensive industries in the field of information networks. Characteristically for these companies is that either their service products are substantially based on information and communication networks or, alternatively, they have to process large amounts of data. The activities of these service providers differ from those of others in so far, as they provide and maintain information networks on the one hand and enable the handling of coded information on the other. Therefore, utilising technological systems, primarily for information and communication processing, is the essential foundation of network-intensive companies in services. Companies who named telecommunication networks as being important or very important for their innovation activities – in combination with multimedia or data processing software – have been classified as 'network-based' companies.

4.3. Scale intensity

These companies are classified dependant on their service output's degree of standardisation. The service firms were asked to allocate their percentage of turnover to standardized services, services with customised changes, and individualized services. Only those companies generating 100% of their turnover

[25] Cf. Soete and Miozzo (1989). An overview of different innovation typologies, taxonomies and patterns for the service industries is provided, among others by Evangelista and Savona (1998), Miles (2002, pp. 172–177), Sundbo (1997), Tether and Hipp (2000, pp. 51–53).

[26] The classes or types are constructed based on literature analysis, and are not always mutually exclusive. Rather, there are overlaps, and firms may belong to more than one of these innovation types. That supports the dynamic approach that firms may move into, or out of some categories. There are also companies in the sample, which innovate—but cannot classified according to one of these four classes. Of the 513 innovators that participated, about 50% cannot be accounted for with theoretically derived indicators. Further work is needed to improve this first typology approach. A detailed description of the conception building process is provided in Hipp (2000a, pp. 141–231).

[27] Pavitt (1984) did not identify network-based innovation types in his taxonomy. That is, because his type – due to its distributive character – is designed to fit service functions and cannot be found in the manufacturing sector.

to standardized services were classified as scale-intensive.[28]

4.4. Supplier dominance

The question was whether other external companies or institutions had developed mostly new or considerably improved products or processes for the service firm. All service companies who indicated that their innovations had been developed externally and, therefore, had been supplied from the outside represent the supply-dominated service innovation type.

4.5. Comparison of service types

The manufacturing sector innovation types can be differentiated and allocated to specific industries according to the concentration principle, a comparable analysis of the service sector does not produce satisfactory results. Fig. 9 demonstrates that the officially classified service industries studied were not very different with respect to their characteristics or according to the above developed innovation types. This finding supports the hypothesis that innovation patterns in services are less sector-depended, and that every type of innovator can be found within each individual service industry.[29]

Apart from the technical services, who are performing internal R&D, all industries have almost the same degree of knowledge intensity; innovative behaviour depends, in 20 to 30% of all companies in the respective industry, on knowledge that comes from scientific research and customers. Only banks, insurance companies and "other business services" are considerably more network-based than the other industries, and only they can be regarded as primarily scale-intensive. Retail trade is just as knowledge-intensive as wholesale trade but the latter is less network-based, less scale-intensive, and less supplier-dominated—an analysis that contradicts many common prejudices (cf., e.g. RKW, 2000).

Table 3 gives a more detailed analysis of each innovation type utilising some of the innovation indicators already discussed in the previous sections, controlling for size effect but not for industry effect (see discussion in Section 2 and above).[30] The Probit analysis points out that the propensity to be classified as knowledge-intensive business services increases significantly when R&D activities are institutionalised. It decreases significantly for scale-intensive and supplier-dominated services. A similar pattern is shown for product innovations and knowledge-intensive services (increasing propensity) as well as scale-intensive services (decreasing propensity). Patents are significantly more relevant for knowledge-intensive services. New processes are more likely for knowledge-intensive and for network-based services.

Size effects can be illustrated, but are less dominant from the analysis than was assumed. Large companies are more likely to be found within scale-intensive service companies whilst less likely to be supplier-dominated. For the two other innovation types no size effect can be supported.

An empirical analysis of the service innovators that were *not* classified via the proposed typology show that the share of companies that cannot be allocated to one of the four types is above-average in the areas of wholesaling, transportation/communication, and other financial services. The share of technical service providers in this group is below average. The latter corresponds best to the classical, technology-oriented innovation process, confirming old thought and measurement patterns. The service innovators employing between 50 and 249 people are the ones that most frequently cannot be placed in any one category, but the differences

[28] It is clear that big companies dominate the scale-intensive companies. Forty-seven percent of all scale intensive firms have 250 or more employees. However, even small companies show wholly standardized service outputs. Around 8% of all scale intensive corporations have less than 10 employees. For these companies it is not clear if the hypothesized link between standardization and scale intensity really exists, e.g. through the use of information and communication technologies. For further discussion see, e.g. Gautam et al. (2001), Tether et al. (2001). However, it has to be kept in mind that other goals (e.g. quality, security, compatibility), too, can certainly result in standardisation.

[29] For the present work data from the German innovation survey has been used. For chapter 4 and 5, only companies, which have participated in the 1995 as well as the 1997 survey are included in the analysis. In total 513 innovative service firms answered both questionnaires.

[30] The table shows the coefficients of the Probit analysis. Every probit analysis compares one type (e.g. knowledge intensive services) with all other types together (network-based, scale intensive, supplier dominated companies). Therefore, the number of observations is always the same. Minor differences occur according to missing data. The results show the propensity to belong to one type when the (binary) independent variable (e.g. 'own R&D activities') is equal one.

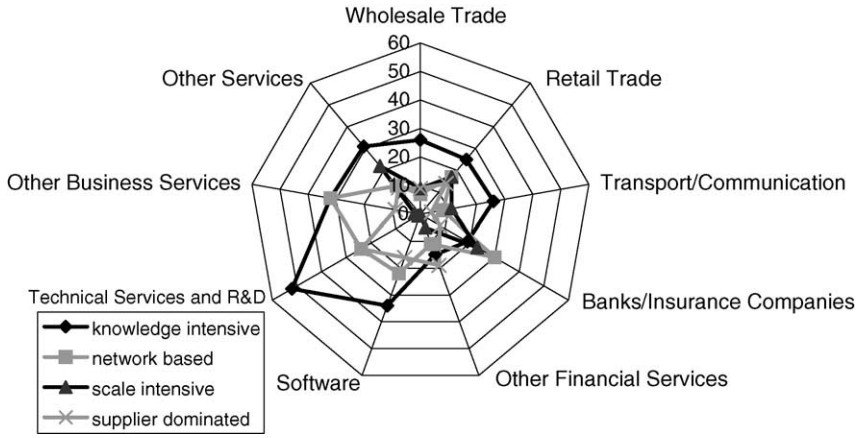

Fig. 9. Characteristics of innovation types in service industries. *Source*: Mannheim Innovation Panel—Services, surveys 1995 and 1997, authors' computations, $N = 513$.

Table 3
Probit analysis of selected innovation indicators comparing different innovation types[a]

	Knowledge-intensive services	Network-based services	Scale-intensive services	Supplier-dominated services
Own R&D activities (1994–1996)	0.648***	0.183	−0.504**	−0.563**
Patents (1994–1996)	0.502*	0.283	−0.187	Not enough observations
Innovation output				
New products between 1994 and 1996	0.399*	0.185	−0.531***	−0.227
New processes between 1994 and 1996	0.343**	0.463**	−0.079	0.085
Size				
1–19 employees	0.083	−0.089	0.111	−0.159
10–49 employees (base)	–	–	–	–
50–249 employees	−0.190	−0.101	0.106	−0.439**
≥250 employees	0.270	0.092	0.776***	−0.810***
Constant	−1.451***	−1.487***	−0.890***	−0.626**
Number of observations	496	496	496	453
Pseudo R^2	0.0922	0.0317	0.0818	0.0685
Prob > chi-square	0.0000***	0.0499**	0.0000***	0.0154**

Source: Mannheim Innovation Panel—Services, surveys 1995 and 1997, authors' computations, $N = 513$.
[a] Significance levels are denoted by (***) (1%), (**) (5%) and (*) (10%).

between the other groups are not large enough to be significant.

Additionally, the unclassified service innovators are characterised by non-technology intensive process innovations corresponding to their industries' standards. They learn by benchmarking their competitors and having a cost-focused strategy. In respect to the actual effect of their innovation activities, the attributes are, almost in every aspect, significantly less developed. This is again partly a result of the measurement problem and traditional questioning methods designed for the manufacturing sector. Although these companies are to be regarded as innovators, they do not show a measurable, classically structured innovation process.[31]

5. Knowledge-intensive service innovators

Service companies that are of particularly interest regarding innovation processes are firms that claim to

[31] Cf. Hipp (2000a, pp. 226–229).

Table 4
Microanalysis of the effects of innovation activities by knowledge-intensive business services[a]

Effects of innovation activities, χ^2-test	Significance	KIBS (%)	No KIBS (%)
Flexible customisation		77	78
User friendly services/products		70	63
Reliability of services/products		79	72
Availability of services/products with respect to time		71	69
Geographic availability of products/services		48	44
Speed of service production or delivery		78	77
Ability to meet safety requirements (data privacy protection, etc.)		41	37
Chances to meet ecological, medical, or ergonomic requirements	**	26	17
Increasing customers' performance level or product range	**	52	42
Raising the experience value for the customer	*	38	29
Raising customer productivity		43	36
Improving product quality with respect to maintenance requirements, reusability, and durability	***	31	17
Raising employee motivation	**	77	67
Raising employee productivity	***	90	79

Source: Mannheim Innovation Panel—Services, 1995 and 1997 surveys, authors' computations, $N = 513$.
[a] Significance levels are denoted by (***) (1%), (**) (5%) and (*) (10%).

depend on *innovation-relevant* knowledge sources. The role knowledge and information play in companies' competitiveness has been increasingly studied from various perspectives in recent years (cf., e.g. Grupp, 1998). For the US, Machlup in the 1960s identified knowledge-intensive service companies and their importance for efficient knowledge distribution within an economy (Machlup, 1962).

When searching for characteristics that are unique to this group of service companies the study of their external environment is very helpful. Apparently, the effects of innovation output on the customer's performance and experience are relevant.[32]

As Table 4 shows, a χ^2-test produces much higher percentages for knowledge-intensive business services with respect to improvement of maintenance, reusability and durability of these products, the chances to meet ecological, medical, or ergonomic requirements, and to raising the customer's performance level or product range as well as his experience value. At the same time, motivation and productivity of employees differ significantly. The direct influence on the user is, therefore, not determined by innovation output alone but is accompanied by further innovation effects that have broader, macroeconomic consequences. Hence, knowledge-intensive service innovators are important knowledge providers for a larger number of economic actors, maybe even for the entire economic and technical development.

For a more in-depth study of the effects, the variety of individual answers have been reduced to four factors using statistical factor analysis:[33]

- *Factor 1*: improvement of the quality of the service product.
- *Factor 2*: compliance with environmental standards and safety requirements.
- *Factor 3*: company internal improvements.
- *Factor 4*: improvement of customer performance or productivity.

A Probit model enables the evaluation of these four factors, industry and size classifications as well as regional effects (differences between East and West Germany) to be controlled for.

Table 5 clearly shows that there are no differences between knowledge-intensive business service providers and other service companies with respect to quality characteristics. Both groups improve quality

[32] This chapter is based on previous work, see e.g. Hipp (1999 and 2000b).

[33] A detailed description of a similar factor analysis can be found in Licht and Moch (1997).

Table 5
Probit-analysis of the effects of innovation activities of knowledge-intensive business services[a]

Effects of innovation activities	Coefficient	Significance
Industry		
Wholesale trade	0.153	0.623
Retail trade (base)	–	–
Transportation/communication	0.022	0.944
Banks/insurance companies	−0.295	0.360
Other financial service providers	−0.151	0.717
Software	0.418	0.223
Technical services	0.839	0.017**
Other business services	0.294	0.370
Other services	0.208	0.498
Company size		
1–19 employees	0.237	0.284
20–49 employees	0.046	0.790
50–249 employees (base)	–	–
250 and more employees	0.668	0.000***
Region		
Eastern Germany	0.163	0.255
Effects of innovation activities		
Factor 1: quality of the service product	0.030	0.662
Factor 2: safety/ecology/regulation	0.248	0.000***
Factor 3: company internal changes	0.128	0.062*
Factor 4: customer efficiency/productivity	0.114	0.087*

Prob > chi-square = 0.0000; pseudo $R^2 = 0.10$; constant: −1.047**; number of observations: 470. *Source*: Mannheim Innovation Panel—Services, 1995 and 1997 surveys, authors' computations.

[a] Significance levels are denoted by (***) (1%), (**) (5%) and (*) (10%).

through product innovation. However, the knowledge-intensive companies comply to a significantly greater extent with environmental and safety requirements. The differences between knowledge-intensive business services and other service companies with respect to company internal changes and improvement of customer performance are slightly significant.

Amongst the dummy variables for the service industries only the technical services stand out, which is not surprising as they are much more knowledge-based than others (cf. Fig. 9). Additionally, large companies depend significantly more on knowledge sources than smaller ones.

6. Prospects for future research

This paper has, albeit briefly, identified considerable limitations in research concerning innovation processes in the service sector. At the same time, thanks to service innovation surveys and new indicator concepts, new empirical approaches have been outlined, which could supply empirical and theoretical research with new instruments. The paper has shown that the existing innovation typology for the service sector is most suitable for all those companies and industries that demonstrate a classical innovation structure. However, many other innovative service companies exist. New types have to be derived in future work and characterised with alternative measurement concepts.

Hence, there is scope for further theoretical and empirical studies. First – in line with Djellal et al. (2003), Drejer (2004), Gallouj and Weinstein (1997) as well as Miles (2002) – manufacturing and services should be analysed together, classified not according to industries but to "service products" regardless of the sector in which they were generated. This would also allow a better account of product-accompanying services (see Section 3.5). The proposal puts considerable demand on conventional economic statistics, but the task is surely not impossible to solve. In principle, it might be promising to study a *product classification of services*.[34] Through expert assessment or the estimation of knowledge intensity, a list of *high-tech services* could then be defined.

A systematic quantitative analysis of high-tech services, however, is constrained by the lack of R&D data and by the uncertain importance of R&D inputs, which are not in the same form as for manufacturing. If such a high-tech services list existed, the problem of comparable production or turnover statistics would remain, as the suggested classification is currently neither employed by the European statistical offices nor can it be extracted from the surveyed data.[35]

In conclusion, theoretical and empirical research on innovation activities in the service sector needs to be extended; interdisciplinary approaches would probably prove advantageous. Industrial associations

[34] There is a service appendix on product classification in PRODCOM, suggesting a 'goods index' for services from consecutive number 40; cf. Bulletin of the European Union (1993).

[35] Cf. respective discussion in Grupp et al. (2000), p. 30.

representing service providers understandably expect that the share of research by economists and others is oriented towards services. Given the opportunities and gaps identified in this article, such a shift should be strongly supported.

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