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Service Innovation in Germany Information Technology as a Driving Force¹

By Brigitte Preißl

Summary

The central role that services play in modernisation and structural change in many national economies, has generated interest in the innovation potential of the sector. The adoption of information and communication technologies is of crucial importance for the development of the potential for innovation in the sector. As intensive users of technology, but also as carriers and facilitators of technology-based innovation, services are no longer the low-tech, low-productivity activities as which they were considered in the past. Furthermore, services support the diffusion and implementation of information technologies in other sectors of the economy. Thus, they are important drivers of innovation in these sectors.

1. Introduction

The central role that services play in modernisation and structural change in many national economies, has created interest in the innovation potential of the sector. For a long time, services have been considered adverse to innovation, and low-tech, low-productivity industries with little impact on a country's economic performance. Since the overall dynamics of growth of an economy is more and more determined by the development of service activities, innovation in services becomes a crucial factor for an economy's competitiveness. Furthermore, the wide-spread use of information and communication technologies (ICT) in services has changed the picture.

Service firms use ICT to improve their business procedures, and to provide new services. However, they are not only users of technology, they also produce technology, and are important carriers and facilitators of its use in other sectors. Thus, the importance of services for technology dissemination and for the realisation of production paradigms that are based on modern technology goes beyond their own innovative activities. Services play a major role in the economy as catalysts and carriers of innovation, and especially of ICT-related innovation.²

Technology has become an essential ingredient in service procedures and has a strong impact on innovation in the sector. Other drivers of innovation have been the internationalisation of service markets and deregulation of service activities, as well as a new division of labour in national economies due to changes in the production patterns in manufacturing industries. All three factors are linked to ICT. Both, internationalisation and a more sophisticated interaction between firms in different economic sectors are

strongly dependent on efficient communication facilities. Economies of scale that result from the introduction of ICT in services promote the search for larger markets. ICT has driven deregulation, because technical progress has made some regulatory rules, which resulted in national monopolies, obsolete. It is now generally accepted that the potential of the technology can only be fully exploited in environments with little regulatory constraint in the field of market access, and well balanced regulation with respect to standards and fair conditions of interconnection between different network partners. Hence, service innovation overlaps to a large extent with changes induced by the use of ICT in services and in the economy as a whole, but also comprises elements of new organisational business models and a new role of services in national production systems.³

ICT is a key technology,⁴ which means that it can be used in almost any industry for different purposes, and it

¹ This paper is based on research conducted within the SI4S project. This project has been supported by DG XII of the CEC.

² See Miles et al. (1994); denHertog/Bilderbeek April (1997).

³ This does not diminish the importance of non-technological knowledge in service innovation. See, for example, Bilderbeek/denHertog (1998), p. 3.

⁴ Information and communication technologies comprise data processing equipment of various kinds, from main frames to pcs and software, as well as communication technology, its backbone, the international communication networks, user equipment and communication services. It might therefore be misleading to talk about ICT as a homogenous „technology“. The different elements of ICT have a different impact on companies and on the economy. It can be assumed that the impact becomes more significant with the transition from mainframes to pcs and from there to networked ICT systems. See Licht/Moch, p. 4, Preissl (1991), p. 21.

has already been proven that it changes the way people work in almost any company. The service sector is not exempted from this wave of change. However, it should be kept in mind that the sector consists of a range of heterogeneous activities. For some services automation made possible by the use of ICT is revolutionising processes of service provision, while others are hardly affected by the diffusion of technology.⁵ Varying absorption capacities for ICT in different service industries determine the impact that ICT can have on innovative activities in each industry.

The introduction of technology into services enhances the assimilation of service and manufacturing sectors.⁶ Services develop features of "industrialisation", as processes of service provision become more capital-intensive and standardised. This opens up possibilities for rationalisation and productivity growth. However, it does not mean that service innovation which is based on ICT does not differ from manufacturing innovation any more. Specific characteristics of ICT as well as peculiarities of processes of innovation in services result in a specific constellation of ICT and innovation in and through services.

The purpose of this paper is to analyse the interrelation between service innovation and the use of ICT in services. It will be argued that ICT enlarges the innovation potential of services and makes service innovation similar to manufacturing innovation with respect to some features, whereas it emphasises the specific characteristics of services with respect to others. The role of ICT will be considered in comparison with that of other factors that drive innovation. Empirical evidence will be taken from case studies conducted in Germany for a project on service innovation in Europe.⁷ The paper has three parts. In the first part the impact of ICT on services and their innovation activity will be analyzed on the basis of the specific properties of ICT. The second part confronts these theoretical considerations with empirical findings on innovation in German service firms. Part three will sum up the main conclusions.

2. Services, information technology and innovation

2.1 Information technology and services

The technical characteristics of ICT suggest that they have a considerable potential to stimulate innovations, especially in services. This holds for process and product, but also for delivery and "new market" types of innovation. The fact that one of the main elements in many service activities is the creation, processing, transformation, and transmission of information and knowledge, means that a technology, which revolutionises the handling and communication of information, will induce significant changes in these activities. However, in order to fully exploit its potential to drive innovation, it is not only important that ICT *is adopted* in service firms, but also *how intensively* it is used, *what kind* of ICT is chosen and how it is combined

with other technological and organisational settings in a company⁸.

The heterogeneity of the service sector implies that the capacity of different service industries to use ICT for a re-engineering of procedures or product strategies varies considerably with the information-intensity of the service and with the way ICT is used in any particular case.⁹ However, the introduction of ICT changes basic characteristics of service provision in general notwithstanding variations in the intensity of the impact. With a tighter control of information flows, the automation of information processing and the standardisation of communication patterns, craft-like processes are turned into mass-production and can easily be controlled and improved by adopting the strict logic of digital systems in organisational procedures. As a consequence, service production shows features that are well known from manufacturing: ICT introduces a potential for productivity growth in service industries. Automated processes of production require standardised inputs and produce standardised outputs. As a consequence, economies of scale become a significant feature in service production.

Services are usually described as labour-intensive activities,¹⁰ requiring little capital input, besides office buildings, and mainly low-skilled workers. ICT has made this notion of "services" obsolete. The implementation of ICT systems involves investment in hardware and software¹¹ and makes services more capital-intensive. It opens up possibilities for more efficient use of office space, because telework schemes can be established, and thus might reduce the significance of buildings as standard assets in service firms. Computer-based procedures can only be handled by employees who are disposed to new sets of qualifications. Not only using a computer and a standard set of software packages, but also technological skills, such as the capability to operate complex ICT networks, are becoming vital for the success of ICT applications. Thus, ICT-related technological change in service industries goes along with an increase in the demand for technically qualified personnel. It involves input structures that are characterised by a higher capital component and more sophisticated labour than traditional service activities.

ICT changes the typical structure of services markets. Enhanced possibilities of control and integration, greater flexibility with respect to location, as well as the need to handle huge amounts of information flexibly, have pushed

⁵ See Preissl (1998).

⁶ See Miles/Boden (1998); Gallouj/Weinstein (1997).

⁷ Services in Innovation — Innovation in Services (SI4S), Research project for DG XII, Commission of the European Communities, (1995-1998).

⁸ See Preissl (1991).

⁹ See Preissl (1998).

¹⁰ See, for example, Miles (1993).

¹¹ See National Research Council (1994), pp. 54-55.

the deregulation and privatisation of service industries, such as telecommunications and financial services. Economies of scale and improved management of large units lead to concentration processes. Thus, in the future, small scale, family-run businesses might no longer be the characteristic type of service firm.

ICT also affects the division of labour within the service sector. The market is developing into two directions: on the one hand, firms emerge, which are able to provide a whole range of services in different disciplines, or which offer the management of consortia of individual service firms which cooperate in the provision of service projects. With this new kind of service the customer benefits from one-stop-shopping service packages without having to negotiate with a large number of service providers.¹² On the other hand, there are more and more specialised service firms with deep knowledge in a narrow field. The first trend responds to increasing demands from customers who would like service providers to take over responsibility for the realisation of a whole project. In this case, it is up to the service provider to find the right combination of services that together serve all the needs that come up in the project. Often projects result from the formulation of a customer's problem. Comprehensive problem solution is therefore seen as a major trend in service markets. The conception and implementation of ICT systems can be seen as a such a project or "problem". It requires the combination of different services: software, and hardware installation, management consulting, ergonomics and training services. As a result, a diversification of activities in service firms can be observed. The second trend is characterised by specialisation. It goes back to the fact that short technology and innovation cycles, internationalisation of markets as well as new regulatory developments (e.g., in environmental issues) enhance the demand for highly specialised expertise in certain fields that can only be covered by firms that concentrate on a few selective activities and provide these with great depth in knowledge and service quality. Both trends complement each other, because highly specialised services that cover only a narrow field need to be combined with others in order to realise problem-oriented service projects.

In service provision, process and product were considered inseparable, and, consequently, services were consumed in the moment of their provision and thus were not storable. This conception has to be abandoned with the emergence of ICT in services. Services can take the form of information and as such they can be stored, transported and consumed without the personal presence of the supplier. The nature of information itself implies specific production characteristics. Information can be consumed or used many times without visible signs of consumption. Thus, one process of production potentially results in an infinitely large number of identical products. This raises problems of property rights and exclusion, but also offers potential for productivity gains.

ICT increases the possibility of delivering a highly customised service while it also enhances the standardisation and automation of many service activities. The combination of these two tendencies leads to a wider range of options for the shaping of service quality.

The possibility of storing services in the form of information removes the constraint of time in the provision of services, and delivery via electronic networks without the physical movement of either supplier or client removes the location constraint. As a consequence, a global reorganisation of service companies is expected to take place.¹³ Apart from innovations that make services independent from time and space, major ICT-related innovations in services are concerned with supplier-customer interfaces. ICT can intensify a consumer's participation in the design and the delivery of the service. The use of computer terminals for information services, where the customer himself/herself provides the service in interaction with the machine, is a prominent example for this. Customers gain more flexibility and often better control of the service in these self-service procedures, but they may also find it more difficult to get access to the required information. There are many examples of service activities, where production and consumption can be separated by the use of ICT; in other cases, however, services will still be consumed in the process of production (e.g., haircuts or psychotherapy).

ICT almost inevitably leads to process innovations in the course of its introduction and the realisation of new production paradigms for services. A new set of services has been established around ICT: information management consulting, software provision and ICT implementation support. However, the innovation potential provided by the technology goes beyond the adjustment to new technological conditions in a transition period. ICT enhances the dynamics of service innovation in the long run. Apart from new waves of adjustment along with new technological developments, ICT enables service firms to react more flexibly to market requirements by providing innovative services that can be conceived and delivered using the diversification and modularisation capabilities of ICT.

2.2 Innovation in services

Innovation theory refers almost exclusively to manufacturing. This has led to a strong emphasis on technology with important implications for innovation indicators and for support programmes. Impulses for innovation are typically expected from *technical developments and inventions of new machines or materials*. Innovation is considered to result from research and development (R&D) activities.

¹² See Bilderbeek/den Hertog April (1997), p. 44.

¹³ See Bressand (1986); Daniels (1993). At present, this tendency can be observed in financial services and in accounting, auditing and management consulting services.

These activities aim at the generation of production techniques or new marketable goods. With the diffusion of ICT in services these features of innovation gain also some validity in this sector. However, there are still phenomena in service innovation, which are specific to this kind of economic activity and need separate theoretical explanations.

It is generally expected that innovations are about methods of production or goods that are *new to the market*. "Markets" in this context are usually conceived as national markets or national economies. Being the first supplier of a new product or the first user of a new technology allows the initiator or generator of an innovation to gain competitive advantages and to realise extra profits for some time. Thus, the driving force behind innovation is competition and the prospect of leaving competitors behind.¹⁴ Technology orientation in innovation studies meant that innovations based on new delivery concepts, organisational changes and entry into new markets that are of some relevance in services, have been neglected.

Process innovation is motivated by the prospect of productivity increases which ultimately lead to a rise in profits.¹⁵ Product innovation allows the realisation of extra profits, because usually prices are not driven down to marginal cost by the effect of competition, until other producers are able to provide the same product or a substitute. The strategic importance of innovations led to secrecy in R&D programmes and a general reluctance of companies to share knowledge related to innovation and to cooperate with outsiders. Innovations were therefore mainly resulting from internal learning processes or from patents bought from an external supplier.

2.3 ICT in services: a special case of technology based innovation

Many impulses for innovation in services go back to technical progress in ICT. The availability of new tools for information handling induces changes in service production and stimulates the creation of new services. Some service industries participate in the generation and further development of basic technologies (software firms, electronic engineering services), they are producers of technology. Others, however, are mainly users of ICT. For them its innovative potential lies in the creative adoption of the technology. The latter does not necessarily result in less dynamic innovation patterns than the former. It has even been argued that the impact of ICT is greater in the adopting than in the producing industries in general.¹⁶

Immaterial end products, a lack of patents and of traditional R&D activities as well as new forms of cooperation in networks make ICT-based service innovation differ from traditional innovation patterns. Innovation activities result in a new service, a software program, an ICT implementation concept, or a higher quality service, and not in a new physical product. They are often emerging in the course of

service provision and sometimes require individualised interaction between a client and a service provider. In problem solution types of services they can be a by-product of the search for adequate service solutions. Therefore, traditional R&D activities play a minor role in ICT based service innovations. This holds for the input side where there is no specific identifiable R&D expenditure as well as for the output side, where the result is more difficult to identify and to define than in R&D processes in manufacturing. Hence the innovation outcome is not protected by patents. ICT-related R&D, which is mainly software production and conceptualisation, normally does not produce results which are patentable.

ICT is strongly dependent on widespread networking, and on a critical mass of users in network technologies. Therefore, it does often not make sense to keep R&D results secret. Attempts to prevent the copying of software and other digital products are continuously made obsolete by new clever reproduction schemes. Network technologies as well as complex processes of knowledge generation, transfer and implementation enhance cooperative rather than competitive approaches in the initial stages of the innovation process.¹⁷ Competitive differentiation is then achieved through specific customer services and an individualised approach to customer care.

Software innovations have high costs of development and very low costs of reproduction. This makes this activity scale-intensive. As a consequence, software development requires high turnover for a quick amortisation of substantial initial costs. ICT enables service firms to cover a larger market because of efficient information transmission capabilities. Services which can be delivered electronically, such as software or pieces of information benefit to a larger extent from efficient and cheap data communication, and thus belong to the dynamic sections of the service market. Other than for non ICT-based service innovation,¹⁸ in the software industry the relevant market for which "innovativeness" has to be achieved, is not the local, but the national or even international markets. However, the implementation of new software into existing business procedures is again a typically local service activity.¹⁹

¹⁴ See Schumpeter (1912) (1934).

¹⁵ This thesis has been challenged, especially with respect to the effects of innovation based on information technology, by the observation of what is known as a productivity paradox. See, for example, Landauer (1995).

¹⁶ See, for example, Antonelli (1992).

¹⁷ In a courageous attempt to involve users in the further development of its software, Netscape has recently disclosed the core of its Internet software package to the user community. It hopes to induce a creative dynamic process that helps to compete with its main rival, Microsoft.

¹⁸ See Preissl (1997).

¹⁹ A prominent example is the support of SAP/R3 implementation. It is usually handled by small local service firms, some of which are officially appointed or authorised by the software firm.

One of the most intensively discussed phenomena in ICT adoption studies is what is known as the productivity paradox. It relates to the fact that investment in ICT was not followed by a rise in productivity which could have been expected given the vast amount of money spent on ICT equipment and given the outcome of investment in other key technologies.²⁰ Licht and Moch provide an explanation for this lack of productivity gains for the service industry. They argue that most ICT based innovations in services improved the *quality* of the service rather than rationalising its process of production. Since productivity measures do not take into account quality adequately, the effects of ICT in services and of innovations enabled by it do not show up in traditional productivity analysis.²¹

ICT in services does not only enhance product and process innovation, but also the less prominent and rarely studied delivery innovations as well as innovations consisting of the conquering of new markets.²² ICT-based delivery innovation promotes technology adoption in customer firms. It induces learning processes and speeds up the transition to new technologies. The realisation of the innovation requires not only a decisive move from the service provider, but also the willingness of customers to invest in adequate equipment and in qualifications to enhance ICT handling capabilities. With ICT, services can be provided at a distance, by transmitting the relevant information over communication networks. As mentioned above, the relevant market for service firms has usually been the local market²³. With the technical possibility to serve a more widespread group of customers, additional business opportunities for service firms are available by entering

new markets. Therefore, an increase in innovation dynamics is likely on the supply side, because service firms diversify their target markets.

The quick turnover of technical and adoption knowledge in ICT has made traditional qualification categories less relevant for the innovation potential of an industry. Therefore, indicators that rely on these traditional categories do not describe changes in qualification needs adequately. Neither computer literacy nor different levels of skills in handling network technology are being documented in official statistics on the qualification level of employees. It is therefore not surprising that statistical evidence for increasing (ICT-related) engineering qualifications in service industries is not overwhelming yet, because obviously this indicator underestimates the actual changes in the sector.

The focus on technology as the main motor of innovations has led to innovation policies that concentrate almost entirely on supporting technical projects and technology-related R&D activities.²⁴ This means that services do not have a high priority in national innovation support. It will be shown in the next chapter that this does not necessarily change with the adoption of ICT in services.

²⁰ See, for example, Landauer (1995).

²¹ Licht and Moch (1997), p. 2.

²² See Schumpeter (1912) (1934).

²³ There are a few exceptions to this, like financial services or long distance trade.

²⁴ See, for example, BMBF+T (1997).

Table 1

Sources of information on service innovation in Germany

	year of data collection	size of sample	service industries covered	scope of research
ZEW/ISI	1995/1996	2900	wholesale/retailing, transport, financial and related services, software, technology consulting, R&D, other business services	innovation in services. representative postal survey, Germany, old and new Länder
DIW/Berlin	1996	775	hard-and software, management consulting, architecture, technical planning, R&D, marketing, other business services	innovation activities in Berlin, all sectors, representative survey
iAi	1996	29 experts	waste disposal, health, trade, security, others	innovation potentials and deficits from a management point-of-view
DIW/SI4S	1997	25 + 8 experts	retailing, publishing, R&D, transport, IT, management consulting, technical planning, marketing, public administration	case studies, selected service industries

3. Service innovation in Germany: the empirical evidence

3.1 Sources of information

The following analysis of service innovation is based on research that has been carried out in the context of four projects: two postal surveys, of which one is a nation-wide service innovation study (ZEW/ISI), the other covers services and manufacturing, but is confined to the Berlin area (DIW/Berlin); a study conducted in the context of the SI4S project which includes 25 case studies in German service firms (DIW/SI4S), and an expert panel which deals with service innovation management (iAi). Additional information has been collected in eight interviews with experts such as academics, industry representatives and government officials.²⁵ (Table 1 shows the main characteristics of these sets of information.)

3.2 Distinctive characteristics of service innovation

This chapter will illustrate the specific characteristics of service innovation and the role of ICT as well as its limitation in driving innovations. The following topics have been chosen for this purpose:

- definition of innovation
- ICT and types of innovation
- R&D and innovation
- technology and innovation
- qualification.

3.2.1 On the definition of innovation

Three cases have to be distinguished (see Fig.1): (1) Service innovation can be initiated by service firms and directed towards an anonymous market (product, delivery and market innovation) or conducted in the service firm without the involvement of customers (process innovation). (2) It can also be stimulated by clients, who ask for a par-

ticular service which is not yet available in the firm's existing range of services. Sometimes, however, in these cases innovations are induced in the service as well as in the customer's firm. For example, the design of a new recycling procedure for waste materials is a service, where first of all an innovation in the client firm is supported, but this can also involve innovative services in the technical engineering firm which is providing the service. (3) In the third case, service firms can function as carriers of innovation: in this case, an innovation is implemented in the client's business, but the service provision itself does not have to be innovative. Most analyses deal with the first case, because it comes closest to manufacturing innovation where goods are being developed with little involvement on the demand side. However, the other types seem to be becoming increasingly relevant in services, because they reflect the characteristics of services as being generated in the course of their provision and of involving customer participation.²⁶ Furthermore, the role of services as agents for the realisation of innovation in other sectors is being acknowledged in the literature as an important part of national innovation infrastructures.²⁷

Most innovations that were identified in the SI4S case studies were either new to the company or new to the regional market, only exceptionally they were new to the national or international market. However, for most service companies, the relevant market is the local or regional, not

²⁵ The different regional scope (Germany and Berlin) makes the two surveys incomparable in a statistical sense. The DIW/Berlin study has the advantage of allowing for a direct confrontation of manufacturing and service industries, because the survey also includes more than 1000 manufacturing firms. It has to be kept in mind, however, that Berlin's economy is a special case because of the long lasting isolation of West Berlin and the direct confrontation of the transition economy in the Eastern parts of the city with the highly protected economic structures in the West. In addition, the disastrous financial situation of the Berlin Senate resulted in a severe intensification of the current recession.

²⁶ See Gallouj/Weinstein (1997), p. 541.

²⁷ See, for example, denHertog/Bilderbeek (1998), Strambach (1997), Miles et al. (1994).

Figure 1

Types of innovation

Service firm		Client firm	
innovation	→ → →	service provision	→ → →
service offer	← ← ←	service contract	← ← ←
innovation	→ → →	problem solution	→ → →
service offer	→ → →	service provision	→ → →
		use of service	
		problem identification	
		innovation, use of service	
		innovation	

the national economy. Therefore, activities which had not existed before in the area where the company meets its main competitors, are to be categorised an "innovation", despite the fact that they are not new to a larger (national or international) market. In terms of the impact on productivity and competitiveness of the firm this makes sense, because both will be positively influenced by the new activity. In terms of the export potential of service firms, the contribution of this type of innovation is rather small. However, if local service companies are able to offer a service which is international "state-of-the-art", although it is not innovative with respect to the national market, this makes it easier for those firms to compete with foreign companies that enter the German (local) market. Furthermore, learning processes involved in providing new services can be used to have a better chance to get access to export markets.

Not surprisingly, German studies on innovation in services use the traditional distinction between process and product innovation and add organisational innovation. At first sight, the two large surveys ZEW/ISI and DIW/Berlin show contrasting findings about the relative importance of the two main types of innovation. The ZEW/ISI study concludes that process innovation is the dominant form of innovation in services, and that product innovation is much less important.²⁸ The Berlin innovation survey suggests the contrary.²⁹ Here, many firms could not relate process innovation to their activities, and, therefore, the authors concluded that this innovation type was not really relevant for services — at least compared with manufacturing. However, Berlin service firms were quite active with respect to organisational innovations. Between 30 and 47 p.c. of the firms (depending on the industry) in the sample had engaged in this type of innovation in the last three years³⁰, whereas in the ZEW/ISI sample organisational innovation was by far the least important innovation type. Process innovations were so insignificant in the service sample in Berlin that no useful results could be derived from the respective data, and this innovation type was not analyzed any further. On the contrary, the ZEW/ISI report concludes that between 33 (in services auxiliary to finance in East Germany) and 60 p.c. (in transport services in the West) of service innovations were related to processes of service provision. It is quite obvious that a large part of the discrepancies goes back to different definitions of process and organisational innovation. The Berlin study categorises phenomena which for ZEW/ISI are process innovation as "organisational" and thus, not surprisingly, comes up with a much lower process innovation figure. If both types of innovation are taken together, the discrepancies between the two surveys almost disappear.³¹

However, this example might also lead to the conclusion that in service innovation the categories product, process and organisational innovation are not adequate to analyse innovation activities and need further specification. Contrary to what one might expect due to the usual characterisation of services as economic activities in which

product and process are inseparable, it did not seem too difficult to separate process from product innovation. The problem with the distinction between process and organisational innovation seems to be related to the specific characteristics of services. In manufacturing "processes of production" refer to the technical side of what happens in the factory along the assembly line, whereas "organisation" refers to administration, departmental structures, marketing and logistics. The two spheres can be analytically separated. In services, however, "processes of production" are often nothing else but the "organisational" settings in a service firm.

Delivery innovations are a modification or sub-group of process innovations which are often generating a new service as well. In service delivery it is most obvious that product and process are one and the same, thus the one cannot be changed without the other. Automation of services as a typical delivery innovation can generate a new service and usually constitutes a major change in the process of service provision. An increasingly important example is *self-service information systems*. The service rendered is "the information", and, in principle, the content of the service does not change whether the information is given by a person or by computer system. Still, automatic information systems can also be seen as service product innovation.

One might expect that the technical properties of ICT that allow the provision of services at a distance, would lead to an expansion of relevant markets towards more remotely located clients. Interestingly, however, ICT does not seem to have a direct positive impact on the expansion of services into new geographically distant markets. Serving a larger market and dealing with customers from a distant location requires marketing as well as customer service skills that are far more difficult to establish than the installation of data transmission networks. A decision to enlarge the geographical scope of a service activity therefore follows an analysis of resources available in a firm for the acquisition of new clients in a more widespread market and the actual delivery of services there. Only, if the market potential and the necessary resources to serve a remote market are there, does expansion make sense. In cases, in which firms have already made a decision to expand their activities geographically, they will find it easier to realise market innovation with the support of ICT. The decision might be motivated by the need to diversify markets due to competitive pressure in the home market, the search for

²⁸ ZEW/ISI (1996), p. 8. All further figures referring to this survey are quoted or adapted from ZEW/ISI (1996).

²⁹ Eickelpasch/Pfeiffer (1997), p. 33 and p. 37. All further figures referring to this survey are quoted or adapted from Eickelpasch/Pfeiffer (1997).

³⁰ Eickelpasch/Pfeiffer (1997), p. 120.

³¹ To a certain extent, differences in the results might be due to sample designs and regional diversity, and not caused by definitional inconsistencies.

new business opportunities or the exploitation of economies of scale. It is rarely motivated by the availability of new communication technologies alone.³² An indirect effect of ICT on *new market* types of innovation might derive from the capability of ICT to introduce economies of scale in service production. The need to provide services to a larger number of clients in order to work efficiently, provides a motif for the search for new markets.

Product innovation

The analysis of product innovation in service firms leads to a set of results which point to the special features of service innovation as compared to manufacturing innovation:

- Services are not as well defined as physical products, therefore the transition from one service to another can be difficult to identify.
- Many product innovations consist of minor changes or additions to existing services.
- Only a few service innovations are new to the market or "pioneer services".
- The attribution of service innovations to the service provider or to its client can be problematic.
- By far the largest group of service innovations are a combination of services which integrate various functions that were previously offered by a whole variety of firms.

Apart from the fact that many service (product) innovations are directly based on ICT and the service would not exist without the technology (see below, chapter 3.2.3), some of the distinctive features listed above are indirectly affected by the diffusion of ICT. For example, the introduction of automation and computer support in services leads to processes of codification and modularisation. Thus, services have to be defined and described in digital language which also makes the identification of changes easier. ICT increases market transparency and potentially enlarges service markets geographically. Eventually this might put an end to the predominantly local character of service markets. Problem solution approaches require the combination of many activities, often provided by different actors. Undoubtedly, the capacity of ICT networks to handle complex sets of information and to provide efficient communication between groups of cooperating partners enhances the possibility of offering this kind of comprehensive service.

A considerable share of service innovations are directly related to ICT. New services emerge in three different fields where services function as generators, carriers and facilitators of technology diffusion and technological innovation:

- (a) new software developments,
- (b) ICT integration services (conception and provision of ICT systems), and
- (c) assistance in handling and adopting ICT products.

These new services are often linked with the distribution of ICT products. They respond to a need to accompany the implementation and exploitation of ICT with expert knowledge (in technological as well as in management areas) which is generally not available in the user firm. The dynamics of product innovation in ICT-related services is strongly dependent on the path of technological development in ICT manufacturing.

Process and organisational innovation³³

Most service innovations in this category are directly linked to the introduction of ICT in various stages along the value chain. In some cases, processes of service provision were re-organised according to newly available technological tools. In others, organisational change was conceived on the basis of business management considerations, and ICT was an enabler, i.e., it made theoretically desirable solutions a viable option. It goes beyond the scope of this paper to discuss whether process innovations in services follow an (ICT-based) technology-push or a (market-related) demand-pull pattern. Case studies suggest, however, that the driving forces vary between industries, and the answer depends on the impact of ICT in individual services.³⁴ Different categories of process innovation were identified in the SI4S case studies:

A first group is centred around the *re-organisation of procedures* of service provision. In larger service firms, like banks or insurance companies, one theme of innovation is *centralisation or decentralisation* of decision making competencies and responsibilities.

Another type of re-organisation is the *outsourcing of support* functions, like accounting, cleaning or printing services. Outsourcing strategies are one phenomenon of a more general tendency of *changes in the division of labour* between departments and in departments, as well as between companies with different specialisations. An example of an internal re-arrangement of competencies is the attribution of personal consultants to bank clients which has substituted functional competence structures in all major German banks. In most cases these innovations can only be realised with the support of ICT, though they are not directly "caused" by it, but motivated by much wider strategic considerations.

Re-arrangement of service organisation is a necessary step for the *introduction of modularised services*. The division of services into *modules* prepares the standardisation and "industrialisation" of service provision. On the one

³² See Preissl (1988).

³³ Since service innovation surveys did not provide meaningful results for the empirical distinction of process and organisational innovation, both types are treated together here. In order to make the text more easily readable, in the following process and organisational innovation are taken together as „process innovation“.

³⁴ See Coombs (1988), p. 295 and Preissl (1998).

3.2.2 R&D and service innovation

hand, modularisation requires a service to be defined (by splitting it up into well specified components), and the introduction of factory-like procedures in service provision. On the other hand, modularised services can be consumed in individual packages without having to re-generate the whole service concept for each individual customer. Clients can choose between full or basic services, simple or sophisticated versions. Thus, processes of differentiation and customisation are paradoxically combined with codification and standardisation, i.e., typical mass market features.

The second group of process innovations comprises those innovations that are based on *automation*. Here personal services provided by human beings are substituted by machines, like ticket vending automates or computer operated train time tables. Other innovations in this group aim at increasing productivity in the provision of services through automation, for example, computer assisted editing or the use of standard software packages to fill in tax declaration forms.

Automation processes are new to most service industries. Innovation in this field requires careful planning of the balance between human and machine supported services. In manufacturing, it might not make a considerable difference, whether an object is hand-made or comes from a fully automated conveyor belt, because essentially the product will serve the same functions. In services, however, automation alters the quality of service, and this may have a negative effect on customer perception of service quality. It can cause a sense of neglect and insecurity in the client, and accompanying measures will be needed, like emergency phone numbers (with real people at the other end of the line) and continuous monitoring of the acceptance of the system. Therefore, many projects aiming at the automation of services are due to fail because of inadequate preparation and a lack of human support structures.

With respect to the motivation for and the impact of the adoption of ICT, services do not seem to differ much from manufacturing. The ZEW/ISI survey data confirm the productivity paradox that has been associated with investment in ICT also for services.³⁵ Although managers claimed that increasing productivity was "important" or very important", innovation impacts seem to lie in quality improvements rather than in quantitative returns on investment.³⁶ ICT-related innovations might therefore be motivated by a "productivity illusion".

Especially smaller service firms in traditional services, like retailing or consultancy, consider the use of ICT as a "must" that cannot be avoided because of the risk of losing out to competition, rather than as an opportunity for innovation. Accordingly, their approach to the introduction of ICT is defensive. They do not really know what to do with it, but have a "feeling" that it must be important. As a consequence, ICT is not integrated in business strategies, and does not contribute to innovative re-organisation of the company.

R&D activities provide the most commonly used indicators for innovation in manufacturing. From negligibly low R&D figures for services it seemed to follow that services were innovation laggards.³⁷ Given the low technology intensity in services, it has also been assumed that R&D was not relevant in this sector. Recent developments throw considerable doubt on the validity of these assumptions: (1) the low technology content hypothesis does not hold any longer in the light of intensive use of ICT in services, and (2) empirical research suggests that R&D, measured as size and expenditures of R&D departments, might not be the best indicator for service innovation.³⁸

Increasing technology intensity due to the widespread use of ICT in services seems to suggest that technological R&D will play a more prominent role in services in the future. It still might not be possible, however, to document this by looking at R&D indicators. The Frascati manual considers only activities performed in a separate department as R&D. This leads to a severe negligence of R&D activities in services, where these functions are in most cases dispersed in the company and performed along with the process of service provision.³⁹ The introduction of ICT in service firms does not seem to change this.

Only a limited group of services are actually involved in the development of basic ICT. The others use the technology, and a typical R&D task consists of making ICT elements that have been bought as ready-made parcels, consistent with systems that already exist in the user firm; another characteristic ICT-related R&D activity is the re-adjusting of business models to the potential of ICT, i.e., an organisational and strategic rather than a technological task. The large variety of options and business opportunities offered by ICT gives rise to a specific form of R&D which deals with the conception and definition of services that use the distinctive characteristics of the technology. A central part of this R&D process is the investigation of likely market responses to a new service. Some managers therefore gave marketing research as their most important and most cost-intensive research activity.

In large service firms R&D activities are either allocated in operations research, strategic planning or ICT departments. In smaller firms, they are performed in ad hoc project teams. Neither large, medium-sized nor small firms

³⁵ Licht/Moch (1997), p. 10.

³⁶ Licht/Moch (1997), p. 10.

³⁷ See, for example, Hauknes (1996), p. 51 and p. 56.

³⁸ The negative message coming from official R&D statistics cannot be interpreted correctly, however, because it is not clear, whether the obvious lack of R&D in services is due to actually lower R&D intensity or just the result of bad coverage of the service sector in R&D documentation. See Hauknes (1996), p. 57 and Hales (1997), p. 28.

³⁹ See Hauknes (1996), p. 57 and Preiszl (1997), p. 54.

have R&D departments. In some cases, cooperation with other service providers enables firms to conduct expensive research and to use knowledge which is not available in-house. As could be expected, patents do not play a significant role in service R&D. One reason for this is that it is difficult to define a patentable service innovation, and imitation can hardly be controlled; another reason is the short duration of innovation cycles which does not allow for lengthy patenting procedures. Some managers regretted the limited possibilities to patent software, because German patent laws do not protect software programs, but only algorithms.

New patterns of service provision are often the result of ad hoc improvements and spontaneous attempts at problem solving. The interesting question is then, how these ad hoc innovations can be codified, documented and repeated. This would be a prerequisite for them to become *true* innovations that can be multiplied and thus improve a company's competitive position in a sustainable business scenario.

3.2.3 Interaction between service innovation and technology

The following scheme shows the different ways in which technology adoption and innovation interact in services (see Figure 2).⁴⁰

In the case of substitution of services by technology, it is left to the customer to handle the technology, and thus he/she has an active part in the success of an innovation. The service provider implements a more or less user-friendly system, and instructs the consumer how to use it. Hauknes points out that substitution may also occur in the internal organisation of a company, for example between

back-office and front-office functions,⁴¹ such as computerised library services in a consultancy firm. Substitution of a service by technology is almost unthinkable without the introduction of ICT. The process has often been compared with automation in manufacturing, where physical power was substituted with steam engines or with electricity. The computer now substitutes the handling and provision of information *and* it can set in motion a physical process, for example, the printing and issuing of tickets.

Definition of services by technology mainly refers to complementary relationships, like Internet technology which requires navigation systems. Here technology is a necessary infrastructure which provides a basis for mushrooming service innovations; on the other hand, the technology remains meaningless without the service.⁴² ICT has a strong impact on the dynamics of service markets, because handling the technology requires sets of services that would not exist without it.

The role of services in the diffusion of technology is much more complex than shown in the table. Here processes of customisation, the support of ICT implementation, linking customer problems with technology functions and — more generally — providing knowledge about technology are features of a newly emerging division of labour between service firms and their customers in innovation processes.

⁴⁰ The scheme is an elaboration of Hauknes' „channels of interaction". Hauknes (1996), pp. 109-110.

⁴¹ Hauknes (1996), p. 109.

⁴² Hauknes gives broadcasting as an example: here physical networks and content providers are perfect complements, and each of them gains its rationale for existing from the other. Hauknes (1996), pp. 109-110.

Figure 2

Interaction between technology and services in innovations

channels of interaction	innovation examples
substitution of service provision by technology	self-service information terminals electronic entry control
definition of service through technology	support of Internet adoption SAP/R3 implementation
determination of service through technology	development of new software for process control computer based consultancy ICT training
diffusion of technology through services	designing Internet presentation for client conception of ICT solutions for small firms assistance in desktop-publishing
production of new technologies through services	blue prints for recycling development of biogas systems

Empirical analyses have shown that all forms of interaction between technology and service innovation exist and that none is dominant. The most relevant technology in service innovation is ICT; however, in environmental services biotechnology and recycling techniques are becoming increasingly important. Nonetheless, it can be assumed that all technologies adopted and developed in service industries are supported by or operated with ICT components. This emphasises the strong absorption capacity of services for ICT as well as the high information intensity of most services.⁴³ Apart from enhancing the industrialisation of services, ICT often induces more complex changes. The technology revolutionises the handling of and the access channels to information. This leads to a great potential for the automation of services that deal with the processing, transmission and diffusion of information. At the same time, the demand for knowledge which enables people to handle rapidly changing technologies and infinite flows of unstructured information, to select the relevant bits and to turn them into meaningful production inputs, rises dramatically. In addition, there seems to be scope for a "human touch" to be added to services which lack a personal component after they have been taken over by computers⁴⁴. This involves a need for highly qualified service providers who are able to provide comprehensive, context-based interpretation and customisation of random information.

ICT and services interact in a symbiotic way: ICT is the most powerful driver of change in services, and ICT diffusion, implementation and adoption need specific expert services in order to fully develop the technology's potential. The various forms of interaction also reflect the role of services in making new technologies effective in an economy. In the substitution case, the technology induces process

innovation, and thus creates a potential for productivity gains at the micro and macro levels. The cases, in which technology defines and determines services, describe the emergence of new services from technical progress. The diffusion case illustrates the role of services as carriers and facilitators of innovation. Customers can take advantage of new technologies and use them efficiently, only when they are introduced and implemented with the assistance of services that act as diffusion agents. The complex nature, quick innovation cycles and the characteristics of ICT as a key technology further promote the role of ICT-related services as enablers of innovation. Many small and medium sized enterprises do not possess the skills and qualifications to implement ICT systems efficiently; in addition, they are often overwhelmed by the variety of ICT products and by the speed with which they seem to become obsolete. This makes investment decisions extremely difficult and requires expert advice.

Computers, software and network access are only „empty boxes" that have to be filled with customer-specific adoptions and integrated in business processes in order to develop their innovative potential. In all three fields, ICT services play a crucial role.

The interaction of services and technology adoption has therefore a strong impact on the overall dynamics of innovation in the economy. In a simultaneous process ICT and ICT producing and adopting services determine new patterns of development in national innovation systems.

⁴³ See Preissl (1998).

⁴⁴ AD-Employ (1995), p. 4.

Table 2

Configuration of qualifications in German service industries
(averages in p.c.)

	university degrees		college for further education	vocational education + training	other
	sciences	business			
wholesale	6	4	13	57	20
retailing	3	4	11	67	14
transport/communication	2	3	9	54	33
financial services	4	12	13	57	14
auxiliary to financial services	6	12	15	56	11
software	33	9	20	31	7
technical consulting/R&D	40	7	12	32	9
other business services	10	11	13	44	22

Source: ZEW/ISI 1996, p.59, Table 7.4.

3.2.4 Personnel and qualifications

ICT changes the labour input requirements of service firms. Nowadays, computer literacy can almost be taken as a basic skill that is taken for granted when a new employee is hired. The real shortage lies in experts that are able to exploit the potential of ICT, to link existing equipment and business processes to the network world and to flexibly adjust the company's ICT systems to new technological developments on the one hand and to new business and market requirements on the other. Large service firms can afford ICT experts, whereas small firms that are not specialised ICT service providers, rely on expertise that is available from some employee "by accident", or they buy in services from other firms or from software producers.

Qualifications in services are likely to vary with the knowledge intensity of the service activity. Table 2 gives an overview of qualification levels in German service firms. The figures emphasise the high importance of vocational education and training and of non-specified qualifications.⁴⁵ Higher education only prevails in software as well as in technical consultation and R&D. Even in financial services and the related auxiliary activities more than half of the employees have gone through traditional vocational training and relatively few (16 and 18 p.c. respectively) have university degrees.

The DIW/SI4S case studies have shown, however, that these formal degrees only provide a set of basic skills which are necessary, but not sufficient conditions for an adequately qualified workforce. In the context of service innovation, flexibility in the adjustment to new challenges as well as knowledge of mechanisms and techniques to acquire new skills and qualifications are the relevant variables.

Despite the eminent importance of ICT skills, service industries in Germany also show a strong emphasis on other qualification needs. Three types of qualification schemes are to be distinguished: (1) programmes to enhance general skills to prepare employees for new challenges, e.g., motivational courses, Total Quality Management seminars, courses on customer service or management skills; (2) learning about innovation and about how to realise it, e.g., information seminars on SAP, conferences on new management concepts, like Efficient Customer Response — ECR, or on corporate design in the Internet; (3) learning to work with new processes and new services, e.g., introduction to computer supported customer care systems, or to desktop publishing.

Types two and three are often organised, encouraged or supported by suppliers of ICT hardware and software. They can also consist of courses in rather basic skills, like communication or presentation techniques.

Another source of knowledge about innovation is experience in the work process. Especially consultants and R&D firms emphasise the fact that their work routines involve continuous learning. This is a particularly relevant phenomenon in ICT-based service innovation, since the potential of ICT often needs to be "unfolded" in creative usage patterns that are developed step by step. The development of skills that "cannot be taught" is an important element in companies' innovation processes. Practical experience in the same firm or at least in a similar job in another firm is a scarce and highly appreciated qualification. Qualification measures are very slowly including standardised knowledge, like courses on ISO 9000 quality standards.

Basic ICT-related skills are either already available,⁴⁶ or can be acquired quite easily in internal and external courses. More sophisticated technical ICT knowledge can be bought in the service market. A bottleneck exists, however, in the adoption of ICT skills in the context of innovative service provision. Different qualifications are needed here, for example, a comprehensive understanding of concepts of customer orientation or of service quality improvement.

4. Conclusions

The main feature of the relationship between ICT and service innovation is their complex pattern of interaction. Technology development drives service innovation, and services are an essential ingredient in the development, diffusion and adoption of ICT. ICT changes the quality of services. It bears a potential towards routinisation and standardisation, but also offers instruments for more individualised service provision.

ICT has changed 'processes of production' in services, but it would be misleading to see the use of ICT in services only as a phenomenon that enhances the convergence between manufacturing and services. The communication and information processing capabilities of ICT rather promote the establishment of a production paradigm that relies on a new pattern of interaction between services and manufacturing. Innovation in services requires not only technological skills in ICT handling, but most of all the ability to translate the capabilities of the technology into viable business opportunities.

⁴⁵ In contrast with the ZEW/ISI interpretation it might be argued that the category „others" does not necessarily contain only people with lower qualification levels than vocational degrees. They might also include qualifications for which the other categories are not adequate, e.g., degrees gained abroad, or non-formal training.

⁴⁶ See Licht/Moch (1997), p. 5.

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Zusammenfassung

Innovationen im Dienstleistungssektor spielen eine entscheidende Rolle im Strukturwandel moderner Volkswirtschaften. Die Anwendung neuer Informations- und Kommunikationstechniken ist ein zentraler Faktor für die Entfaltung des Innovationspotentials im Dienstleistungsbereich. Durch sie wandelt sich das traditionelle Bild von Dienstleistungen als wenig technik-intensiven Aktivitäten mit geringen Möglichkeiten für Produktivitätsfortschritte in das eines außerordentlich dynamischen Segments der Ökonomie. Darüber hinaus wirken Dienstleistungen, die die Diffusion und Implementation von Informationstechniken unterstützen, als Katalysatoren für die Realisierung von Innovationen in anderen Sektoren.