Insights into services and innovation in the knowledge intensive economy

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TEKES

Insights into services and innovation in the knowledge-intensive economy

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Tekes – your contact for Finnish technology

Tekes, the National Technology Agency, is the main financing organisation for applied and industrial R&D in Finland. Funding is granted from the state budget.

Tekes' primary objective is to promote the competitiveness of Finnish industry and the service sector by technological means. Activities are aimed at diversifying production structures, increasing productivity and exports and creating a foundation for employment and social well-being. Tekes finances applied and industrial R&D in Finland to the extent of nearly 400 million euros annually. The Tekes network in Finland and overseas offers excellent channels for cooperation with Finnish companies, universities and research institutes.

Technology programmes – part of the innovation chain

The technology programmes are an essential part of the Finnish innovation system. These programmes have proved to be an effective form of cooperation and networking for companies and the research sector for developing innovative products and processes. Technology programmes promote development in specific sectors of technology or industry, and the results of the research work are passed on to business systematically. The programmes also serve as excellent frameworks for international R&D cooperation. Currently, 35 extensive technology programmes are under way.

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Foreword

Service business sector is increasingly important to the Finnish economy, representing nearly two thirds of the GNP. In addition to traditional service industries, other industry sectors as well are rapidly adding service business elements to their core production activities.

Knowledge-intensive services are particularly dynamic and rapidly growing area of the service sector. Such services have a key role, since they support innovative activities across a wide range of other business fields. In addition, knowledge-intensive services have an increasingly important role in transferring technology between the different industry clusters. Service business competence is of great importance to the traditional manufacturing industry as well as to the rapidly evolving fields of new technology based/enabled businesses. The manufacturing industry is striving to apply new business concepts that can take it closer to the end user. Service competence development is one way to ensure that the users' needs, availability and technological solutions are adequately taken into account already in R&D. On the service delivery side the development has also been rapid. Advanced information and telecommunications technologies have enabled totally new ways to deliver traditional services to the customers. Internet and mobile communication technologies have already changed, and will continue to change industry structures. Such changes in service delivery and industry structures are particularly apparent in banking, insurance, commerce and healthcare.

Knowledge-intensive service businesses have a key role in the strategy of Tekes, the National Technology Agency, as this field represents a significant potential for strengthening and renewing the businesses and widening the spectrum of their operations. The objective of this report is to describe this area from different perspectives, with regard to both innovations and services. The following areas have received particular attention: what service business models exist in different fields of business, what is the significance and role of services in the major clusters and their innovative activities, as well as how can technology be utilised to enhance the existing services and to create new service business fields.

The study was conducted by Dr. Jari Kuusisto and Dr. Martin Meyer of the SC-Research unit operating in conjunction with the Finnish Institute for Enterprise Management. The work was guided by a team assembled from all the fields of technology represented in Tekes; its members were Tiina Tanninen-Ahonen, Helena Laine, Tiina Nurmi, Risto Setälä, Rauli Hulkkonen, Matti Säynätjoki and Jerri Laine.

Tekes wishes to extend its thanks for the excellent work carried out. Special thanks are also due to the representatives of the different companies, interest groups and research institutes who have provided their expertise through interviews carried out for the study.

Helsinki, January 2003

Tekes, the National Technology Agency

Executive summary

Technology development as such will not create wealth; it needs to be coupled with the successful commercialisation of products and services on the increasingly global markets. Services represent an important link in the commercialisation process, in that they bring together available technologies and customers' needs/problems that can be solved with the help of appropriate technologies.

Knowledge intensive represent a significant growth area in the developed economies, and such services can advance innovation in many different ways. There are several supply and demand factors that drive service development. On the innovation system level, *knowledge-intensive business services* (KIBS) play an important role as carriers, shapers and creators of innovations, whether they are technological or managerial in nature. On the business level, services are important inputs into modern production processes, where they are being used /consumed at an increasing rate. *Product-related services* are growing in importance, since customers typically purchase a product-service package rather than pure products. In many cases, customers would be unable to make use of complex products without services. *New technologies enable a wide range of entirely new types of services*, and the developments in information and communication technologies (ICTs) and services are tightly coupled. For the product-service suppliers, such services are a significant and stable revenue source and some manufacturing firms generate more revenue from services than product sales. Due to their joint problem-solving nature, services also provide valuable insights into customers' business processes. Such knowledge is essential for proactive technology development.

In the light of comparative international statistics, Finnish service industries do not appear to be as innovative as the manufacturing sector. In terms of R&D, the expenditure services' share in business R&D seems to be lagging behind that of manufacturing. However, it can be argued that these statistics reflect the extraordinary innovative strength of ICT-manufacturing rather than a general weakness of the Finnish service sector. In terms of geography, *knowledge-intensive business services* (KIBS) are concentrated around the capital region and south-western part of Finland. Computer and related services, R&D, marketing, consultancy and recruitment services are much more agglomerated in the capital region than are technical, legal and financial services. KIBS can play a critical role as intermediaries and agents of innovation, and under-proportional activity in some regions may explain why they do not do as well in certain types of innovation as others. *ICT-using services* have not achieved a level of growth that is comparable to ICT-production. However, this gap seems to be closing rather than expanding. In recent years, the growth rate of ICT-using services has been greater than that of ICT-producing services and more than twice as high as ICT-using manufacturing.

The prominent role of services in the innovations process is becoming evident and there has been a shift in the innovation balance from products to non-tangible innovations. Knowledge-intensive services, technology-enabled services and the role of services in a manufacturing context are becoming increasingly important. Service firms themselves are becoming important customers of R&D and technical service firms. Furthermore, certain services are taking the lead role in the innovation process, subsequently leading to the contracting out of the entire production. This paper provides some empirical evidence of the typical characteristics of service innovation, as well as the barriers to and drivers of service innovations.

Service firms can be as R&D-intensive and technologically innovative as are high technology manufacturing firms. Suppliers of knowledge-intensive services are taking a more central role in innovation within national and international innovation systems. Overall, service firms and organisations appear to have a more proactive role in the innovation process than formerly perceived. Finally, due to increased outsourcing and networking, service firms are increasingly becoming partners to manufacturing firms in innovation. Case studies illustrate how strategic-level service innovations create new business models that can have industry-wide impacts. It is clear that service firms themselves are becoming important customers of R&D and technical service firms. Furthermore, certain services are taking the lead role in the innovation process, subsequently leading to the contracting out of the entire production. The above developments illustrate that service activities and related innovations cover a broad perspective, from strategic business concept development, to operational- and personal-level issues.

Case studies illustrate the important role that services can play in cluster development. The role of services within industry clusters is investigated in: ICT, life sciences, logistics, the environment, and electricity supply. Knowledge-intensive business services play an increasing role in the *forest cluster*, especially with respect to the use of the

computer and the Internet. The *life sciences* are a vast area with a potential for applications that goes far beyond the pharmaceutical cluster. The prominent role played by services in the clusters examined is illustrated in numerous ways. For instance, the drug development process has become so complex and multi-faceted that it is no longer carried out in the pharmaceutical industry alone. Any one of the several phases of the drug development process can be outsourced to a service provider. These include drug discovery, preclinical testing, clinical trials, registration, manufacturing and marketing. Hence knowledge-intensive services play a prominent and growing role in the cluster. The above example illustrates the multiple roles that services play in various clusters.

Cluster analysis also identified a range of distinctive innovation modes: *science-based, network-integrated high-tech firms* are characterised by ICT, R&D and professional business services. Firms are more export-oriented than other groups, and are characterised by highly qualified staff. These are R&D-intensive firms that are embedded in an environment that offers technological opportunities and market perspectives. In-house R&D is supported by the intensive use of science-related external knowledge sources. *IT-oriented, outward-looking developers* are characterised by a highly qualified labour force as well as high investments in development and information technology; however, expenditure on research is relatively low. *Market-oriented, inward-looking incremental innovators* are incremental innovators with internal and market focus. The innovation input of the segment is rather low but the innovative activities of the firms profit strongly from very favourable market perspectives; the IT content is high. *Low-profile, inward-looking innovators* are typically small firms and most of them produce for domestic markets. This group is characterised by a low or only moderate innovation intensity and low average economic performance level. These firms adapt rather than innovate in the original sense of the word.

Contents

1 Introduction

1.1 Background of the study

During the 1990s, Finland experienced a deep recession, with unemployment rising to nearly 20%. This drastic experience was followed by a strong recovery fuelled by structural changes and revised policies. Finland could enter the new millennium as an internationally competitive economy that is increasingly driven by high technology exports.

An efficient innovation policy has contributed to the successful recovery of the economy, through focussing on R&D and knowledge society development. International statistics on R&D spending show that Finland is among the leading nations in terms of R&D spending, with a share of 3.37% of the GDP in 2000. In absolute terms, this means that the yearly spending on R&D is EUR 4.4 billion (OECD, 2001). Even if such investment is very significant for Finland, it constitutes only a small fraction of global R&D spending. Hence, the correct targeting and efficient use of available funding is vital.

Technology development as such will not create wealth; it needs to be coupled with successful commercialisation on the increasingly global markets. In many sectors, technological cycles are progressing at an increasing rate, and yet customers require individually tailored product-service offers. Due to such development, the risks of technology commercialisation are increasing. Exhibit 1 illustrates how technology and services are bound together in a number of different ways.

Knowledge-intensive services play a crucial role in the creation and commercialisation of new products, services and processes. They are vital as carriers, shapers and creators of innovations, whether they are technological or managerial in nature. Intermediary services constitute important inputs into modern production processes, where they are being used at an increasing rate. For instance, many technology- and management-related services are necessary for the effective utilisation of complex technologies. Also, end-user services are growing in importance, since customers typically purchase a product-service package rather than pure products. In many cases, customers would be unable to make use of products without services. For the suppliers, services are a significant revenue source and in several cases they are already exceeding the value of product-related profits. Due to their joint problem-solving nature, services also provide a valuable insight into the business processes of customers. Such knowledge is essential for proactive technology development. To summarise, the successful commercialisation of innovations requires both technology and service development efforts.

Despite their significant role in the developed economies, which dates back to the 1960s, services have attracted rela-

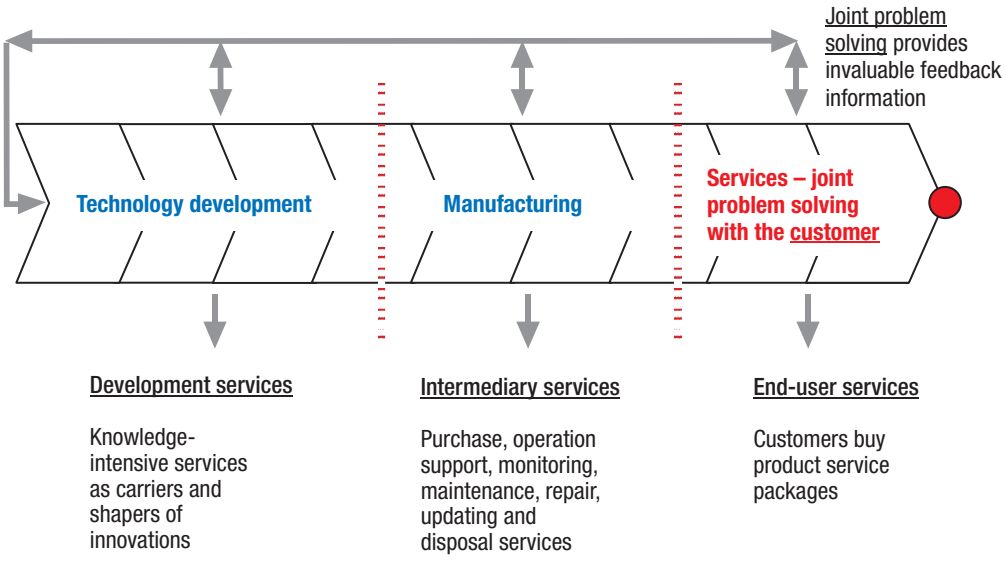


Exhibit 1. Services, technology development and commercialisation.

tively limited attention in innovation and technology research. In the evolving knowledge economy, the role of services is so prominent that their full acknowledgement is long overdue.

1.2 Scope of the study

Innovation and services are both complex processes that have technological, economic, social and cultural dimensions. They relate to processes and products and involve scientists, developers and marketers, as well as customers.

To provide this study with a focus in such a broad domain, we have restricted our survey in a number of different ways. The *statistical section* will present data related to services and innovation, knowledge-intensive business services, as well as services and the knowledge-intensive economy. The *service innovation* section has two main elements. The first will analyse the dominant approaches to innovation and their capability to address services. The second part presents an empirical analysis of service-related innovation. The focus is on different modes and sources of service innovation, services as agents of innovation as well as drivers and barriers of service innovation. Industry cases will elaborate on the role of services and service innovations in a practical context. A discussion on *clusters* focuses on groups of players with intimately linked expertise, and economic resources and the ability to co-operate. Five industry-based clusters discussed include ICT, life sciences, logistics, the environment, and electricity supply. Where possible, cluster descriptions are elaborated with a firm an actualcase

1.2.1 Objectives and research questions

The objective of this research was to explore the role of services in relation to technology development and innovation. A critical investigation into existing research and statistics was carried out, in order to obtain a better understanding of the nature and role of services. This secondary material was complemented by the original analysis of the empirical material collected. This report presents the key findings from the interdisciplinary study, which analyses services such as business-level activity, as well as broader industry-level phenomena. Most of the interview material was obtained from Finland, although a number of expert interviews were also conducted in Denmark, France, Norway and the UK. The secondary material analysed explores service-related statistics, as well as literature on service innovation and industry clusters. A survey of expert views was targeted towards industry practitioners and researchers. The aim of the analysis is to clarify key concepts and to identify emerging patterns concerning technology and services-related innovations. The research will explore the following focus areas:

- Service innovations based on
  - Statistical evidence
  - Conceptual models
  - Industry cases
- Services as agents of innovation
  - Statistics on knowledge-intensive services
  - Recent research on service innovations
  - Industry survey and case studies
- Services role in industry clusters
  - Literature-based evidence
  - Industry cases.

The conclusions will present a summary of the key findings, emerging trends, and possible directions for innovation-related policies.

1.3 Perspectives of services and innovation

The following section will discuss service and innovation concepts from various perspectives that are relevant to this report. The aim is to distil a useful working definition, which can capture the key aspects of service innovation.

1.3.1 Outlining the service concept

One of the key tasks of this section is to clarify the service and service innovation concepts. The aim is to present concepts that are exact enough for practitioner use and still able to capture the multidimensional nature of the phenomena (Exhibit 2). To cope with this task, we will first present a practitioner-oriented working definition for services. This definition has been distilled from a large volume of existing material, some of which will be presented later on in this chapter. The latter discussion will highlight the multidimensional and complex nature of services.

Exhibit 2. Working definition of services.

Service activities help customers to solve problems. In many cases, problem solving involves both physical goods and services. Research, development, consulting and technology transfer are examples of knowledge-intensive services that are useful in problem solving (Sundbo, 2002).

During the last 25 years, researchers have made efforts to conceptualise services, to establish that they are different to other products and that they represent special challenges for management (Grönroos, 1978; Gabbot and Hogg, 1997). The first serious problem in discussing services lies

in defining what they are (Foxall, 1985:2). Neither service management specialists nor economists have been able to develop a widely accepted definition for the term, and the conceptual debate on services continues. Economists tend to classify services by *industry, occupation* or on the basis of the *markets served*, whereas management theorists base their classifications on the *characteristics of the processes* and *service activities* (Kuusisto, 2000). The main focus in the following sections will be on business-level service processes and activities. Nebulous service definitions can lead to extremely 'fluid' boundaries between manufactured goods and services (Quinn and Paquette, 1990). Sayer and Walker (1992) claim that such theorists create confusion from the outset by failing to distinguish carefully between goods and labour. All goods provide a service in the sense of a benefit, or filling a need, i.e. the use value. Hence, the valid distinction between goods and services lies in their material form, services being mainly intangible in nature.

1.3.2 Intangibility is the key feature of services

Despite the difficulties in conceptualising the term 'services', the majority of the literature accepts that following basic characteristics distinguish services from manufactured goods (Mills, 1977; Shostack, 1977; Grönroos, 1990):

- Service itself is intangible;
- Service is more like a process or a performance than an object;
- Production and consumption are to some extent simultaneous activities;
- Services are produced jointly with the customer;
- The concept of services encapsulates a great variety of activities – heterogeneity.

In addition to the above features, a number of other characteristics have been associated with services. For instance, due to their perishabilityservices cannot be stored like physical goods. However, many of the given characteristics do not apply in all situations and this can create some confusion. Key features such as intangibility and heterogeneity alone make the service concept difficult enough to cope with. As for heterogeneity, services involve a great variety of activities, ranging from cleaning services to strategic business consulting. Intangibility in turn has two key dimensions. *Absence of materiality* means that an intangible object cannot be seen, felt, touched or tasted in the same way as a tangible object. *Mental intangibility* refers to the fact that it can be difficult to have a clear and precise mental image of the intangible. Exhibit 3 further illustrates the dimensions of intangibility.

1.3.3 Service innovations in the knowledge-intensive economy

This section provides further insights into the key terminology focussing on service innovations and knowledge-intensive economy concepts.

In this paper, we chose to use the term *knowledge-intensive economy*, which refers to the widespread impacts of ICT across economic activities. This term encapsulates issues such as globalisation, technology development, skills upgrading and network organisations, all of which have significant impacts on business and innovation environments (Pietarinen, 2001; Koski et al., 2002).[1]

Modern economies have been service economies for several decades, and the point of return has long been passed (Fuchs, 1968). Today services as a sector, and service activity-based relationships[2] are essential and well-established characteristics of the knowledge economy. The same applies to innovation, which is another central ingredient of a contemporary economy. Paradoxically, services and innovation have long been treated as if they were parallel universes that coexist in blissful ignorance of each other (Gallouj, 2002). There has been a considerable gap between the efforts to understand innovation and other change processes and ongoing structural changes in national economies. While service sectors, though widely disparate in their economic roles, account for about two-thirds of the overall employment in the European economies and include the most dynamic sectors in terms of employment growth over the last decades. There has been very limited amount of research focussing on service innovations and services role as agents of economic change (Hauknes, 1999).

There are a number of potential reasons why the role of services in innovation has, for so long, been largely neglected by innovation researchers as well as policy makers[3]. *Innovation in services tends to be incremental* and it is largely based on *informal activities* within firms, and between service suppliers and customers (Gallouj, 2002). Such developments are difficult to capture in statistics and hence services have often been regarded as innovation laggards. It is also evident that the linear innovation model is not the most suitable tool for analysing service innovation. At the early

1 We have chosen not to use the term information economy, because we feel that it is limited in scope. The concept New Economy is not used due to the negative connotations that are linked with the dot com boom–bust cycle.
2 Service relations between economic agents refer to public and private organisations that are involved in productive activities.
3 Although innovation research has largely neglected services so far, in economics there has been relatively intensive research conducted on services since the 1960s. Furthermore, management, operations and marketing research on services have had a strong tradition since the late 1970s (Sayer and Walker, 1992).

stages of innovation research, this may well have directed the attention of innovation researchers away from services. Bearing in mind the heterogeneity of services, the assumption that services are innovative laggards has been largely abandoned. Many services are very innovative, especially high value-added and knowledge-intensive services, which often co-exist with advanced technology. Their contribution to technological change and innovation is significant, and services have several interfaces with innovation (Hauknes, 1999; Metcalfe & Miles, 2000).

Although the significance of services has now been recognised, their full scope in the innovation process remains a relatively uncharted area. The focus on manufacturing competitiveness and technological innovations primarily in manufacturing industries has led to a weak integration of service-related issues in these policies (Hauknes, 1999).

1.3.4 Perspectives of services and innovation

There are a number of perspectives that are relevant to the innovation interaction of services (Hauknes, 1999). These include services growth and innovation, innovation in services, services as agents of innovation, and services in innovation systems. All of these are influenced by information and communication technologies that are seen as major drivers of service-related innovations (Metcalfe & Miles, 2000).

The growing role of services is based on two main thrusts. The sector itself is growing, and the role of services within manufacturing is also increasing to the extent that it is justified to talk about convergence of the grand sectors of the economy. The underlying general aspects of the growth process of services show two opposing trends in terms of service employment. New service activities and a generally increasing demand for producer-oriented services create new employment. In parallel, there is an ongoing development where rationalisation is leading to new labour-saving processes of service provision. Service sector developments reflect at least three key phenomena:

- a reorganisation of the division of labour between manufacturing and service sectors;
- the internationalisation of service activities, supported by deregulation;
- the introduction of technical progress, mainly due to the widespread use of information and communication technologies.

Innovation is shaped by the general characteristics of the competitive environment. This reinforces the dimension of innovation as an essentially market phenomenon. Understanding the challenges for industrial innovation policies in an integrated 'knowledge-intensive' economy leads to a need to understand innovation in service markets, and the role that service functions play in systemic innovation. A fundamental aspect of this understanding is the necessity of venturing beyond technological innovation approaches, to encompass the plurality of business strategies and functional characteristics across the industrial landscape.

Innovation in services

Services are innovators in their own right and innovations in services cover many dimensions (Hauknes, 1999; Metcalfe & Miles, 2000; Miles, 2001; Gallouj, 2002). Many service innovations are based on the possibilities enabled by information technology or market changes related to globalisation and regulation. There is an emerging tendency towards more deliberate attempts to innovate in services. These attempts are targeted to improve the cost efficiency and quality of service production and products as well as to develop new service concepts. Such development reflects changes in the nature and structure of competition in various service markets. A significant portion of innovation patterns in services is 'soft', or non-technological, even when restricted to product and process innovations. Such soft product innovations are frequent; typical examples include new financial instruments, new sales concepts and formats in the retail trade, bundling of new services with existing core products and services. However, some categories of services, such as new technology-related offers, tend to be more technologically oriented than other innovations. The characteristics of service innovation still allow the use of traditional taxonomy in product, process, organisational and market innovations. However, such innovation attitudes may be enriched by the consideration of modes of innovation. On the basis of a general model of service innovation, three categories of emerging innovation trajectories are identified, professionalisation of services, strategic management-based and technological trajectories. The trends associated with these categories involve an increasing formalisation of service innovation activities, for instance organised strategic innovation[4] (see Djellah and Gallouj, 1998; Hauknes, 1999; Gallouj, 2002).

Services in innovation systems

On a systemic level, KIBS act as agents of innovation across the industries. Through their activities they act as bridging institutions in innovation systems, and they contribute considerably to the 'knowledge distribution capacity' and learning capacity of innovation systems as a whole (Hauknes, 1999; Miles, 2001). Two main types of knowledge-intensive services can be distinguished (Metcalfe and Miles, 2000). Traditional professional services help users to deal with complex systems. These include regulations and administrative rules such as legal and accounting services, marketing and consultancy, architecture, building

4 See Metso case in Chapter 3.

services, medical and veterinary services, etc. Typically these services are users of technology rather than agents in technology development and diffusion. The work of new-technology-based KIBS focuses on emerging technologies and technological challenges. IT as a generic technology is particularly important, whereas biotechnology and new materials are less pervasive technologies but their daunting knowledge requirements create markets for services. Knowledge-intensive services are also growing around problem-driven technological issues associated with complex systems, or with environmental issues, to name some obvious areas. New-technology-based KIBS are of particular interest in the context of the innovation process since they rely heavily on the professional knowledge of scientists, engineers and other experts. These types of knowledge-intensive services provide:

- information and knowledge to their users;
- intermediate inputs to the client's own knowledge generation and information processing activities;
- specialised knowledge for other technical functions.

With the emergence of knowledge markets and distributed knowledge generation, knowledge-intensive service firms supplement and broaden the generative and distributive functions of the public technological infrastructures, R&D institutions, and advisory and extension services. A fundamental aspect of KIBS interaction is that it is an essentially bilateral learning process, a co-production of capabilities. KIBS do play an important role in the various knowledge conversion processes and they have a symbiotic relationship with their clients. The functioning and role of KIBS can only be understood if we include process-oriented/intangible, non-contractual, tacit and human embodied forms of knowledge. It can even be concluded that KIBS play a key role in transforming firms into learning organisations. Effective innovation systems seem to rely heavily on services as agents of innovation. They play a substantial role in helping to diffuse technological knowledge, via marketing, training, and consultancy. Services have a direct and immediate role in localised innovation systems where knowledge is distributed and localised in the contexts of application. However, service-related 'specific' innovation systems in general appear to be only weakly integrated into wider innovation systems. In particular, the links between several service sectors and the public infrastructures of national innovation systems are weakly developed.

1.3.5 Structure of the report

This report provides a synthesis of the key findings on the focus areas discussed above. The presentation has been organised into the following chapters.

- *Chapter 2* presents key statistics on services and innovation in the knowledge economy context.
- *Chapter 3* explores the evolving role of services in innovation. The discussion addresses theoretical issues and presents empirical evidence on service innovations. Industry case studies illustrate the evolving developments.
- *Chapter 4* provides insights into the knowledge-intensive services and their role in the industry cluster contexts. The associated industry case studies illustrate the evolving developments.
- *Chapter 5* brings together the key findings and presents relevant policy implications.

2 Statistical review

This chapter gives an overview of statistics related to developments in the service sector. It draws mainly on sources such as OECD reports and newsletters, and information from Statistics Finland, both printed and online. In addition, we used various publications from the literature available on innovation studies; these contained statistical information as well as interviews with individual experts.

The section presents three key findings:

1. In an international comparison, Finland's service industries are not as innovative as the manufacturing sector. The Finnish service sector does not do as well as manufacturing industry internationally in terms of R&D expenditure as a share of turnover and the share of services in business R&D. While some of the statistics may reflect the extraordinary innovative strength of the ICT manufacturers rather than a general weakness of the service sector, the question remains whether parts of the service sector need to catch up with international standards.
2. Knowledge-intensive business services (KIBS) are proportionally over-concentrated in Uusimaa. There are also considerable differences between different KIBS. For instance, computer and related services, R&D, marketing, consultancy and recruitment services are much more agglomerated in the capital region than are technical, legal and financial services. KIBS are assumed to play a critical role as intermediaries and agents of innovation. Under-proportional KIBS activity in some regions may help explain why certain regions do less well in certain types of innovation than others.
3. ICT-using services have not achieved a growth that is comparable to ICT production. However, their acceleration from the first to the second half of the 1990s in these areas is greater than in ICT-producing services and more than twice as high as ICT-using manufacturing. ICT-using services may be one potential area where the additional support measures of an agency, such as Tekes, may be of use. Actions that support potential users of ICT in the adoption of the technology may constitute a sensible means of responding to the described developments.

Before discussing any statistics in more detail, a word of warning is warranted. The reader of this report should not base strong conclusions on statistical data alone. There are considerable methodological problems associated with service statistics. A recent OECD report reviews some of these issues (Pilat, 2001). Measurement problems may obscure productivity gains. Output measures are said to be of dubious quality. While statistics tend to miss productivity gains in services, some of the observed productivity growth may be due to recent improvements in measurement methodology. There are also problems associated with classifying firms that are moving from a focus in manufacturing to services.

2.1 Findings

This study will present its findings in three sections – services and innovation, knowledge-intensive business services, and services and the knowledge-intensive economy. We focus on these areas as they are closest to the fields of activity of Tekes.

2.1.1 Services and Innovation

A number of studies have characterised certain parts of the service sector as highly dynamic and innovative. Innovation surveys for European countries show that service firms spend between 1.2% and 4% of their sales on innovation. Across the OECD area, services sector R&D has risen from less than 5% of total business enterprise R&D in 1980 to more than 15% in 1995. In countries that accurately measure services R&D, such as Canada, it now amounts to about 30% of total business enterprise R&D. Sectors such as communication and transport are now more technology intensive than many manufacturing industries.

Knowledge-intensive services, such as computing and consultant services, have experienced very rapid growth and are generally acknowledged to be important sources of innovation. Many other services have become more innovative following the implementation of ICT in service delivery, the competition-enhancing effects of regulatory reform and the increased role of networking in the innovation process.

Apart from improved measurement of service R&D, an OECD study identified three main factors that are behind the increased innovative activities (OECD, 1996):

- *More research.* Services are simply performing more R&D. Some is directed towards developing complex services, and some goes towards the application of new hardware in the firm, *e.g.* R&D on software that allows consumers to engage in on-line banking.

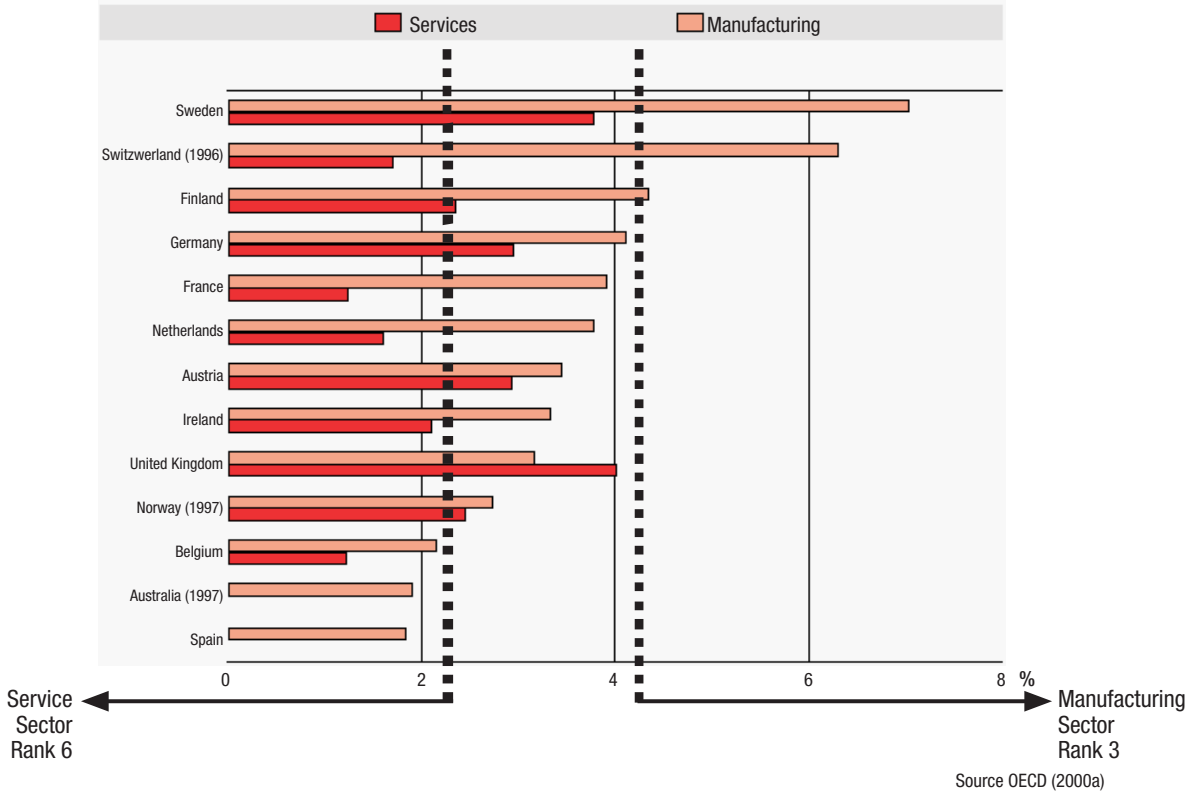


Exhibit 3. Business expenditure on innovation (expenditure on innovation as a share of total sales, 1996). Source: OECD (2000a)

- *Business outsourcing.* Manufacturing firms sometimes buy (or outsource) R&D by spinning off their laboratories into a separate corporate entity or by choosing to purchase R&D services from another private firm.
- *Government outsourcing.* Governments sometimes choose to "buy" rather than "make" R&D. This is likely to become more prevalent as research on software increases, although the general decline in government funding of business R&D is a mitigating factor. Quasi-private research centres funded by government contracts have also experienced some growth.

Where is Finland? A country comparison of R&D expenditure in the manufacturing and service industries shows that Finland has the third highest R&D expenditure in the manufacturing industries, yet the country ranks only sixth in the service industries (see Exhibit 4) . The share of the service sector R&D in total business R&D is lower in Finland than in Norway. In fact, in Finland, the share of total business R&D constituted by services has fallen below the OECD average. This situation may be due to the extreme strength of the ICT-manufacturing sector, rather than due to a particular weakness of the service industry. Having said this, the data point to an imbalance between service and manufacturing innovation.

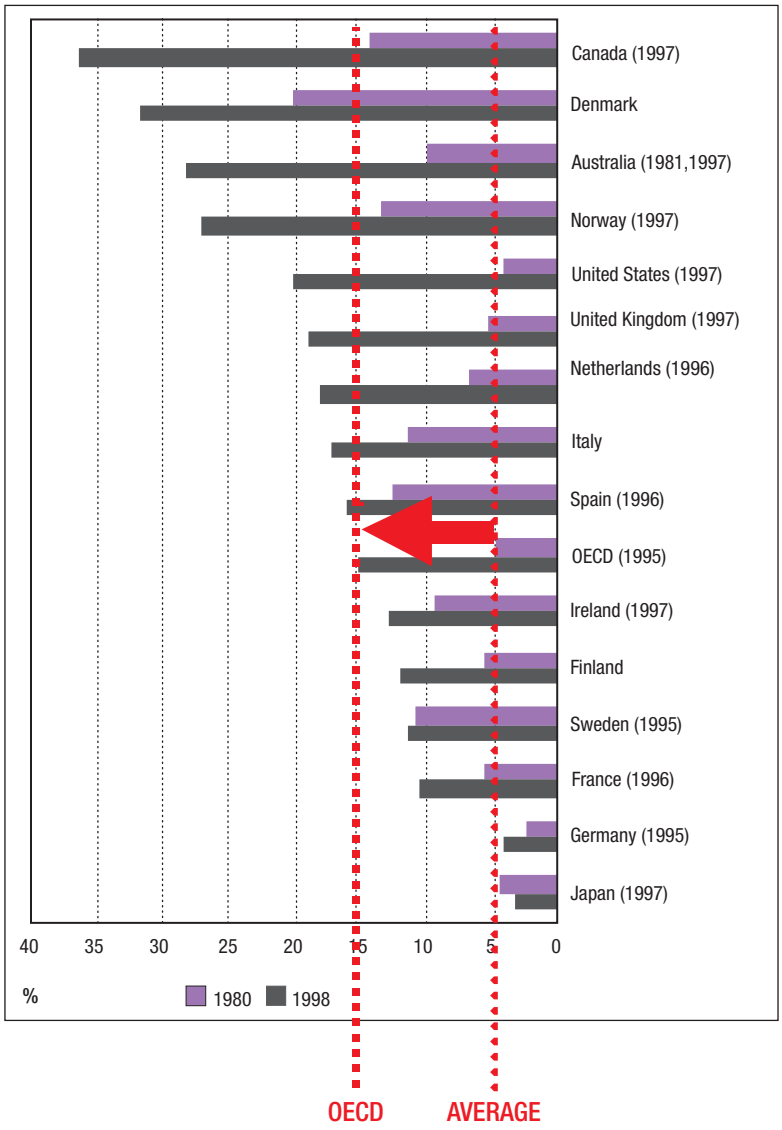


Exhibit 4. Share of services in business R&D, 1980 and 1998.
Source: OECD, ANBERD database, May 2000

2.1.2 Knowledge-Intensive Business Services (KIBS)

Knowledge-intensive business services – sometimes also referred to as strategic business services – are considered to be one of the factors behind sustainable growth and are a key element of the knowledge-driven economy. This section will present a more detailed view of this sector. Even though there are many definitions of knowledge-intensive, knowledge-based, or strategic business services, most definitions include computer software and information processing services, research and development and technical services, marketing services, business organisation services and Human Resource development services.

Of these strategic business services, an OECD study identified computer-related services as the category with the largest turnover in Finland, averaging 56% of the total in 1993–1995.[5] The computer-related service sector grew by 31% during that period. Software represented over 60% of this category and grew by 46% during the same period. Small database services were the only other field in this category that experienced very strong growth, with an almost four-fold increase in turnover.

5 See also the Statistical Appendix, which summarises the developments in terms of employment and turnover.

Development since 1995

We also analysed data on knowledge-intensive business services provided by Statistics Finland and Marja Toivonen at Uusimaa Employment and Economic Development Centre. A more inclusive definition was used here. KIBS include the following areas of activity:

- Computer and related services
- Research and development
- Legal and financial services
- Marketing services
- Technical services
- Consultancy and labour recruitment
- Training in the private sector.

The data show that a trend similar to that in the OECD study continues after 1995. Computer and related services are still one of the fastest growing categories, more than doubling their employment between 1995 and 2000 (see Exhibit 5). Only consultancy and labour recruitment services have grown more rapidly in the period. Employment in this field has increased by a factor of 2.4. It is interesting to note that research and development services seem to have reached a plateau. While there was a considerable increase between 1995 and 1997, there was a slight decline in employment between 1997 and 2000.

While a considerable increase in employment was observed in most KIBS fields, the growth has not occurred evenly across the KIBS sector. There have been quite considerable shifts between 1995 and 2000. Computer and related services, consultancy and labour recruitment, and to some extent also training in the private sector, increased their share in KIBS employment, while the other categories, such as technical, legal and financial services, R&D and marketing services, have decreased in relative importance. For instance, technical services accounted for almost one-third of the KIBS employment in 1995. In 2000, their share was approximately one-quarter.

In terms of establishments, there was growth in all areas of KIBS. The most dramatic increase seems to have been in computer and related services as well as training in the private sector. Employment growth does not always concur with the number of establishments. For instance, the number of R&D establishments still increased between 1997 and 2000 while the absolute number of R&D employees decreased over the same period. This may point to structural changes in this area.

Regional Differences

A comparison of service statistics on employment and the number of establishments across the region indicates differences in concentration. Knowledge-intensive business services appear to be more concentrated in Uusimaa than other services. Exhibit 6 presents an overview of the regional distribution of employment for all service industries and KIBS in particular. Uusimaa accounts for 35% of total service employment.

The regional distribution of KIBS is different. KIBS, which account for about one-tenth of all service activities, tend to be much more concentrated in Uusimaa than all service activities together. There is a strong imbalance between this and all other Finnish regions. For instance, almost half of all KIBS establishments are based in Uusimaa, more than 58% of KIBS employees work there, and almost 69% of the turnover was generated in that region (data for the year 2000).

While all KIBS are more concentrated in Uusimaa than services in general, there are also considerable differences between different types of KIBS. Exhibit 7 points to the differences by comparing employment data for different KIBS areas. Technical services in this respect are the least concentrated in Uusimaa, with the region accounting for about 45% of employment in this area. At the other end, almost 70% of all employees in marketing and more than 67% in computer and related services work in Uusimaa. Employment in consulting and labour recruitment services as well as R&D services is similarly concentrated in Uusimaa. About 62% of the employees in these areas work in the region.

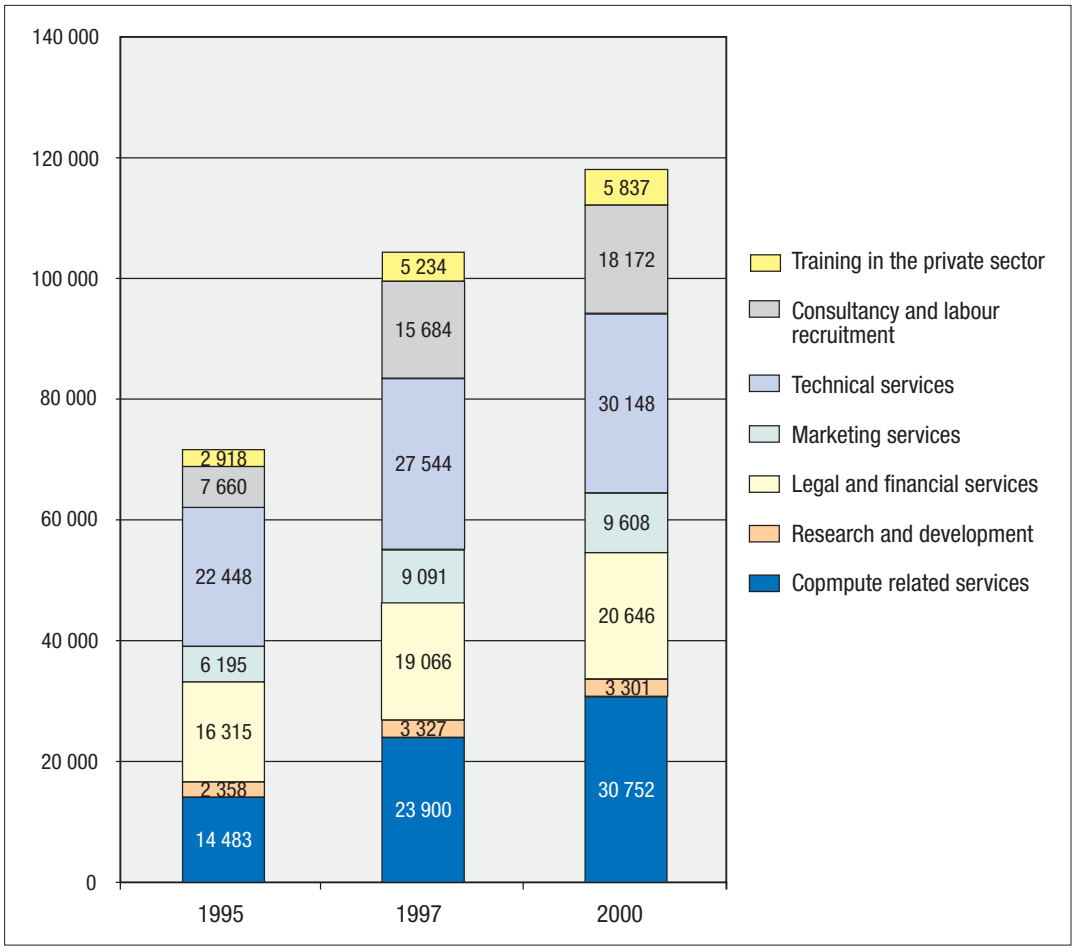


Exhibit 5. KIBS in Finland by employment.

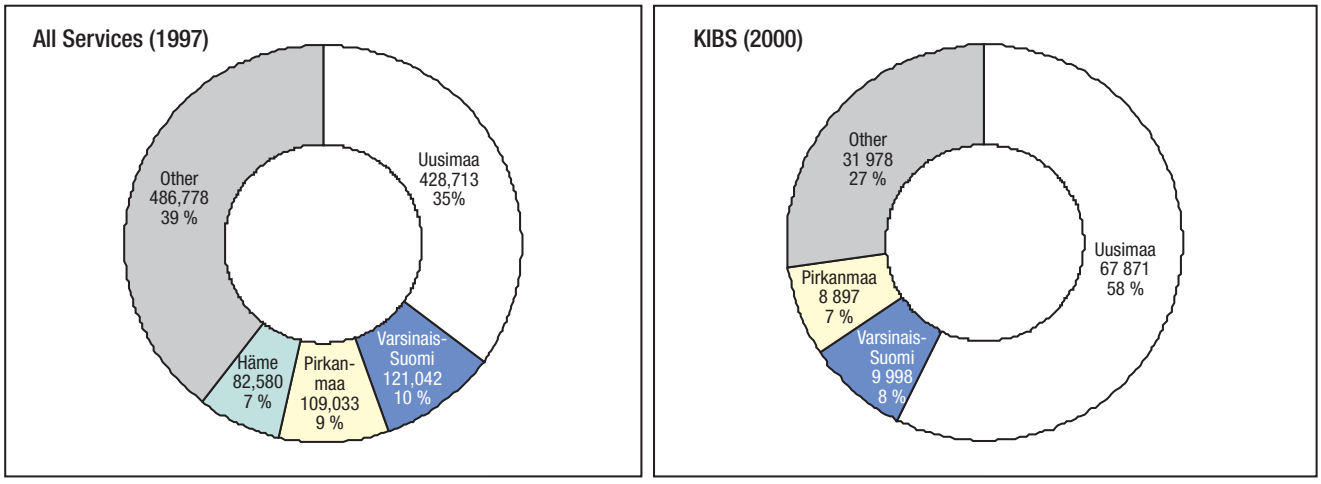


Exhibit 6. Employment in the Services and KIBS: A Comparison by Region.

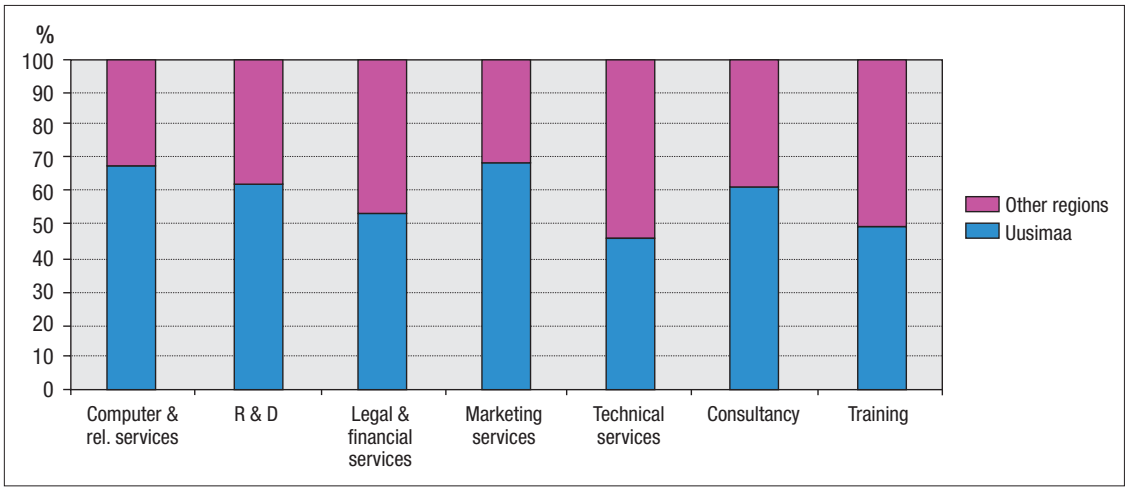


Exhibit 7. Regional distribution of KIBS by employment (1997).

2.1.3 Services and ICT development have many linkages

The general situation

Information technology is seen as the key driving force behind the growth of the economy and the service sector. However, it appears difficult to empirically link information technology in any definitive way to the expansion of the service sector. In a detailed study of the banking, insurance, air transport, and telecommunications industries, the US National Research Council (NRC) concluded that although the benefits of IT for individual industries could be qualitatively described, IT could not be causally linked to the gross product output of the individual industry for methodological reasons (National Research Council, 1994). Specifically, IT investment impacts in the 1980s cannot be isolated from the effects of many market, industry, and economic factors such as the deregulation of banking, telecommunications, and air transport.

Two observations are worth making, however. First, based on case study evidence and expert reviews, it is unlikely that the expansion of the air transport, banking, finance, and trade industries would have been as significant in the absence of IT. In this sense, IT acted as a technological precondition for growth in many service industries.

Second, IT is unevenly distributed throughout the economy and is particularly concentrated in the service industries that have experienced rapid expansion. This suggests that IT is instrumental to the delivery of many services, and that growth in services fuels demand for IT (and vice versa). Investments in IT similarly vary among industries. For example, the communications industry invests five times as much in IT as would be expected given the size of this sector relative to overall GDP. The disparity in the relative presence of IT among industries indicates that IT is clearly more critical for some types of business activities than others, and thus may be said to be responsible, in part, for the growth of those industries.

Recent work by the OECD underscores this by pointing to a growing demand for ICT services or the rapid development of R&D in IT-related service sectors. ICT is seen as one of the main drivers of the rapid productivity growth. Also, the service sector is the main purchaser of ICT equipment (OECD, 2000). Another study stresses the connection between the growing economic importance of ICT and a mounting demand for ICT-related services. This is seen as one factor driving the increasing weight of services in the economy, and also as one that is closely linked to the emergence of a knowledge-based economy. The relevance of ICT is "partly due to the fact that many services process and diffuse information, particularly in financial services, communication and public administration. Advances in ICT that allow more information to be codified and the increasing move into knowledge technologies such as expert systems, have expanded the scope for ICT use in many services" (Pilat, 2001).

While information-intensive service sectors are said to have been strongly affected by ICT, ICT is also considered important for areas such as logistics because of efficiency gains through ICT use.

The observer needs to bear in mind that official productivity estimates still obscure the impact of ICT. We find measurement problems here also.[6] So the statistics may not fully indicate the role of ICT in enabling productivity improvements in many services sectors, including transport, communications, wholesale and retail trade, and finance and business services.[7]

6 See the Appendix for details.

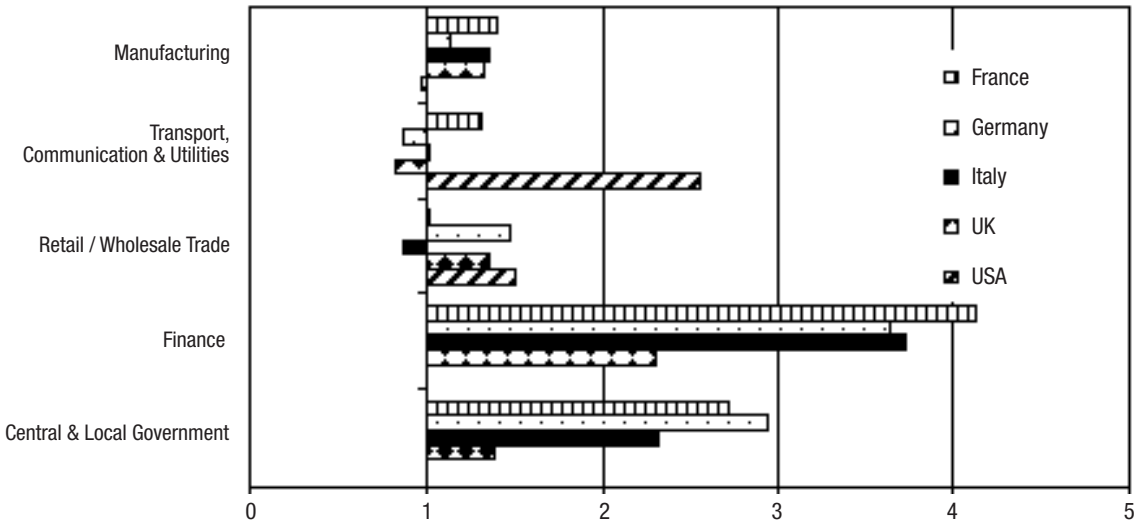


Exhibit 8. The role of purchased ICT equipment in manufacturing and services, 1995[1].
Note: The figure shows an industry's share of purchased ICT equipment relative to its share in GDP. An index higher than 1 suggests that the industry is purchasing more than the average for the economy. US data are for 1992.
Source: OECD, based on IDC data and National Science Foundation

In sectors such as transport and distribution, ICT is often integrated into technologies that improve logistics and automate complex processes. In human and social services, such as medical and health services, ICT is also increasingly used. In recent years, electronic commerce has furnished an important stimulus to ICT investment in the services sector (OECD, 2000b). Exhibit 8 gives an overview of the importance of purchased ICT for selected sectors and countries.

The Finnish situation

Finland is one of, if not the most, ICT-intensive country in the world. For instance, the country is strong in ICT-related patenting. More than 1,000 telecom-related patents have been granted by the USPTO to Finnish assignees. Finland was identified as the worldwide leader in ICT-patent growth. ICT intensity is visible in many factors. For instance, Finnish ICT manufacturing has the highest share of value added (21.4% of total manufacturing), and the ICT producing services have a comparatively large share (10.2% of total business services), even though it is not as pronounced. In terms of employment, Finnish ICT production also plays a significant role. More than one-tenth of the service and manufacturing workforce are employed in ICT-related fields. Both Finnish employment and value-added data indicate a strong position of the ICT-producing sector, even in comparison with other countries (see Exhibit 9 for a country comparison of the growth of labour productivity).

However, the reach of ICT also goes beyond the core ICT sector. In addition, the knowledge-intensive or information economy encompasses the so-called *content industries* and *ICT-using* sectors. The question as to how the ICT sector affects content-producing and other ICT-using services may go beyond what current statistics can answer, but some data are available.

Interestingly, Finland is less intensive in ICT *use* than in ICT *production*. The sizes of both the ICT-using service and the ICT-using manufacturing sectors are not as large as they are in other countries. While Finland is certainly ICT intensive in terms of production, other countries appear to be more intensive in terms of ICT use and application. One can see clear differences between productivity growth in the ICT-producing and using sectors of the economy. The productivity growth of ICT producers was still considerably higher than for users. Growth in the first half of the 1990s was close to 8% in the ICT-producing industries while ICT users increased their productivity only marginally (0.5%).

However, the second half of the 1990s saw a dramatic increase in the productivity of ICT users, i.e. almost 5%. ICT users increased their productivity levels by a factor of 10, while ICT producers almost doubled their productivity. A

7 Proper measurement of output in services may show rapid growth, however. A recent official study for the US banking industry showed output growth of 7.4% per year between 1977 and 1994, well above the previous official measure of 1.3% per year.

Exhibit 9. Labour Productivity Growth by Sector 1990–1995 and 1995–1999.*

	CA	DK	**FIN**	F	D	I	J	NL	UK	US
Total economy										
1990-1995	1.2	2.0	**3.4**	1.1	2.1	1.9	0.7	1.3	2.5	1.2
1995-1999	0.9	1.0	**2.8**	1.3	1.7	0.6	0.8	0.9	1.2	2.1
Acceleration	-0.3	-1.1	**-0.6**	0.2	-0.4	-1.3	0.1	-0.3	-1.2	0.8
ICT-producing sector										
1990-1995	0.9	7.5	**7.8**	4.1	6.8	5.1	4.2	4.0	6.8	4.8
1995-1999	4.0	4.4	**13.7**	8.5	11.1	4.7	4.1	4.4	4.9	7.2
Acceleration	3.1	-3.1	**5.9**	4.3	4.3	-0.4	-0.1	0.4	-1.9	2.4
ICT-producing manufacturing										
1990-1995	6.0	6.2	**10.9**	8.6	4.9	3.9	5.8	7.3	8.9	10.0
1995-1999	10.1	2.4	**17.6**	16.2	7.3	0.4	6.3	2.4	4.4	16.8
Acceleration	4.1	-3.9	**6.7**	7.5	2.5	-3.4	0.5	-4.9	-4.4	6.8
ICT-producing services										
1990-1995	-0.2	7.9	**4.7**	2.4	6.2	5.5	1.4	1.8	5.7	2.1
1995-1999	2.9	5.0	**8.3**	5.4	12.1	6.0	1.3	4.4	5.0	1.5
Acceleration	3.1	-2.9	**3.6**	3.0	6.0	0.5	-0.1	2.5	-0.7	-0.6
ICT-using sector, excl. producing										
1990-1995	1.7	1.7	**0.5**	0.9	2.2	2.1	1.5	1.3	1.3	1.3
1995-1999	1.5	1.8	**4.9**	0.7	1.5	-0.5	0.4	1.8	1.3	4.4
Acceleration	-0.1	0.1	**4.4**	-0.2	-0.7	-2.6	-1.1	0.5	0.0	3.0
ICT-using manufacturing, excl. producing										
1990-1995	0.9	4.5	4.0	4.7	4.3	3.2	3.0	4.7	3.9	1.6
1995-1999	5.6	2.8	6.0	4.1	2.5	2.3	2.0	4.0	1.7	4.7
Acceleration	4.7	-1.7	2.0	-0.6	-1.8	-0.9	-1.0	-0.7	-2.2	3.1
ICT-using services, excl. producing										
1990-1995	2.0	1.1	-0.4	0.0	1.0	1.7	1.2	0.5	0.7	1.4
1995-1999	1.0	1.6	4.5	-0.1	1.1	-1.2	0.0	1.5	1.3	4.5
Acceleration	-1.0	0.6	5.0	-0.2	0.1	-2.9	-1.1	1.0	0.6	3.1
Non-ICT sector										
1990-1995	1.1	1.5	3.4	0.6	1.7	1.2	0.3	0.9	2.0	0.8
1995-1999	0.5	0.2	0.7	0.8	0.8	-0.1	1.0	0.2	0.9	1.1
Acceleration	-0.6	-1.3	-2.7	0.2	-0.9	-1.4	0.7	-0.8	-1.2	0.3

* Source: OECD, ICT database.

possible explanation for the observed developments may be that ICT-using sectors tend to be more exposed to the general economic situation.[8] Services that were *users* of ICT had negative growth in the first half of the decade but then experienced 4.5% productivity growth in the second half. The acceleration between the two periods exceeded even the acceleration rate for ICT-producing services (see Exhibit 10). Therefore, ICT-using services could be viewed as a dynamic area of business activity that may benefit from policy measures that are directed at facilitating the uptake of ICT in service businesses.

8 An OECD study also indicated that a large ICT sector is not necessarily a prerequisite for growth. The proximity to software producers/service providers could potentially be more important than proximity to hardware manufacturers. This may be one potential explanation as to why ICT services even in Finland are not as strong as some would expect.

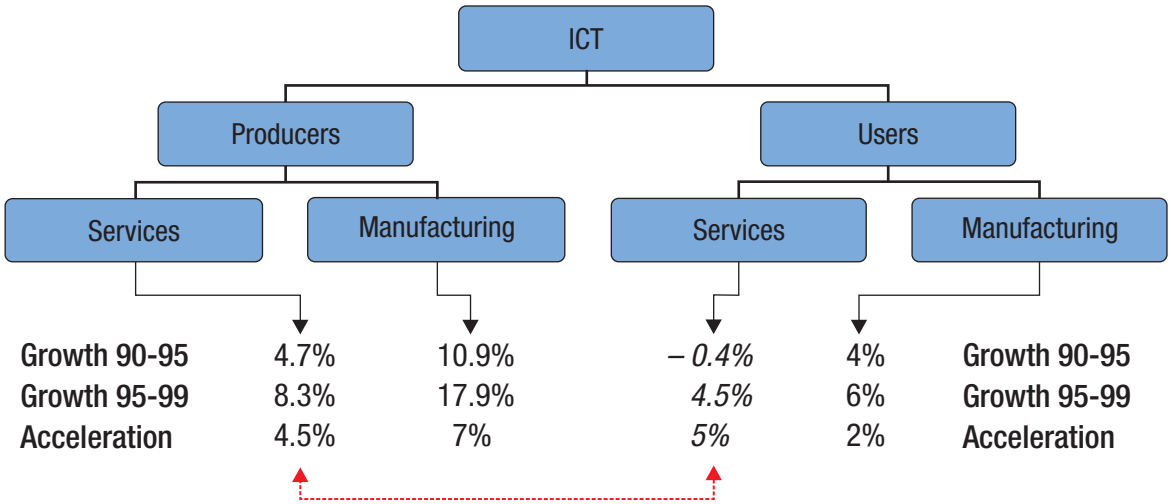


Exhibit 10. Productivity growth of ICT producers and ICT users: Services vs. Manufacturing.

2.1.4 Enterprises, the Internet, and E-commerce

In terms of ICT-producing and -using services, the adoption of the Internet and e-commerce by Finnish firms should be mentioned. Statistics Finland published information on Internet use and e-commerce in a recent publication (Statistics Finland, 2001a). This section will present a selection of the data. The key findings are as follows:

- Use of computers and the Internet are ubiquitous. Nine out of 10 Finnish companies with five or more employees use computers. There is little difference between sectors of economic activity. Whether it is transport (89%) or business services (99%), computers are used almost everywhere.
- There are sectoral variations in the degree to which employees make use of computers. While 82% of employees in the business service sector use computers, only 29% of employees in the construction sector use them. Similar distributions can be observed for the use of local area networks.
- Too frequent introductions of program updates and insufficient ICT skills of employees were seen as the most important factors hampering the use of ICT in companies.
- Information search, particularly on the homepages of co-operation partners, and bank transactions appear to be the most common uses of the Internet.
- The most common 'e-commerce' services provided are marketing on homepages and the ability to have customers browse product catalogues on the company homepage.
- Data security issues and little expected benefits are the most frequently mentioned reasons preventing even more frequent use of the Internet by enterprises.

2.1.5 Trade in services

The general situation

Trade in services is growing more rapidly than trade in goods. Yet, despite this development, trade in services still accounts for less than 20% of overall trade, according to an OECD study (OECD, The service economy, 2000). This is said to be partly due to market barriers. However, foreign direct investment in services exceeded FDI in manufacturing in the 1990s, as service providers intensified efforts to establish a commercial presence in foreign markets.

In contrast to merchandise trade, which is generally measured in terms of cross-border transactions, the General Agreement on Trade in Services (GATS) defines four modes of trade for services. The four modes give rise to a much broader concept of trade, including transactions performed by foreign subsidiaries as well as transactions performed by individuals who have temporarily travelled to a foreign country to perform services (or, conversely, consumers who have travelled to foreign providers to effect a service transaction):

- *Cross-border supply*, which involves services supplied from the territory of one party to the territory of another (similar to trade in merchandise).
- *Consumption abroad*, which involves services supplied in the territory of one party to the consumers of another (for example, tourism).
- *Commercial presence*, which involves services provided through the presence of service-providing entities of one party in the territory of another (for example, banking).
- *Presence of natural persons*, which involves services provided by nationals of one party in the territory of any other (for example, construction projects or consultancy).

As conventionally measured (i.e. in terms of cross-border supply and consumption abroad), the share of services in total exports of goods and services has been relatively low (19% in 1998), if one thinks of the major role that they play in economies. However, the level has been rising. Between 1990 and 1998, world trade in commercial services grew at an implicit average annual rate of 6.4%, to USD 1.3 trillion. Thus, service growth was slightly higher than growth in merchandise trade (exports, which increased by 5.9% per year, to USD 5.4 trillion).

An analysis of the structure of trade for 1997 indicates that the highest growth occurred in services other than transportation and travel. Within this general "other" category, data for six leading countries indicate that trade in financial services (including banking and insurance), construction and computer and information services grew faster than the overall rate of 6% attained in 1997. Trade in cultural and recreational services, royalties and licence fees and other business services, on the other hand, grew more slowly than the average. Attempts have also been made to calculate the value of modes 3 and 4 of trade in services. There are estimates that these modes could have accounted for another USD 820 billion in trade in 1997, bringing the total to about USD 2.2 trillion or 7–8% of world GDP.

Growth in international trade and investment in services is influenced by a number of factors, including:

- The difficulty with which services can be stored or transported.
- The high level of person-to-person interaction that is common to many services and which may require local presence.
- The fact that many service providers are small firms that are less globalised and less disposed to exporting high-volume, homogeneous products than larger manufacturing or agricultural concerns.
- Cultural barriers and differentiated products, which can limit demand for imported services.
- Trade barriers.
- Restrictions on local establishments and operations.

The Finnish situation

Statistics Finland carried out a survey that focused on foreign trade in business-to-business services (Statistics Finland, 2001b). The office uses a new methodology. The change is due to the introduction of the euro. In several European countries, foreign trade statistics were based on payment data. With the introduction of the new common currency, these data will loose their significance. Consequently, data collection has to be adapted from bank payment data towards direct data collection.

Exhibit 11 presents an overview of the Finnish service trade balance. Finland is a net exporter of services in the following areas: post and telecommunications, data technology and information services, trading and other services, services provided by affiliates as well as personal, cultural services and entertainment, and other unclassified services. Finnish imports exceed exports in fields such as construction, royalty and license payments and leasing. The trade balance is also negative for other business services, professional and technical services.

Statistical data suggests a general increase of foreign-ownership in the area of business services (see Exhibit 12). In business services, foreign owners were significant in investigation and security activities, advertising, computer and related activities, and industrial cleaning. Over 50% of

Exhibit 11. Finnish service imports and exports (2000).

Main classes	Service	Imports (million FIM)	Exports (million FIM)	Import share (%)	Export share (%)
245	Post and telecommunications	1663	2051	9	8
249	Construction	2519	326	13	1
262	Data technology and information services	1310	1992	7	8
266	Royalty and License payments	5871	3684	31	15
269	Trading and other services	1367	1877	7	8
272	Leasing	152	103	1	0
273	Other business services, professional and technical services	4510	4087	23	17
285	Services by affiliates, and others	1588	9528	8	39
287	Personal services, cultural services, and entertainment	21	378	0	2
982	Other non-classified services	202	244	1	1
	Total	**19194**	**24270**	**100**	**100**

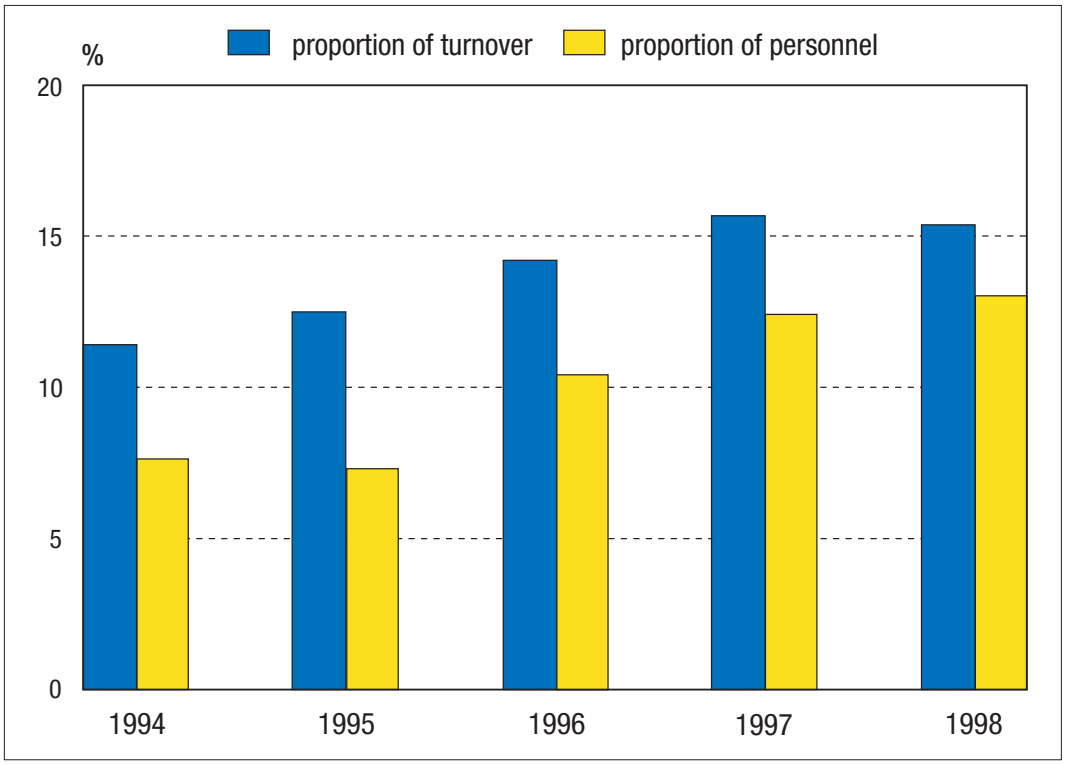


Exhibit 12. Foreign ownership in business services. Source: Statistics Finland

the turnover in investigation and security activities was accumulated by foreign-owned companies in 1998. Foreign-owned enterprises amassed 28% of the turnover in advertising and 26% in computer and related activities. In industrial cleaning, the figure was about 20%.

However, the statistics also indicate that financial intermediation and insurance were almost completely controlled by Finnish owners. In 1998, foreign ownership was mainly found in activities auxiliary to financial intermediation, in which 16% of the personnel worked for foreign owners.

2.2 Summary

The statistical data presented in this report appear to suggest that Finland's service sector is not innovative to the same extent as its manufacturing counterpart. However, one has to consider that there are still considerable problems in the collection and analysis of statistical data in the service sector.

The data on knowledge-intensive business services seem to indicate that these types of services are proportionally over-concentrated in Uusimaa. There are also considerable differences between different KIBS. For instance, computer and related services, R&D, marketing, consultancy and recruitment services are much more agglomerated in the capital region than technical, legal and financial services.

ICT-using services have not achieved a growth that is comparable to ICT-producing services, not to mention ICT-manufacturing. However, their acceleration from the first to the second half of the 1990s in these areas is greater than in ICT-producing services and more than twice as high as ICT-using manufacturing.

Service statistics may not provide decision-makers with results but the data may give some pointers as to why Tekes may want to engage in this area. There appear to be two reasons. First, as seen, the statistical data suggest that in country comparisons of innovative activities, the Finnish service sector is not as well positioned as the Finnish manufacturing industry. Of course, this is to some extent the result of the strength of the Finnish manufacturing industry, especially in the ICT area, rather than a weakness of the service sectors. Yet the fact that the share of service R&D as a total of business R&D has fallen below the OECD average may at least raise the question of whether support dedicated to the technology-related services is warranted.

The findings of other studies suggest that KIBS play a central role in facilitating innovation in a number of industries (see, for example, the section on professional services in

the life-science industry). Hence, one can assume that a balanced distribution of KIBS across the country would be wishful. However, the statistics on the regional distribution of employment in KIBS suggest a regional imbalance. The Uusimaa region over-proportionally attracts KIBS. In addition, one may raise the question of whether this imbalance in regional distribution should be addressed by policy-makers.

The data we collected also provide some hints as to where activity may be of use. ICT-using services may be one potential area. Productivity growth is not at the same level as for ICT-producing services, yet the acceleration rate was higher. ICT seems to be one of the most important driving forces behind the growth in the service sector. Therefore, actions that support potential users of ICT in the adoption of the technology may be a sensible way of responding to developments.

3 Exploring the evolving role of services in innovation

3.1 Introduction

Over recent years, services have become an integral part of the innovation debate. This chapter will discuss the relationship between services and innovation from both conceptual and practical perspectives. The argument is that services and innovations have influence across the industries, and their importance in the knowledge-intensive society should not be underestimated. See Chapter 4 for a discussion on the role of services in clusters.

Evidence of the prominent role of services in the innovations process is accumulating. As a result, innovation concepts and models are beginning to take better notice of knowledge-intensive services, technology-enabled services and the increasing role of services in a manufacturing context. The empirical section of this chapter sheds light on the typical characteristics of service innovation as well as barriers to and drivers of service innovations. Industry cases illustrate how strategic-level service innovations create new business models that can initiate industry-wide changes. The evolving role of services in the innovation process is reflected in the recent literature, from where the following themes frequently emerge (see, e.g., Howells, 2000). Many of the issues below are related to the evolving division of labour and, in particular, the distributed nature of knowledge creation.

- Services are becoming more research and technologically intensive over time (although, this development is not fully represented in R&D statistics and in patenting activity).
- Some service firms are as R&D intensive and technologically innovative as high technology manufacturing firms.
- Service firms are taking a more central role in innovation within national and international innovation systems.
- Service firms and organisations play a more proactive role in the innovation process than formerly perceived.
- Due to increased outsourcing and networking, service firms are increasingly becoming partners to manufacturing firms in innovation.
- Service firms themselves are becoming important customers of R&D and technical service firms.
- Certain services are taking the lead role in the innovation process, subsequently leading to contracting out of the entire production process.
- There has been a shift in the innovation balance from products to non-tangible innovations. This has always been true of organisational innovations, but it is now increasing across the productive activities.

3.2 Objectives of the chapter

The aim of this section is to explore the characteristics of service innovation from both conceptual and practical perspectives. The conceptual discussion will focus on the evolving innovation approach and supporting empirical material, whereas development in the industry context will be addressed in business cases. In the conceptual discussion, the focus is first placed on the innovation models and their recent developments. Traditional innovation models emphasise technology and tend to underestimate service innovation characteristics. At the same time, existing service innovation models are mainly industry specific, which limits their scope. Their focus is on any type of service innovation feature but technological dimensions receive limited attention. Integrative innovation models seek to address these problems by placing a more balanced emphasis on both the service and technology features of innovations.

Empirical findings elaborate on the evolving business models where manufacturing and service activities are converging into selling solutions for customers' problems.. These case studies represent traditional manufacturing, the car industry (consumer markets) and machinery manufacturing (business-to-business markets), both of which are generating an increasing amount of revenue from services. These examples highlight the convergence of services and manufacturing sectors and hence the need for integrative innovation models.

3.3 Services are becoming a key element of evolving innovation models

Over the years, innovation models have evolved in a manner that reflects scientific advances as well as the external environment. There has been a significant change in the environment, where innovations are being commercialised from

demand-driven markets to over-supply of products/services and intensifying competition. On the innovation research and development side, the shift has been from a technological push towards a more market-oriented mode that puts more emphasis on the commercialisation of innovations. At the same time, service-related innovations have become an increasingly important part of the innovation debate.

3.3.1 Linear and interactive innovation models have a technology focus

At the early stages of innovation research, the linear model of innovation was a dominant approach to the analysis of innovation activities. The inherent assumption of this model is a technological push of ideas towards markets: basic research – applied research – development – production – the end-users. This model and the related approach to innovation need to be seen in context. It was developed during an era when government spending on basic research had grown significantly (especially in the US, where it was motivated by the arms and space races). Such investments in basic research created a flow of new ideas that originated from research. At the same time markets were not flooded with competing products and services. On the contrary, until the 1960s, the post WW-II period was characterised by reconstruction, and the demand for products regularly exceeded the supply. Hence, typical customers were willing to buy products that were on offer. To summarise, in the linear innovation mode, development was characterised by a technology push, and demand tended to exceed supply on the markets.

Over time, the linear innovation model faced increasing criticism and that provided an impetus for the development of an interactive innovation model. It places less emphasis on a technological push and assumes that innovations can be initiated at any stage of the process, rather than merely at the research stage. Overall the interaction between the research community, manufacturer and customers becomes a platform where innovations take place. However, even interactive models of innovation emphasise technological innovations, and service-related innovations tend to be underestimated.

3.3.2 Integrative approach seeks to address all forms of innovation

An integrative approach to innovation seeks to provide a more balanced view of innovation without underestimating either technological or service innovations. Linear and interactive innovation models mainly represent a technological approach, which tends to equate or reduce innovation in services to the introduction of technical systems into service firms and organisations. Hence, service businesses are seen as users of innovative solutions, without having invented them themselves. At the same time, purely service-oriented models try to identify any possible particularities in the nature of organisation and innovation in services. These models in turn pay limited attention to the technological forms of innovation. Hence there is a need for a more balanced integrative approach, which captures all types of innovations rather than some specific sub-categories. The convergence of industries and the blurring of boundaries between goods and services favours a similar approach to innovation in all cases (Hauknes, 1999; Gallouj, 2002). An integrative model can contribute to the understanding of both service and product innovations. The systematic R&D practices in manufacturing offer development insights into the services that are less developmental in this respect, whereas manufacturing- and technology-related development activities can gain from well-established customer interaction and the joint development efforts typical in services.

Exhibit 13 illustrates the scope of the integrative innovation model. It seeks to capture various forms (technology – services) and different drivers (technology push – market pull) of innovation. Such models can be applied to goods and services as well as to technological and other types of innovations (Hauknes, 1999).

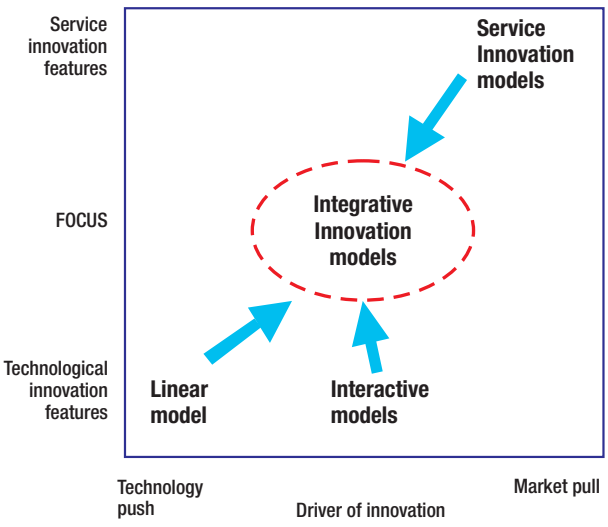


Exhibit 13. Integrative innovation model.

Basic components of product and service innovations

The integrative approach innovation can be based on any of the following components or their combinations (Djellah and Gallouj,1998; Sundbo and Gallouj, 1998; Gallouj, 2002):

- New or improved service or good;
- New or improved process of production or delivery;
- New or improved internal organisation;
- Market innovation, changes in external relations.

New types of products and services are the most obvious elements of innovation. Service skills development and staff motivation are the key ingredients of successful service delivery. Typical process innovations include renewals of the prescriptive procedures for producing and delivering goods and services. Organisational innovations include new forms of organisation and management techniques such as total quality management (TQM) and balanced score card systems. In the service context, production and delivery activities are distinct parts of the process and can be treated separately. For instance, electronic order-delivery systems have had a significant impact on traditional industries, even if the core production process has remained much the same. Market innovations include new behaviour on the markets, such as finding a new market segment, entering another industry and its market, e.g. a retailer offering financial services, and so forth. New or improved processes of tailoring a product service package according to a customer's needs play an important role in the service-related innovations. Another specific case can be called ad hoc innovation, which is typical of knowledge-intensive business services. In such cases, the client and service provider co-produce an innovative solution to a strategic-, organisational-, social- or IT-related problem (Sundbo and Gallouj, 1998). In each case, the degree of novelty of innovations can be different (radical vs. incremental innovations). For instance, the product/service can be new to the global markets, new within the national markets or new to the company itself. Naturally, global/absolute innovations can have a major impact on the markets. However, innovative company-specific management practices also play an important role, especially in the case of service innovations.

3.4 Empirical evidence of service-related innovations

The following section will analyse services and related innovations from various perspectives. These issues include different types of service innovations, drivers and barriers of service innovations and the wider effects of new types of services. These findings will add to the conceptual discussion by providing information on the current views and practices in the industry. The aim is to link the conceptual ideas of service innovation to the current industrial practice. The empirical analysis is based on two main sources of information. In total, 25 in-depth face-to-face interviews were conducted with industry experts and researchers. This primary material is presented as tables and some illustrations. The secondary material is based on a survey of 279 service firms[9] conducted by Djellah and Gallouj (1998) in France.

3.4.1 Different modes of service innovation

Exhibit 14 illustrates the significance of different types of service innovation according to the French survey. It indicates that the customer-specific tailor-made services (57.9%), new combinations of existing service elements (51.7%) and added service features (51.7%) are the most significant modes of innovation among surveyed firms. Service innovations mainly appear to take place in small incremental steps, which can be captured only by conducting relatively detailed surveys. Typically a new service feature is first adopted with one customer and it can subsequently be used on a needs basis with other customers. Hence, many 'small innovations' enter the markets 'silently' as the service process gradually evolves. These incremental developments tend to avoid statistics because there are few indicators that can capture them.

Exhibit 14. Different modes of product-service innovations % of firms (French data).

Type of service	Mode of innovation	Unimportant/ not very important (%)	Important/ very important (%)
Customer-specific application	Tailor-made	24.1	57.9
Combining elements	Associative	25.9	51.7
Splitting up elements	Dissociate	70.2	11.8
Close co-operation	Ad hoc	44.7	27.6
Adding service	Incremental	25.4	51.7
Delivery mode changed	Formalisation	53.1	25.0

n=228

9 The sample of 279 service firms mainly includes businesses from four industries: financial services, consultancy, operating services, and Hotel/catering.

Exhibit 14 illustrates the need for an integrative approach to innovation that also covers non-technical incremental innovations to product and service elements. Overall service innovations seem to originate from customer interaction rather than from any formal R&D activity (customer involvement in the service provision, see Appendix A).

3.4.2 Recent examples of service innovations

An industry survey produced some empirical evidence of service innovations. The investigation took place mainly in Finland and the sample includes both manufacturing and service firms. However, there are some overseas companies in the sample and most of the firms operate globally. Discussions with industry representatives produced a wealth of material on service innovations. This material was analysed and classified in the following categories: innovations based or enabled by new technology, innovations that improve efficiency, and innovations that have wider impacts on industry sector development. Technology, in particular generic ICT, was largely the key driver of numerous service-related innovations. Exhibit 15 presents examples of innovative technology-based services and business concepts.

To a large extent, new technologies have an enabling role in relation to service innovations. Examples of such cases include remote product configuration, virtual design environments, tracking systems, intelligent climate control, distance diagnostics, software tools and electronic bank-

Exhibit 15. Technology-based or -enabled service innovations.

Innovation	Explanation
New business models based on electronic delivery channels	Amazon.com. Travelocity.com (travel sales) Schwab.com (share dealing), and Tesco.online (retail) are examples of successful dot.com businesses. Internet-based trading platforms for consumers expand existing services. Most of the above businesses utilise a new electronic service delivery channel and add new features to the service offer.
Electronic retail banking services	Currently incremental service innovations dominate in the retail financial services, since the customers' ability to adopt new services is limited. The previous generation of innovations, ATMs and other forms of electronic banking are now being further developed. A move to full telephone banking in 1989 was a significant service innovation. Other incremental steps include: 1982 PC banking, 1984 abolition of cheques, introduction of cash cards, 1986 internet access to banking services from office-based computers, 1989 bill payment ATMs, 1999 2nd generation internet bank and e-business platform.
Distance healthcare and medical services	Better availability of doctors could be achieved by using new technology-enabled service delivery channels.
Remote product configuration on the Internet	Internet-based apartment configuration tool, e.g. YIT. The potential buyer can try different combinations of wallpapers, kitchen equipment, room layouts, etc. This tool also includes a calculator that shows the costs of each configuration. The car industry offers similar web-based product configuration/calculator services, e.g. General Motors.
Virtual design environments	A three-dimensional virtual space where different building designs can be experienced before the room is built. A customer can walk into this virtual room and experience it as if it were already built.
Tracking systems and smart labels	Shipment can be traced in time throughout the process, e.g. while being transported. Smart labels can also be used to track and trace products or packages, or to prevent theft, fraud and the counterfeiting of branded products. For instance, Raflatac is producing smart labels and FedEx is making use of tracking of products.
Intelligent climate control	Climate control as a way of increasing the productivity of the business environment. Advanced atmosphere control systems and cooling systems in supermarkets based on information gathering, control and optimisation of the process.
Distance diagnostics, control and management-related services. Supply chain integration.	Essential elements for service development, enabling information gathering, processing and control functions. Such new technology is merging machinery, automation and ICT systems. Centralised management centres can process information obtained from distant locations, for instance distance diagnostics of power plants. Overall data collection, transmission, diagnostics, reporting and cost control can increase process transparency between the supplier and service provider. Development of smart machines, systems and materials enables further expansion of embedded services. Wärtsilä Diesels, Metso and Rolls Royce Aero Engines make use of distant diagnostics.
Software tools	Specialised software applications and related consulting, wireless applications and diagnostics, real-estate management, healthcare, etc.

ing. Typical of these innovations is the use of vastly improved data processing and transfer facilities. Monitoring systems make use of distant data availability, whereas Internet banking is based on the electronic delivery of financial services. Many of the technology-based services add new features to existing services. Evolving electronic banking services show how information technologies can gradually change the service delivery system. In the past, extensive brick and mortar branch networks were the backbone of any retail banking business. As soon as the electronic delivery channels became popular among customers, the physical branch networks were scaled down. As for the routine transactions, far more efficient electronic channels have now largely replaced costly branch networks. Amazon.com appears to be one of the few new businesses that has profited from using the electronic delivery channels. Most of successful dot.com business models are merely delivery channel extensions of well-established businesses. In the retail sector, Tesco-Online provides a good example of a service that combines the benefits of the existing retail infrastructure and the new electronic service channel. It provides a customer-friendly interface, which enables product/price browsing, an automated shopping list function based on previous purchases and a home delivery service. In addition to the usual grocery services, customers can make use of 14 specialist stores, numerous club services (e.g. health related), and financial services, and they can join user communities (www.tesco.co.uk). Overall the service offer is impressive and represents a significant added feature to the traditional grocery business concept. Here customers benefit from added features, a wider product portfolio, and the convenience of home shopping

3.4.3 Service innovations that improve the effectiveness of the industrial process

Industrial facility management services represent a growing knowledge-intensive service activity where maintenance and control have been outsourced to outside contractors. These services will be discussed in more detail later in this chapter (see Life-cycle services in Exhibit 16 and the Metso case).

Outsourcing and new financing models are behind several efficiency-related service innovations such as Energy Saving Companies (ESCO), facility management, professional real-estate management and life-cycle services. Open invitations for bids published on the Internet represent a global search for solutions. They aim at creating savings by using the latest communication technologies (mainly Internet) for locating better solutions for problems. The contractor publishes the bid and project documentation on the Internet and calls for solutions. Here the problem has been outsourced and the idea is to make use of global resources accessible through the Internet. This model represents an attempt to create a new problem-solving model that utilises the distributed knowledge markets.

Extended product offers are paving the way for facility management contracts

Life-cycle services represent an innovative approach that offers significant scope for service activity expansion. They are also paving the way for even more comprehensive

Exhibit 16. Service innovations enabling cost savings and improved efficiency.

Innovation	Explanation
ESCO energy saving companies	A service business model where new technology-based energy savings are used as payments against the new system.
Facility management service and performance guarantees	A complete service package including spare part packages and a management service for entire factory units. Instead of equipment, service suppliers sell performance to the customer. A service supplier takes over responsibility of the agreed performance level of the entire production plant, e.g. a factory or power station. For instance, ABB is involved in such contracts.
Professional real-estate management	Focus on productivity of the capital – outsourcing of maintenance activities. Distant diagnostics, centralised control centres, tailored software applications and related consulting. Granlund Engineering develops these types of software tools for real-estate management purposes.
Life-cycle services	Services that cover an entire product life cycle generate more revenue than product sales, e.g. in the rock and mineral processing business. When life-cycle features are built into products, they can be activated when a customer is ready to take up the service. Hence they can be called pro-active marketing. See the Metso case, p. 33.
Global search for solutions/open invitations for bids	Internet pages where open invitations for bids are published. These sites contain documentation of a project plan or a problem description. Anyone capable can respond to these calls and offer services, see, e.g. Denver Airport open invitation for bids (www.flydenver.com/biz/bizops/bids.asp)

facility management services (see Exhibit 17). Extensive product-service packages are gaining more ground on business-to-business markets, as buyers are looking for solutions for their problems rather than individual products. Typically the sales of industrial goods have included some service elements. However, the current development is towards extended customer relations, and services are gradually overtaking the manufactured goods, which are the main source of revenue.

In the model presented in Exhibit 17, the core product is surrounded by services that help the customer to obtain the full value out of it. Many of the featured services are also aiming at the improved efficiency of the customer's process as a whole, because the supplier services represent increased revenue flow on top of the product sales. Attempts to sell product-related services represent a great potential but they have so far progressed relatively modestly, the main reason being customers who are reluctant to pay for such services, or see them as a threat because of the increasing dependence on the supplier. The key to the success of life-cycle services would seem to lie in the potential productivity improvements for the manufacturers. Enabling technologies are also playing a key role, enabling effective distant control and monitoring, which are key elements of the maintenance service.

The efficiency-improving services presented above seem to be mainly business model innovations rather than specific service activities. However, it is clear that a great number of incremental efficiency-related service improvements escape any attention. Such business models represent an evolving division of labour and a continuum in long-term productivity development (Sayer and Walker, 1992). For the moment, technology and related services together are the key drivers behind value chain re-configurations and improved productivity.

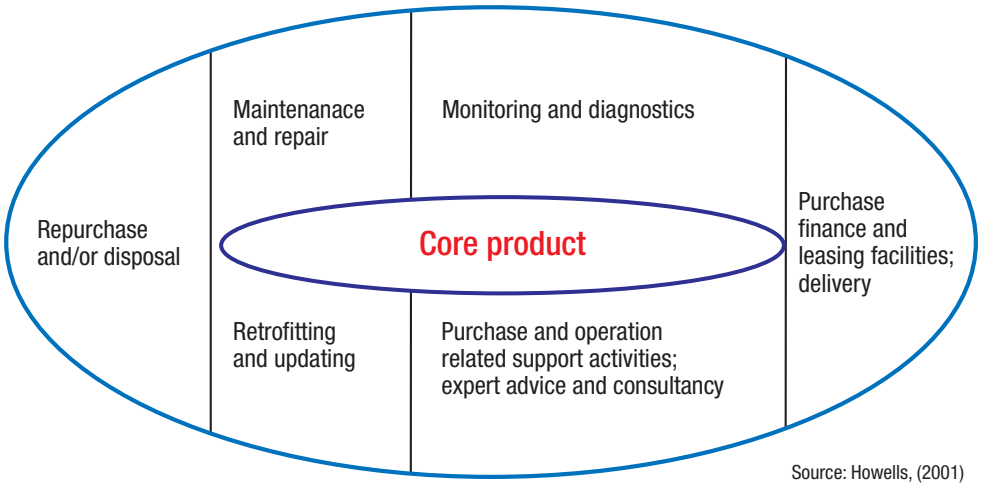
3.4.4 Services as agents of innovation

The previous examples illustrate the impressive range and scope of new types of services coming on the markets. The following sections discuss the wider impacts of new types of services, in particular their role as agents of innovations. Particular attention will be given to knowledge-intensive services and related dynamics. It appears that these services can even have an impact on industry-level development and hence they exert significant economic impacts. According to Hauknes (1999), knowledge-intensive services influence industrial competitiveness in a number of different ways, because they:

- act as bridging institutions in distributed knowledge creation systems;
- can be facilitators, carriers or sources of innovation through co-production capabilities;
- have a role in transforming firms into learning organisations.

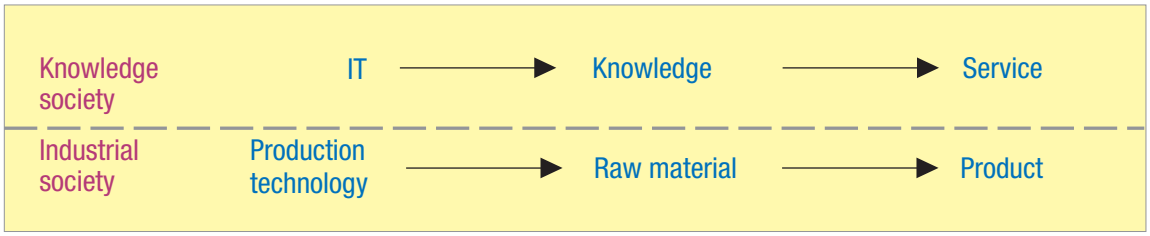
According to Sundbo (2002), KIBS have a very high value in the knowledge economy. They apply basic science knowledge so that research results can be used in solving customers problems, see Exhibit 18. Here, knowledge-intensive services, rather than science-based knowledge, represent the highest value added. Basic knowledge is seen as raw material for knowledge-intensive service applications. The practical reasoning behind the argument is very simple. In the knowledge society, universities should be very wealthy if the basic knowledge has a high added value. However, this does not seem to be the reality. Instead, knowledge-intensive services command high margins and their significance is growing rapidly.

The growth of KIBS reflects increased demands for specialised knowledge, based on developing a division of labour, which leads to specialised services that play a prominent role in knowledge accumulation and transfer



Source: Howells, (2001)

Exhibit 17. A conceptual model of life-cycle services.



Source: Sundbo, 2002

Exhibit 18. Value chain in the knowledge economy.

(Metcalfe and Miles, 2000). Specialisation and distributed knowledge production are also creating a demand for integrative services that create useful packages of distributed knowledge, e.g. insurance brokers that have extensive knowledge of complex and fragmented markets. Such brokers can help customers in acquiring tailor-made and cost-effective insurance covers and portfolios. Higher education does play a key role as part of a knowledge infrastructure, which creates and maintains capabilities that allow businesses to make use of knowledge-intensive services. This is important because the added value of the knowledge-intensive services is created jointly within the customer's business process, typically in complex situations. Hence knowledge-intensive services are resources used as inputs into a customer's value creation process and the enhanced process is the outcome of the service.

Due to the wide variety of services, there are a number of parallel developments that, in some cases, have contradictory effects on the particular industry. Technology-based innovations, especially ICT and software applications, are turning some traditional professional services into commodity packages. For instance, web-based libraries of legal contracts represent this type of development. Similarly, basic accounting tasks and some medical diagnostics are areas where professional services are moving from the client-intensive mode to commodity packages and a combination of standardised modules (see Metcalfe and Miles, 2000:4). Such development represents an interesting service innovation, since modularity and commodification can lead to improved productivity, better quality and lower prices. All of this together can have significantly wider impacts on the industries concerned. Parallel to commodification, new technologies with extremely high knowledge requirements create a demand for new knowledge-intensive services. Here personal interaction remains important and it cannot be replaced by electronic interface and service delivery channels. Hence development in the knowledge-intensive services is affected by multiple and contradicting drivers that have different impacts on the various sectors of the industry. In some industries, such opposing developments are having simultaneous effects (see accounting example in Exhibit 19). This results in a complex overall picture that is well worth further investigation.

New independent power producers provide an example of a new business model where financial investors provide funding for the project, leaving the operational management of the power units to outside contractors. New business models have also emerged in other deregulated industries such as the telecommunications sector and in the air traffic industries. Regulatory changes, either deregulation or increasing legal obligations, are creating opportunities for new types of services. Deregulation can initiate competition, which gives an impetus to value-chain reconfigurations. These value-chain changes typically involve outsourcing, which creates room for new services. On the other hand, increasing regulation creates a demand for new services, especially in the areas of process control, monitoring and clean product/process development. Regulatory changes, as drivers of innovation, will be addressed in more detail in the section on drivers of service innovations.

Branding of manufactured products has a long history in consumer marketing and more recently also in the case of services. Branding is typically seen as a way to differentiate a product from other competing goods and services on the markets. For instance, markets are full of virtually identical cola drinks, which can be easily manufactured by numerous manufacturers (Murphy, 1990). However, it is virtually impossible to copy brands such as Coca-Cola and Pepsi. Famous brands such as Nokia, Microsoft, Mercedes and IBM are extremely valuable assets and it takes huge marketing efforts to create a global brand. Strong brands can carry a price premium and they can also generate a loyal customer base. In the case of services, branding can also have other additional benefits. A strong brand can make an intangible service more 'tangible' and understandable for the potential customer. In order to be successful, branded products and services need to maintain a constant high level of quality. This can be even more difficult in the case of services than for goods manufactures. Here again modularity and standardisation are proving to be important service innovations. For instance, McDonalds has been very successful in utilising a combination of brand management, and standardisation and modularity of services. As a result it has evolved into a highly efficient and scalable global service operation.

Exhibit 19. Service-related innovations that are initiating industrial change.

Phenomena	Explanation of service-related innovation
Accounting is transforming into a knowledge-intensive service	Traditional industries and services are transforming themselves into knowledge-intensive activities and are outsourcing some of their routine tasks. While basic accounting is increasingly a commodity package (often turned into self-service or outsourced to software businesses), most capable accountants are turning into high-level consultants and economic advisers. For instance, Wabuco is offering self-service accounting through the Internet. Traditional services can become more knowledge intensive also due to ICT integration into the process. Such ICT presence requires skilled management staff in addition to those working in the customer interface. For instance, in the cleaning industry such development is clearly taking place.
Internet-based legal services	Model contracts can be downloaded from the net for a moderate fee. Here traditional professional services have been turned into commodities. 'Low-end' professional services are becoming routine tasks enabled by the ICTs. The development is moving away from client-intensive service delivery towards standardised, modular commodity packages.
Independent power producers (IPP)	These have a mainly financing background and tend to outsource power production and related activities. A new business model which is re-shaping the energy industry.
Branding of products and services	For example, the car industry, McDonalds, branded electricity. Branding can make a service more tangible, as in the case of McDonalds. In the case of the car industry, brand management may become the core business for manufacturers. Here the role of the branding is customer loyalty and an ability to carry price premium. In the case of green electricity, suppliers try to create a branded product from the commodity by linking the brand to a highly popular/relevant issue.

3.5 Sources, drivers and barriers of service-related innovations

This section will provide information on the sources, drivers and barriers of service innovations. It begins by presenting the results and commentary on the French survey, followed by sections on the drivers and barriers to service innovation. The latter sections are based on the original data collected for this paper.

Overall the survey results offer some support for the innovation mode findings presented in Exhibit 13. Most of the recorded service innovations are, to some extent, based on customer tailoring. The tendency is also towards adding new service features and combining existing service activities in innovative ways. A closer look at the service-technology relationship indicates that the mutual relationship between services and technology is a complex one and it involves at least the following features (see Djellah and Gallouj 1998; Gallouj, 2002:5):

- Innovative technology-based services may substitute for 'old' services as in the case of ATMs and internet banking, which have largely replaced front office functions.
- Technological innovation determines the emergence of services as in the case of developing IT and related new services.
- Service innovations determine technological innovation, as in the case of the retailing industry, which is putting pressure on packaging and many other product features.
- Some services contribute to the diffusion of technological innovations, for instance high technology consultants.
- Service firms may produce technological innovations, for instance insurance companies have developed electronic document management systems.

Exhibit 20 elaborates on the origin of service innovations by presenting the key results of the French survey. The table lists the main sources of information and knowledge leading to service innovations. Clients are considered an important source of innovations-related material by 76% of surveyed firms. Sales force and customer contact personnel are also important according to 66.7% of the respondent firms. Other important sources of innovation-related information include competitors, informal networks and, to a lesser extent, fairs, conferences, journals, etc.

The nature of most important information and knowledge sources highlights the fact that service innovation protection is difficult and imitation is a 'natural law'. The survey also indicates that Universities and research establishments (71.3%) and RTOs (68.8%) are not important sources of service innovation. According to Gallouj, the weak role of French public research establishments, Chambers of Commerce and RTOs is no surprise, since the same result has been confirmed in several manufacturing surveys. Also, consultants seem to play only a minor role (16.5%) as sources of information, although one of their main missions is to supply information. A study by Cowan et al.,

Exhibit 20. The main sources of innovation, knowledge and competencies for innovation in the sample of French firms.

Sources	Unimportant/ not very important (%)	Important/ very important (%)
Sales force and contact personnel	10.4	66.7
Other staff in the firm	33.3	26.2
Parent company	31.9	17.6
Subsidiaries	35.1	10.7
Competitors	26.2	31.2
Clients	5.4	76.0
IT equipment and systems suppliers	41.6	24.7
Other suppliers	52.3	16.1
IT consultants	58.4	12.9
Other consultants	49.8	16.5
Universities and other educational inst.	71.3	9.0
Public organisations (e.g. Anvar)	68.8	6.4
Fairs, exhibitions, conferences, meetings, journals	42.3	23.3
Informal networks of executives	35.1	31.2

n=279

Exhibit 21. The origin of innovations within the sample of French firms.

Modalities of innovation organisation	Unimportant/ not very important (%)	Important/ very important (%)
Informal individual process	31.2	44.8
Informal team work	19.3	56.6
R&D department	81.4	6.8
Innovation department	71.7	12.5
Marketing department	46.9	33.0
IT department	48.7	32.3
Other departments	50.5	17.2
Project groups across departments	42.6	41.6

n=279

(2001) presents rather similar empirical results from the Netherlands. According to this report, the most important knowledge transfer channels in services are foreign direct investments[10], training and two-way knowledge transfer between consumer and producer. In comparison to manufacturing, where links with academia and patents are the most important means of knowledge transfer, the difference is significant (for further details, see Appendix B). These empirical findings seemingly contradict the traditional models of co-produced innovation, where universities, research establishments and consultants play an important role.[11] Services are produced jointly by suppliers and customers, and the bulk of the knowledge transfer appears to happen during these interactions.

The same survey also highlights the informal nature of new service development. In Exhibit 21, a formal R&D department is seen as the least important part of an organisation, in terms of service innovation process, by most (81.4%) of the firms. Instead, informal groups (56.6%) and individual activities (44.8%) are seen as important in new service development. This exhibit confirms that service innovation is rarely organised as a specialised department, either in traditional R&D, or more in terms of an innovation department.

10 In Finland, cross-border mergers were mentioned as an effective way of diffusing service innovations.

11 Comments that were obtained from the Finnish business practitioners were fairly well in line with the French and Dutch findings. Consultants were seen to be relevant in a supportive role in innovation-related work, rather than as initiators or leaders of the process.

It is clear that aggregate-level statistics are unlikely to capture such flexible forms (temporary formal and informal 'structures') of organising innovative activities. This means that R&D activities in services are not fully represented in statistics and their role is likely to be underestimated. Another implication is that R&D development in the services is far less institutionalised than in the manufacturing sector. On these grounds, there is a clear need for technology policy actions that facilitate more systematic research and development activities within the service sector.

3.6 Factors that act as drivers of service innovations

The following sections will present some empirical evidence on the dynamics around service innovations. Evidence presented earlier in this paper, as well as from the wider literature, illustrates that services do have an important innovation dimension. Some characteristics associated with service-driven innovations include: (see e.g. Metcalfe and Miles, 2000).

- The distributed nature of the innovation process – innovation-driving contributions come from the supplier, buyer and external experts;
- The evolving division of labour is changing the balance between internal and external knowledge acquisition and innovative capability;
- The heterogeneity of service activities and related innovations offers room for a wide variety of service innovation drivers;
- Knowledge-intensive services activities have a role as carriers, shapers and communicators of innovation.

Exhibit 22 highlights a range of service innovation drivers that emerged from the interviews with industry representatives and service experts.

Clearly, information technology is the key driver of service innovations. Information technology is enabling new services such as distant diagnostics, monitoring and numerous other services to operate, based on data processing and mobile communications. Such services have created productivity gains through specialisation, networking and increased process control. Knowledge-intensive services are also increasing in a number of specialist fields such as ICTs, biotechnology, intellectual property management, to name some prominent areas. New information technologies create advances in the division of labour and new types of value-chain configurations across the sectors. The resulting distributed knowledge development creates a demand for integrative knowledge-intensive services. Supply-chain development and IT-related consulting represent growing markets for such integrative knowledge-intensive services. In the most advanced industries, the systematic and professional development of new services is increasingly becoming a driver of innovations, as the use of modular service elements and brand management indicate. Regulatory changes, either deregulation or increasing obligations, have been major drivers of service innovations. For instance, stricter environmental controls create a demand for testing, diagnostics and control services as well as for the development of environmentally friendly products and processes. At the

Exhibit 22. Drivers of service innovation (Finnish and international expert views).

Phenomena	Explaining the forces driving service innovations
Information and communication technology	As a generic technology, the impacts are widespread and only beginning to emerge. Can be a driving force in the knowledge society after a sufficient number of user-friendly applications have been developed. Information technology enables real-time data collection from the customer's process (e.g. paper mill), sophisticated analysis of massive amounts of data and practical user applications with the help of tailored software tools. Even traditional services, such as cleaning, are becoming more knowledge intensive due to an increase of ICTs and related tasks.
Complex technologies	Complexity creates a need for support services. Product sales need to be accompanied by services, especially training and consulting.
widctlparSystematic development of new types of services	Modularity of services provides an example of the increasingly effective ways in which services are being developed. Modularity enables standardisation and cost effectiveness. At the same time customised service packages can be built using different combinations of standardised modules.
Regulatory changes and competition	Evolving markets create space for new services and business models, as value chains are being re-configured, e.g. environment-related consulting and diagnostics services such as knowledge-intensive services for process control and monitoring of waste management.
Industry champions	The car industry appears to lead service development in the manufacturing sector in terms of productivity, outsourcing of production and R&D, custom-built products and brand management. The industry is close to the customer, the product is a relatively large purchase decision for the customer and the manufacturing effectiveness is reflected in the service concepts.

other end, deregulation has increased competition and as a result new types of services are being offered to customers. More recently, deregulation has taken place in the energy sector which is still emerging as a competitive marketplace. Whereas the energy sector has been somewhat slow in development, the telecommunications industry represents a case where simultaneous market liberalisation and advanced technology have given impetus to a proliferation of 'innovations'. However, many of these service innovations have had little demand on the markets. An over-emphasis on technology and a lack of understanding of customer behaviour seem to have contributed to such service failures.

3.6.1 Barriers to service innovations

The interviews with industry experts also revealed a range of factors that tend to slow down service innovations. A range of identified barriers in Exhibit 23 can be divided into three main categories: market-related obstacles, service development deficiencies and the general characteristics of services and related innovations. In their survey, Djellah and Gallouj (1998) identified a number of main constraints to innovation, which are broadly in line with our findings.[12]

Exhibit 23. Barriers to service innovations – (views mainly from the Finnish experts). Source: Adapted from Kuusisto, 2000

Obstacle	The nature of service innovation barrier
Rigid structures	The healthcare sector in particular could utilise new technology in service delivery but rigid structures seem to delay this development.
Lack of intensive competition	Despite deregulation, a lack of competition continues to delay the development of the energy sector services.
Over-capacity	Finance-driven distributed energy production represents an important global trend, yet independent power generation plants are not very likely to succeed because of the over-capacity on Finnish electricity markets. At the same time, a saturated market segment motivates energy producers to diversify into new markets.
Dot.com boom-bust cycle	Extremely volatile market development is still casting a cloud over innovative Internet-based services.
Demographics	Elderly people are not very prone to the adoption of new types of services.
Lack of R&D funding and systematic service concept development	Service sector firms have relatively few tangible assets to secure bank loans, this can lead to a funding gap. R&D in services is undeveloped in comparison to manufacturing, where practices have evolved over the years. Rates of process innovation (services) are slow.
Unbalanced business process development	Technology development needs to be complemented by service concept development. It is time consuming to develop practical applications, and organisations need time before they can make full use of existing technology.
Lack of specialised development facilities	There are numerous ideas for innovative services but very few incubators that are interested in service innovation development. There is also a need for a 'service laboratory' where new concepts could be tested before a market launch.
Services are context specific	Due to language, demographics and cultural barriers, there are difficulties in the scalability of certain types of services. In any case, local economy of scale is decisive in a competitive situation. A lack of standards is typical of services.
Intangibility of services	Personnel and customers lack awareness or understanding of new types of services. As a result, there is a low level of willingness to utilise such services
Availability of skilled staff	Lack of staff able to deliver knowledge-intensive services. Service staff management practices need to be developed to cater for the needs of personnel at different stages of their career. Applied business skills are in demand; there is a need for business graduates to manage cost control and risks.
Increased formality in purchasing practices	In technology consulting services, increased formality makes it difficult to initiate proactive changes.
Diffusion of service innovations between firms	Mergers facilitate cross-border diffusion of service innovations. In the service sector, looser co-operative forms do not cater for the effective diffusion of innovations. A fear of copying is evident within a new service development context.

12 The key obstacles in France included lack of financial resources and public support for service development, regulations and bureaucracy, tax system, professional regulations and standards, clients reluctance, lack of a skilled labour force, organisation of the firm and access to outside expertise.

Rigid industry-specific structures, lack of competition and over-capacity are the current market deficiencies that are seen as obstacles to new service development. It is clear that deregulation as such is not sufficient to guarantee well-functioning markets. Also, market volatility can slow down development. Negative experiences from the dot.com boom-bust cycle are clearly holding back development in the ICT sector. At present, investors tend to be over-cautious due to the recently incurred losses in the industry.

In terms of new service development, a lack of systematic R&D activities, specialised development facilities and skilled staff are issues that were considered barriers to service development. Intangibility is considered to be a factor that can place services in a disadvantaged position in terms of available development funding. The diffusion of service innovations can be slower than in the case of manufacturers products; this is mainly related to a context specificity typical of services. Only very few services are scalable without sufficient tailoring for each specific market. On the other hand, a new service can be imitated relatively easily and many businesses tend to keep innovations within the firm. This limits the fast and systematic cross-border roll-out of innovative services. Finally, buyer behaviour is seen as a factor that slows down the diffusion of innovative services. There are some segments on the markets, such as elderly people, who are not keen to adopt new services. In the case of electronic banking services, the flow of innovative services is limited by the customers' ability to adopt new banking practices. Overall, it seems that enabling technologies could produce far more services than the markets are currently able to absorb. Hence, the development focus ought to be in the commercialisation rather than in the development of new technologies. The key to successful commercialisation lies in comprehensive market analysis and understanding a customer's capacity to absorb innovative services.

3.6.2 Implications of the service innovation analysis

The convergence of the grand sectors, services and manufacturing, is a key factor that needs to be taken into account in service innovation analysis.[13] This development sweeps across the industries as business outputs are increasingly product-service combinations rather than pure goods or services (Briggs, 2000). Hence, the goods/services dichotomy is becoming less and less relevant and it can even be counterproductive to the advance of innovation research. So far, the convergence has hardly been reflected in the innovation research, which has been unable to pay simultaneous and balanced attention to service and product innovation features. Integrative innovation models are in line with convergence development and offer a more balanced view of innovation. They can capture a broader range of features, including technological, service, network and market-related issues, all of which are relevant features of innovations in the knowledge economy. The following case study will elaborate these recent developments which have a profound impact on innovation activities.

3.7 Industry case studies

The following case studies will highlight evolving industrial practices and the growing interdependence of manufacturing and service sectors. It is clear that services play multiple roles in the manufacturing context. Some of the services provide important inputs to a manufacturer's business process and are consumed during the manufacturing process. Such services include, design, R&D, IT and other technology-related services, which can play a key role in the development of new process and product innovations. The other category of services is those that are part of the product-service offered to the customer. It seems that the role of services on offer is increasing and often exceeds the value of manufactured goods. Life-cycle services and factory maintenance contracts are examples of product-service packages where service elements have taken a leading role.

3.7.1 Converging manufacturing and services requires integrative innovation development

The convergence of products and services has already instigated profound changes across the industries. By now it is widely accepted that services have an important role in almost every existing value chain (Sayer and Walker, 1992). However, the role of services in manufacturing has evolved gradually. Up to the 1970s, services were often seen as an unfortunate necessity, which manufacturers had to cope with. In the 1980s, they became a valuable means of competition, and, in the 1990s, services were often organised as a separate business alongside manufacturing (Grönroos, 2002). Currently, services are increasingly seen as a strategic business perspective by manufacturers, who are adopting service-oriented strategy and business practices.

13 The global manufacturing conference Informan 2000 analysed international expert views of manufacturing trends. They include globalisation, IT/e-commerce, customisation, demographic changes, environmental and sustainability issues. Here customisation clearly reflects the increasing role of services in manufacturing as it places the focus on responsiveness and meeting customer expectation, tailoring of products to individual needs, mass customisation, customer as the main driver, customer is buying more than a product, and finally, product features.

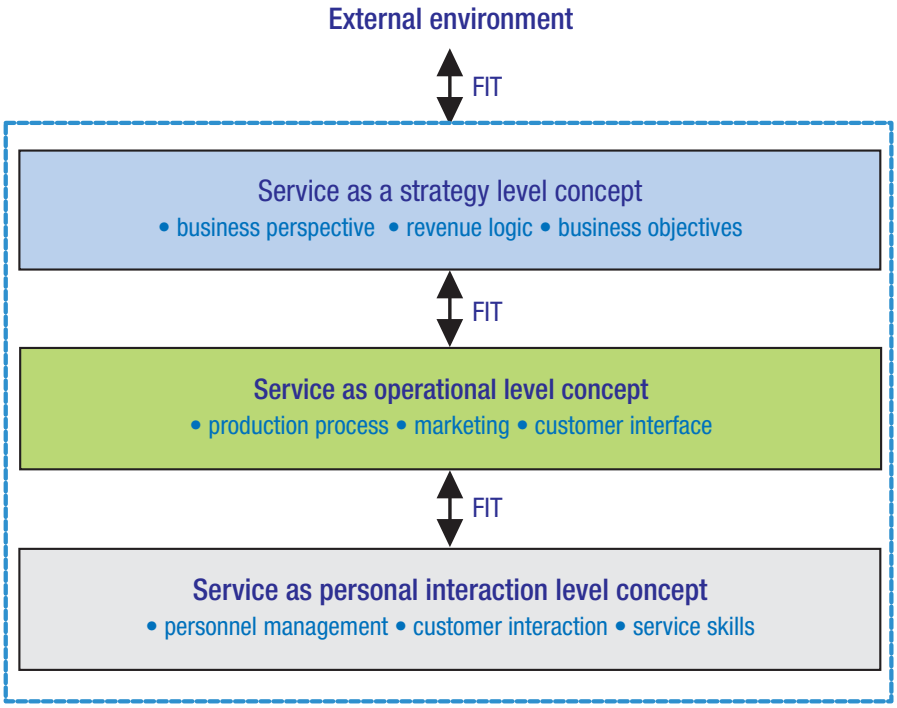


Exhibit 24. Strategic-, operational- and personal-level service concepts.

Exhibit 24 shows that a balanced service development requires attention at three levels; business strategy, operations and personnel. All of these levels need to support each other, i.e. there needs to be a good fit between them. Also, the chosen strategy and business concept needs to be competitive in the existing market situation. A co-production of knowledge and joint problem solving are key functions of services. These types of activities are largely based on personal interaction, hence business strategies and operational practices ought to motivate and support staff for high quality service delivery.

In a manufacturing context, the service concept has evolved from a personal- and operational-level activity towards a strategic-level business perspective. As a result the influence of services in manufacturing has become more pervasive over the years. There are a number of drivers that have influenced the increasing role of services in a manufacturing context. These include:

- Technology push (complexity) and pull (enabling technologies)
- Customer perspective, customer receives value as well as the supplier
- Better understanding of customers' processes – source of innovations
- Better margins than in pure product transactions
- Services create more stable revenue flow.

Exhibit 25 illustrates the service development approach of the Metso Corporation. Here a traditional metal manufacturing business has adopted a business model, which emphasises the balanced development of innovative service concepts, enabling technologies and sustainable revenue logic.

Increasing competition and complex technologies have also brought customer perspective and joint problem solving, which were previously typical of services, into manufacturing. A typical gain from manufacturing-related service activities is a better understanding of a customer's business process. Manufacturers that solve problems jointly with the customers are able to learn a great deal from their business process. Such information provides valuable impetuses for product and service innovations.

Last but not least, the increasing role of services in manufacturing has been motivated by economic factors. In addition to better margins, services typically generate a more stable revenue flow than pure product transactions. Exhibit 26 provides some idea of the revenue contribution of services in typical manufacturing industries. In this example, it is 5 to 21 times more than the revenue generated from manufactured products.

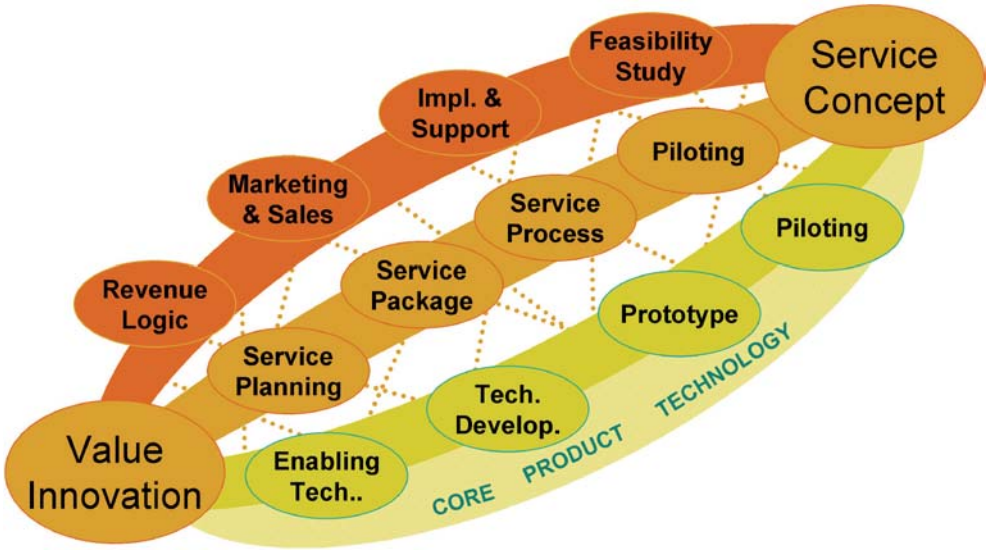


Exhibit 25. Balanced service concept development model. Source: Metso 2002

Exhibit 26. Product and service-related revenue ratio in selected industries.

Product category	Revenue generation ratio service vs product
Computers	5 to 1
Locomotives	21 to 1
Cars	5 to 1

Source: Tchaicha & Davis, 2002

3.7.2 Services are shaping manufacturing businesses

Within the manufacturing sector, Metso represent a globally operating engineering firm that is operating on the business-to-business markets. It is a leading supplier of rock and mineral processing equipment, paper-making lines and automation systems for the process industry. Despite the heavy engineering background, the firm has adopted a service-driven strategy. It is seeking to transform itself from an engineering and technology-driven firm into a service supplier. This requires a change in the business mode away from transactional sales towards long-term customer relations. The increasing interaction with customers is seen as producing valuable insights into a customer's business process and a continuous flow of development signals. In terms of business logic, the new strategy represents a change from technology push towards market pull.

The implementation of service-driven business concepts can face many difficulties.[14] First, it takes time before all customers understand this new way of thinking. The same applies to internal staff, who have to adopt a new type of attitude to the business. For instance, sales people need to shift their focus away from individual transactions and adopt a continuous customer care attitude. Intangible services contrast strongly with heavy engineering products such as rock processing equipment. Understandably there are some customers who question why they should pay for the service that they cannot even see? Despite these problems, the revenue from servicing is already exceeding the revenue coming from the sales of new rock processing equipment.

14 There are several recent examples of service concept failures especially in mobile communications and internet businesses. In many cares the failure can be traced to the uneven development of the three core elements; revenue logic, core technology and service concept development. One of the most spectacular failures was boo.com. This internet-based retail clothing store was mainly let down by the technology. Either the web site did not function at all, or it was so slow that customers were put off by the experience. By the time core technology finally worked, the business was already insolvent.

Metso Future Care, service business is driving manufacturing

Metso Corporation is a global supplier of process industry machinery and systems, as well as expertise and after-market services. In 2001, the net sales of the corporation were EUR 4,343.00 million. The core businesses are fibre and paper technology (Metso Paper), rock and mineral processing (Metso Minerals) and automation and control technology (Metso Automation).

Service-driven vision and strategy

In 2001, Metso chose four areas, closely related to the needs of customers, as the focal areas of its business concept. These four development areas include: a) maintenance and after-market service concepts for the primary needs of customers, b) maintenance solutions and process upgrading with the aid of new methods based on remote diagnostics, c) knowledge-based services related to the preparation and implementation of customer investments, and d) customer-specific service offers. The aim of these developments is to transform Metso into a total service provider for its clients.

Implementing a service-driven business concept

Metso is expanding its business scope from a traditional machine supplier to a comprehensive supplier of services. The focus is on improving the efficiency, quality and competitiveness of the customers' core processes by supplying value-adding solutions and services based on Metso's R&D, engineering and manufacturing skills. The cornerstones of Metso's strategy are:

- the development of value-enhancing solutions for the customers' core processes
- the integration of control technology, process automation and the most advanced information technology solutions in Metso's products and services
- development of expertise and after-market services for the large quantity of machinery, equipment and processes delivered by Metso

The adopted business thinking leads to new ways of managing customer relationships and developing earnings logic. By benefiting the customer, the aim is to strengthen the partnership between the customer and Metso, and through the customer's success, the aim is to improve Metso's profitability. Metso's aim is to deliver product-service systems that can enhance the performance of a customer's production process. This has shifted the focus towards problem solving and solution sales. The understanding of the customers' processes is a vital element in this type of service business. Complex production systems need to be analysed systematically, and the cumulating knowledge has to be managed effectively within the global organisation. Expert centres, e-learning platforms and virtual operating assistance provide tools for the knowledge management. To ensure the required level of customer service, Metso has opened service technology centres in Wuxi, China and in Beloit, USA and has made a decision to set up two new service technology centres at Järvenpää and Oulu, Finland. Results from these service development efforts can be seen already, as the contribution of service operations to net sales has grown significantly. The strengthening of the service network is part of the Corporation's strategic business concept. Metso Future Care implements Metso's vision: from a supplier of machinery to a supplier of competitiveness. The goal is to maintain the competitiveness of the customers' industrial core processes and to develop them throughout their life cycle. Another aim is to create new market potential, by exploiting machines and process technology systems already installed. Metso has delivered more processes, machinery and equipment to its customers than any of its competitors: 2,000 paper machines and 800 pulping lines, as well as over 30,000 crushers, 15,000 screening systems and 3,000 grinding mills for rock and mineral processing. This large installed machinery base, together with Metso's automation expertise, creates the basis for developing expertise and after-market services over the entire life cycle of the process.

Service activities represent future business potential

Service performance development requires further advances in the system integration. The development in this area is rapid due to the advances in remote control systems, distant diagnostics, materials technology and improving IT infrastructure. Also, product development is increasingly incorporating the life-cycle approach where the installation, operation, maintenance and disposal services are an integral part of the product. This benefits the customer in many ways, not least because of the improved transparency of the lifetime revenue impact of the industrial systems. For the moment, Metso maintain or otherwise service only about one-third of the machinery and equipment that it has delivered so far. This means that service activities represent a significant future business potential for Metso.

Source: Metso 2002.

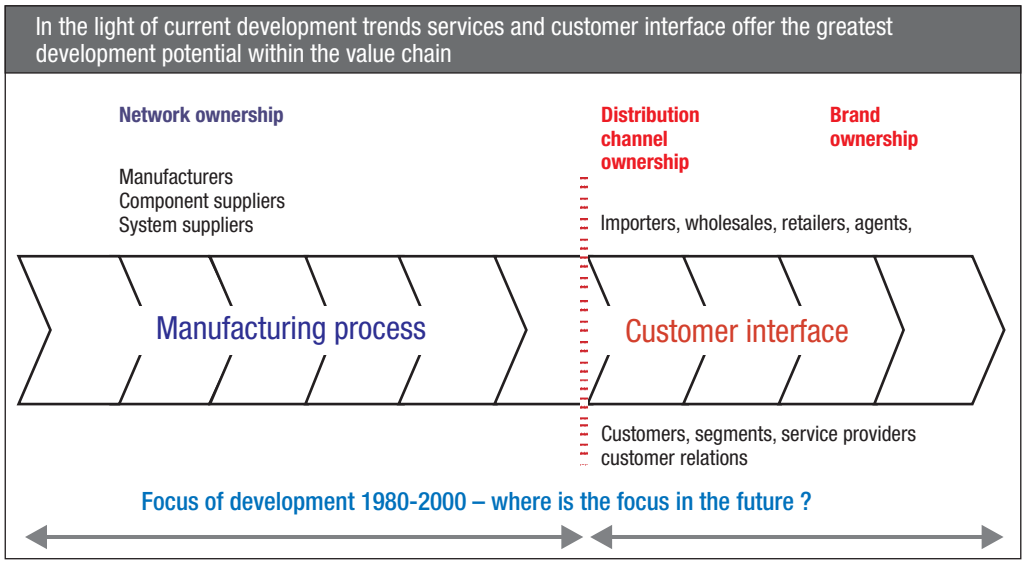
The Metso case highlights the increasing role of knowledge-intensive maintenance services in the manufacturing context. These services are likely to grow significantly and they represent a significant addition to the traditional professional services such as management, strategy, technology and IT consulting as well as accounting and legal services. Hence, the significance of services is growing within the manufacturing sector as well as a separate industry sector.

3.7.3 The car industry is showing the way towards a more intensive customer focus

Car manufacturing is one of the leading industries in the durable consumer goods sector. The product represents a relatively expensive purchase for consumers, hence the decision represents an extensive amount of research for competitive offers. The car industry is also a very competitive global business that has achieved a high level of manufacturing efficiency in relation to many other industries. The division of labour, which often means outsourcing, is already well developed in the car industry. For instance, Denso and Porsche design specialise in complex products, which integrate numerous different technologies. Such specialisation has contributed to industrial effectiveness in the car industry, where the production costs per kg are only 5 EUR. For instance, in the laptop PC industry the logistics costs alone approximate to 16.7 EUR per kg for the completed product (Pylkkänen, 2002).

Nippon Denso Global develops (R&D) brakes, cooling systems, air conditioning and security systems for many global car manufacturers. This is the same for Nokia and Porsche Design, who develop solutions for several different car manufacturers. These types of knowledge-intensive services require very high levels of skill. To be competitive, Denso and Porsche are both involved in basic research as well as applied R&D. Such high knowledge levels enable global sales. For instance, there are only three firms that are currently developing security systems for the global car industry. The overall industrial effectiveness is also reflected in the marketing channel and brand development in the car industry, as illustrated in Exhibit 27.

The customer end of the business process is becoming an increasingly important source of added value for consumer-oriented manufacturing industries. In the case of the car industry, manufacturing has already been developed into a very effective process where further productivity gains are difficult to achieve. Hence, the development focus is shifting from the manufacturing process towards the customer interface, delivery channel and brand development. The following industry case (Exhibit 28) highlights the development where the customer end of the value chain is becoming an increasingly important part of the chain. One aspect of this development is the increasingly effective segmenting of the markets and the supply of individually tailored product-services packages. The increasing tailoring and service content are leading to distributed manufacturing, where each market segment is catered for by a relatively small assembly plant. Such small units can be effective in producing small quantities of tailored products and services. Here the development is towards a manufacturing structure that bears a close resemblance to typical service delivery systems. In this mode, large companies have significant centralised resources for management and development, but the actual production and service delivery is distributed to relatively small units that operate in proximity to their markets.



Adapted from: Pokela, 2002.

Exhibit 27. Recent development trends in the metal and electronics industry.
Pokela, 2002.

Exhibit 28. Car industry case – from manufacturing towards brand management.

Shrinking car manufacturing plants

Car factories of the future will be smaller and cleaner, and not all owned by car companies

THE Rouge plant in Dearborn on the outskirts of Detroit is the spiritual home of car manufacturing. It was here that Henry Ford developed his manufacturing ideas, creating a huge integrated factory complex that sucked in coal and iron ore at one end and pumped out cars at the other. It became the model for the world's biggest manufacturing industry. Now this icon is changing into a slimmed-down, flexible assembly line that is indicative of modern car making. The complex, which once employed 100,000 workers making 1,200 cars a day, is now down to 3,000 workers making 800 Mustangs a day.

This says two things about the car industry, each as relevant in Tokyo or Stuttgart as in Detroit. Not only has it become much more efficient, but its manufacturing structure is also changing. Car companies no longer own steel mills and they are selling off their in-house parts businesses. The whole industry is disintegrating (or becoming less vertical) as vehicle assemblers try to outsource more and more of what they once did for themselves.

The car industry is changing from manufacturing towards brand management

As the industry's relics are razed, the shape of car manufacturing will change radically. The ultimate pattern, according to industry seers, is that today's metal-bashers will disappear. In their place will be vehicle brand owners (or VB0s). They will do only the core tasks of designing, engineering and marketing vehicles. Everything else, including even final assembly, may be done by the parts suppliers.

This happens already with niche cars, such as the Porsche Boxster (assembled by Valmet, an engineering firm in Finland), but one day it might become the pattern for the whole industry. Already Magna, a Canadian company with innovative manufacturing techniques for body parts, is taking over more contract assembly from Detroit. Significantly, the car factory that DaimlerChrysler is selling in Austria is being bought by a Magna subsidiary (Magna Steyr), which will continue to make Chrysler Voyager minivans there under contract. Magna Steyr also has contracts to assemble niche cars for Mercedes, BMW and Saab.

Before things reach this stage in volume car making, the assemblers have to redefine their relationship with their suppliers. They need to become more co-operative and less adversarial before design and engineering processes can be re-assigned. This re-drawing of the boundary between the car company and its suppliers is least advanced in America. In Japan (at companies such as Toyota, Nissan and Honda) and in Europe (with Volkswagen and BMW), it is already working quite well.

Flexible manufacturing plants rely on suppliers

There is a growing need to design and supply niche models manufactured in small volumes, even though they may be using common parts, such as chassis platforms and engines, which feature in other models. Most new factories are now built to make around 200,000 units a year. According to some visionaries, there could be many more built at one-tenth of that size, as suppliers take over more of the construction of cars, and car companies themselves move towards a snap-together final assembly, much less complex than today's.

The message about flexible plants is passing rapidly around the industry. It takes Detroit between four and six weeks to alter models in a factory, re-jigging the robots and other tools. Honda can now do it overnight, simply by changing the software in the robots. To achieve this it has installed one single global manufacturing system. Honda has harmonised its production systems—the positioning of welding points in body shops, for instance—in order to make such a switch faster.

In pursuit of such flexibility, car companies need to re-define their relationship with their parts suppliers. Instead of bashing them on the head, manufacturers should work co-operatively, but avoid duplication, e.g. in the aerospace industry, where Boeing and Airbus leave engine development to the three makers of large jet engines (General Electric, Rolls-Royce and Pratt & Whitney), and hand over responsibility for their landing gear and avionics to a small number of world-class suppliers.

Despite the residual shadow engineering, there are a growing number of car companies that are working fruitfully with suppliers to produce pre-assembled modules, rather than bins of parts. For example, Chrysler used to buy its seals and engine gaskets from a company called Freudenberg NOK. Now the supplier has taken over responsibility for preventing lubricants and other fluids leaking from Chrysler engines. It went on to design and supply packs of parts to achieve this. At Volkswagen's Resende truck factory in Brazil, suppliers were signed up to supply whole sub-assemblies for steering, brakes, suspension, engines and gearboxes, and to fit them on the assembly line.

The truck industry is successfully showing how to disintegrate car manufacturing. In North America, the fleet buyers of large trucks dictate which engines, gearboxes or braking systems go into their trucks. The vehicle assembler simply takes in and fits what the customer wants. It is possible that the car industry will gradually move to a pattern where most of a car will be made in modules that are simply snapped together in small assembly lines close to the consumer, where details can be adapted to local tastes. He calls this trend "distributive manufacturing", which he sees as being largely driven by the growing demand for mass customisation (or "build-to-order") in industries such as purchase.

Source: The Economist Newspaper© (2002),
Incredible shrinking plants, Feb 21st 2002.

3.8 Summary and conclusions on the service innovation

Service innovations need to be seen in the wider context of a continuously evolving division of labour and specialisation, resulting in productivity gains and a growing complexity of the economic systems.

New technologies, especially ICTs, are key drivers of a number of more specific service-related developments. This applies to the single most significant process currently under way, the convergence of the two giant sectors of the economy – services and manufacturing (Hauknes, 1999; Briggs, 2000). Recently this development has also been recognised in innovation-related research, development and policies alike. However, much needs to be done before innovation models and policies cater for service development at a standard comparable to that already in place for promoting technology and manufacturing activities. Such policies are long overdue, considering the important role that services play in the commercialisation of innovations and in enabling agents of proactive innovations.

3.8.1 Towards integrative innovation models

Traditional innovation models have ignored many dimensions that are essential for service innovations. Currently evolving integrative innovation models address this problem by attempting to present a more balanced view of innovations. However, there is still a need for further development and a better understanding of the dynamics around product-service innovations. This type of development requires empirical research designed to capture the key features of service innovations as well as manufacturing-related innovations. One of the key challenges is to recognise the specific features of services and manufacturing at one level. Yet, at the same time one should be able to see the increasingly interconnected nature of both sectors and related activities. Essentially, the integrative innovation model needs to contribute to the understanding of both service and product innovations and their increasing interconnectedness.

The challenge that integrative innovation models face is the complexity with which they should cope. They should be capable of addressing a variety of innovations related to new products, services, processes and delivery modes, organisational issues and market innovations. Due to the heterogeneous nature of services, such issues span a large number of industries with very different features. Despite the above-mentioned challenges, the potential benefits of integrative innovation models are obvious and worth pursuing. It is clear that the systematic R&D practices in manufacturing also offer development insights into the services that are less developed in this respect, whereas manufacturing- and technology-related development activities can gain a great deal from the well-established customer interaction and joint development efforts typical of services.

3.8.2 Key features of service innovation

Service innovations are typically incremental improvements in the service itself or to the way in which service is delivered to the customer. Customised applications, new configurations of existing service activities, ad hoc innovations that are jointly developed solutions to the problems with the customer, and delivery mode changes are the most typical classes of service innovations at the service activity level. On a more strategic level, service innovations are related to new business models that can have an impact on entire industry sectors. Highly cost effective electronic banking services provide an example of a new business model, which has had industry-wide implications. The main sources of innovation, knowledge and competence are the customer and the firm's own personnel, who are in regular contact with customers. In contrast, universities and business/technology development organisations and outside consultants appear to be relatively weak in stimulating service innovations. As such, the above outcome is not surprising because services are produced jointly with the customers, after all they represent solutions to customers' problems. Hence, it is natural that customer interaction plays a key role in service innovations. However, these organisations can have a significant indirect influence on service innovations through developing business capabilities at strategic, operational and personnel levels. Such capabilities can provide the necessary basis for the development of the new service; however, more research is required in this area. Within the firm, informal team work and informal individuals are the key sources of innovations, whereas the R&D departments appear to have only a very minor role in service development. This highlights two points: service development is still very much an informal process and the traditional R&D functions are not yet very good at facilitating service development activities.

Product-service offers are becoming increasingly dominated by the service components especially in the business-to-business markets. *Life-cycle services* is a concept where the manufacturer's core product is surrounded by an extensive range of supporting services, from the assistance available at the purchasing stage, to monitoring, diagnostics, maintenance, repair, operation support consulting and disposal of the product. Here the customer is seeking maximum gains from the products purchased by buying a range of support services. *Industrial facility management services* represent a step further in the evolving division of labour. Here customers are not only buying extensive product-service packages, they are also outsourcing the entire manufacturing process for the service provider, which offers performance guarantees for the buyer. Such services are emerging in a number of industries ranging from dairies to paper mills.

Services as agents of innovation

Knowledge-intensive services can influence innovations across the industries and they represent a rapidly growing sub-sector of services. Their growth reflects the increased demands for specialised knowledge and such specialised services are also playing a prominent role in knowledge accumulation and transfer. Specialisation and distributed knowledge production are also creating a demand for integrative services, such as insurance brokers that assist customers in the tailoring and purchasing of insurance covers. New-technology-based KIBS are of particular interest in the context of the innovation process, since they rely heavily on the professional knowledge of scientists, engineers and other experts. This type of knowledge-intensive service provides information and knowledge to their users, intermediate inputs to the client's own knowledge generation and specialised knowledge for other technical functions.

New technologies with extremely high knowledge requirements create a demand for new knowledge-intensive services. Here personal interaction remains important and it cannot be replaced by an electronic interface and service delivery channels. Some technology-based innovations are turning traditional professional services into commodity packages where professional services are moving from a client-intensive mode to commodity packages and a combination of standardised modules. Such services include web-based libraries of legal contracts, basic accounting tasks and some medical diagnostics services. Here modularity and commodification lead to improved productivity, better quality and lower prices. These can have significantly wider impacts on the industries concerned.

3.8.3 Drivers and barriers of service innovation

Even if customer interaction represents the key source of service innovations, *technology push* is also a key driver of innovations. In particular, ICTs as a generic technology have a central role, since they enable numerous new types of services. Empirical examples of technology-enabled innovations include remote product configuration, virtual design environments, tracking systems, intelligent climate control, distance diagnostics, software tools and electronic banking. The use of vastly improved data processing and transfer facilities is typical of these innovations, and often a new technology facilitates the introduction of improvements, such as cost savings and novel features, into the existing services. The ever increasing complexity of technologies also creates a demand for specialised expert services. When introduced, *regulatory changes* have a significant impact on new service development. Deregulation has created a flow of new services in telecommunications, financing, insurance, and energy industries. However, many of these new services may not be based on sustainable business logic, or markets are simply not ready for some new services. Instead, increasing regulations seem to create a robust market for new types of services, especially in environment-related industries. Here the demand is based on regulatory obligations and the issues are often so complex that firms need external expertise to tackle them.

Increasingly *systematic development of new services* is beginning to emerge as a driver of service innovations. Most advanced firms have been active in systematic service development for years, utilising modular development and scalability of services. Now such professional practices are gradually becoming more common, and the policy-making community has recognised the need for systematic service development. However, the development is only taking its first steps and there is still a long way to go until the service development practices have achieved the same level as exists in manufacturing. *Leading industries* such as car manufacturing are setting an example for the business community in terms of combining a manufacturing and services element to highly competitive branded goods. They have been able to configure a highly effective industrial system based on the balanced development of the core product technology, sustainable revenue logic and service development. In such businesses, the share of revenues obtained by services is typically 5 to 21 times that of manufactured goods. Hence, the profitability of service activities is providing a very good motivation for further development.

The most typical *barriers to service innovations* voiced by the interviewees include various market-related obstacles such as lack of competition, over-supply of services, unfavourable business cycle (dot.com boom-bust), rigid industry structures and shortages of skilled staff. Other barriers to service innovations brought up were a lack of resources and funding, and general characteristics of services such as intangibility and context specificity.

4 Services and Industry Clusters

4.1 Introduction

One way of defining economic activity is through clusters. One can define clusters in many ways. For instance, OECD studies interpret clusters as reduced forms of National Innovation Systems and refer to two definitions in particular (see, e.g., Bergman, 2001):

> *"Networks of production of strongly interdependent firms (including specialist suppliers) linked to each other in a value-adding production chain. In some cases, clusters also encompass strategic alliances with universities, research institutes, knowledge-intensive business services, bridging institutions (brokers, consultants) and customers"*

> *"A group of business enterprises and non-business organisations for whom membership within the group is an important element of each member firm's individual competitiveness. Binding the cluster together are buyer-supplier relationships, or common technologies, common buyers or distribution channels of common labour pools"*

In this context, clusters are understood to be groups of actors with intimately linked expertise and economic resources and the ability to co-operate. These clusters then can be associated with a core industry around which they develop. Here, Finland's competitiveness relies on the forest, telecommunications, base metal, transportation and energy clusters. These clusters are also characterised by certain styles. For instance, commercial services are viewed as knowledge-intensifying and value-creating while the agro-food cluster is considered as 'self-sufficing'. While one can develop a cluster view starting from the industry, another approach to clusters is to group firms according to shared characteristics. For instance, the analyst can try to cluster firms according to factors such as dominating modes of innovation. These factors can, but do not necessarily, coincide with industrial boundaries.

This study will present both approaches of clustering services and industries. The first approach helps explain the interrelationships and trends in a particular industrial context while the latter reminds us of intra-industry differences, in terms of performance, that are due to firm characteristics. The purpose of this chapter is to illustrate key developments in services in the more familiar context of clusters. Therefore, the aim is not to analyse each cluster in detail. The objective is rather to give a general idea, for each of the clusters presented, of how information and communication technologies relate to knowledge-intensive business services, where technology-enabled services occur, and the role that services play in technology and manufacturing enterprises.

4.2 Industry Clusters

This section will discuss industry-based clusters. We selected five clusters: ICT, life sciences, logistics, environment, and electricity supply. Where possible, we tried to illustrate cluster descriptions with firm cases. For logistics, environment and energy, we were able to carry out a num-

Exhibit 29. Selected clusters, cases and data sources.

Cluster	Cases	Data Sources
• Electricity Supply	• Fortum • Wärtsila • ABB	• Primary • Secondary
• Environment/Utility	• KemWater • Labko • Ekolab	• Primary • Secondary
• ICT	[General Overview]	• Secondary
• Life sciences	[General Overview]	• Secondary
• Logistics	• Done • Raflatac • FedEx	• Primary • Secondary

ber of interviews with firms in the cluster. Here, our aim was to identify major trends in these clusters. The broad scope and the tight time-scale of the study, however, made it necessary to base some of the cluster analysis on secondary sources. This is particularly the case for the forest and ICT clusters. Exhibit 29 gives an overview of the industry clusters studied and the cases featured.

4.2.1 The Life Science Cluster[15]

The life sciences are a vast area with a potential of applications that goes far beyond the pharmaceutical cluster. Pharmaceuticals are one of several fields of application, such as diagnostics, biomaterials, and industrial enzymes. Functional foods with health promoting effects are yet another important field. Several companies and research institutes are working towards a combination of modern food technology and biomedical research. Given the variety of activities and the nature of our study, this section will focus on drug development processes and the role that knowledge-intensive business services play. The drug development process has become so complex and multi-faceted that it is no longer carried out in the pharmaceutical industry alone. One can distinguish several phases of the drug development process: drug discovery, preclinical testing, clinical trials, registration, manufacturing and marketing. Exhibit 30 provides an overview of the stages and relates them to a selection of key technologies.

In each of these phases, different types of specialist knowledge are required. Academic professionals from a variety of disciplines are required, ranging from biochemists, pharmacologists, IT professionals in the drug discovery phase, toxicologists and animal testing professionals in the preclinical testing phase, clinical scientists and biostatisticians in the clinical phase, registration and regulatory experts, and production specialists to marketing specialists in the final phase of the process. Exhibit 31 illustrates the various types of professionals and expertise required in drug development.

A study of the emerging life science industry in Finland identified the following knowledge-intensive business services in the pharmaceutical industry, which can be associated with the various stages of the drug development process (Tulkki et al., 2001): pre-clinical research services, clinical research services, legal services and patenting, business development and marketing services and financial services.

The study identifies two kinds of KIBS organisations in the sector. On the one hand, there are KIBS that have strong linkages to the industry. On the other, there are KIBS that are less industry-specific and assist actors with a certain issue at a certain point in the process. While the former are extremely dependent on the development of the pharmaceutical or biotechnological industry, and, in practice, do not have any linkages outside the sector, the latter have a

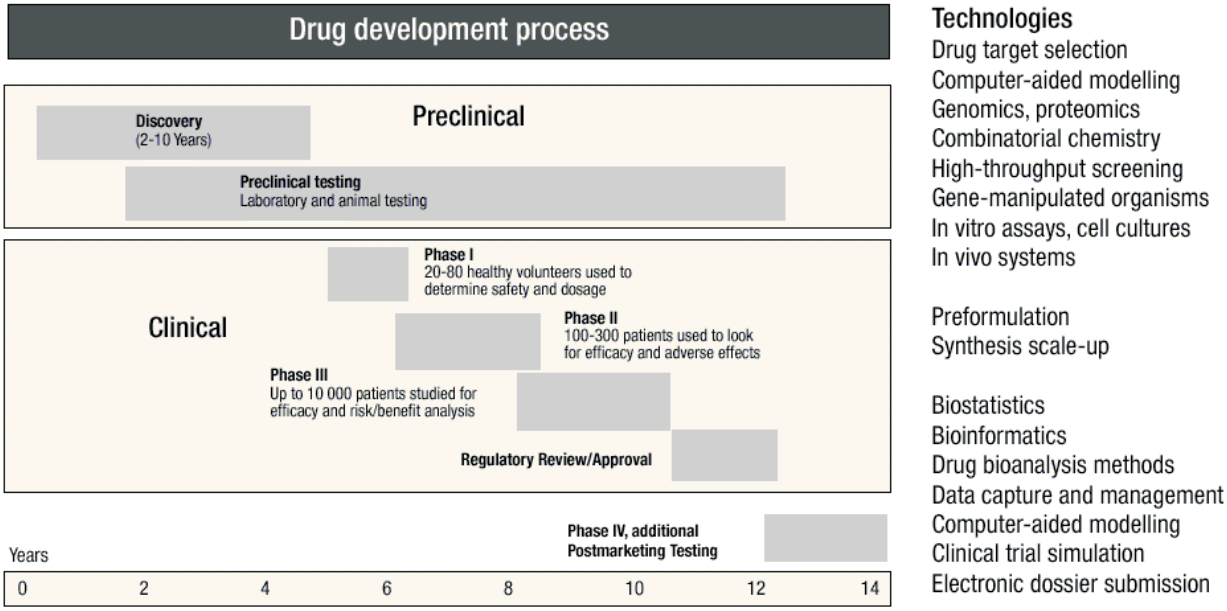


Exhibit 30. The drug development process and related technologies. Source: Brännback et al. (2001)

15 The section makes extensive use of two studies: P. Tulkki et al. (2001) and Brännback et al. (2001).

Discovery	Biochemists Pharmacologists Pharmaceutical chemists Molecular biologists Professionals in data capture and -mining Analytic & synthetic chemists
Preclinical Testing	Professionals in animal experiments Biopharmacists Toxicologists Professionals in pharmaceutical development and manufacture
Clinical phases	Clinical scientists Clinical research associates (CRA) Biostatisticians Professionals in data management
Registration procedures	Professionals in registration & regulatory strategies
Manufacture	Professionals in manufacturing
Marketing	Professionals in marketing Pharmacoeconomists

Exhibit 31. Academic professionals needed in the drug development process.

possibility of directing their operations and specialising in several industries. This is due to their general business ideas and their wide and loose network formation.

The industry specificity of the knowledge-intensive business service organisations determines their functions in the innovation system. Considering the industry-specific KIBS, the study refers to the term – one-industry innovation chain. In terms of cluster styles, life science clusters may be viewed as self-sufficing clusters. While many pharmaceutical-industry-specific KIBS have linkages to or plans to expand into a food branch or into related biotechnology-based industries, these KIBS have very few links to the rest of the innovation system, and, in particular, have no direct linkages or effects. The non-industry-specific KIBS organisations again operate within a larger network.

Considering the pharmaceutical-industry-specific KIBS organisations, the study found that they operate first and foremost by generating in-depth, industry-specific knowledge through the creation of new knowledge, by putting the already existing knowledge into a more easily understandable form, and by recombining it. The non-industry-specific KIBS organisations operate above all by disseminating their own knowledge and expertise within a larger innovation system in which the knowledge provided by KIBS is rarely available (Exhibit 32).

Future studies may suggest a trend where non-industry specific organisations may play a significant role in the emerging bioinformatics. Bioinformatics has gone beyond its original context and is nowadays considered to contain more than just characterisation of sequences. Bioinformatics can be defined as collecting, processing and analysing biological and biomedical data. Processing includes, for example, data mining, sharing and distributing. Thus, biocomputing is thought to be a part of bioinformatics. While it is difficult to distinguish bioinformatics from other fields of biosciences, it is safe to say that genomics, proteomics, structural biology and systems biology are impossible without bioinformatics.

A foresight study suggested that by the year 2005 only those pharmaceutical companies that have invested in emerging silico technologies and cyber-business opportu-

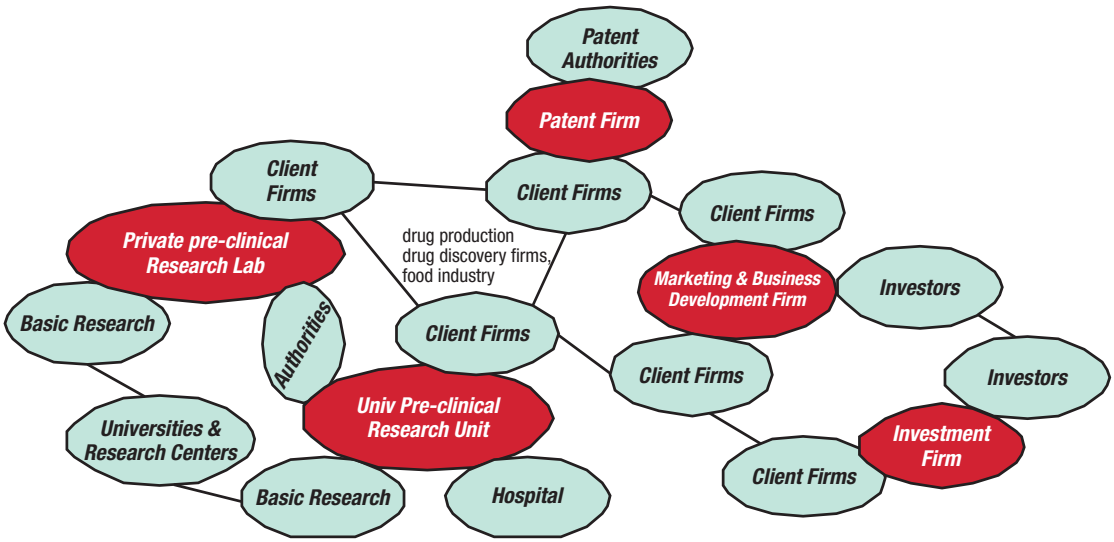


Exhibit 32. Expert services and the various organisations/institutions interfaces.

nities, have learned to mine the knowledge that they contain, and have made the transition to e-R&D will be able to function properly. After identifying IT as one of the major determinants enhancing the competitiveness of the Finnish pharmaceutical network, the study suggests that

> *improved data management and bioinformatics techniques should be established especially in integrating preclinical and clinical studies. Bioinformatics is considered to be a key area to be developed in the immediate future. To enhance the bioinformatics infrastructure, several biocentres in Finland have actively developed this area. For example, the Centre for Scientific Computing (CSC) has established a biocomputing network with all the universities in which biotechnology research is carried out. Such networks will facilitate communication and collaboration between research groups at these universities (Brännback et al., 2001).*

This example underscores once more the pervasive nature of ICTs and illustrates the ways in which knowledge-intensive activities can influence the innovativeness of clusters.

4.2.2 The ICT Cluster[16]

Information and communication technologies are a fast-moving cluster that has undergone rapid and dramatic changes. Reports and studies on the Finnish ICT cluster point to the central position of telecommunications equipment manufacturing and service provision as the key industries. Often, the role of Nokia as the dominant actor and engine for the entire emerging cluster has been highlighted.[17] However, the cluster has exhibited a strong dynamism and can be related to a wide range of end-user markets, as Exhibit 33 illustrates in the case of revenue distribution.

At times, the ICT cluster is described as 'Infocom industry' and defined as a branch that has emerged around digital communication (Exhibit 34). The cluster consists of content industry, communications infrastructure and information technology, digitalisation being the common denominator. Both hardware and software support the distribution of digitised information, be it speech, text or imagery. During the last couple of years, traditional industries have also started using the newly established communications infrastructure and virtual communities. These traditional actors include branches such as trade, finance, insurance, travel, and transportation industries. A great deal of their processes can be transformed into flows of digital information that support the physical activities. These trends are outlined in more detail later in this section.

In recent years, it has become increasingly difficult to place firms on the cluster chart. An ETLA report identifies three megatrends that are behind this development: convergence of networks, terminals and services, digitalisation, and deregulation. These major developments have "drastically altered the clear-cut cluster chart that we had a few years ago," concludes the report. The cluster actors are gradually penetrating each other's domains, blurring the competitive

Exhibit 33. Revenue distribution within the Infocom industry in Finland.

Infocom Industries (End-user markets)	Revenue (billion FIM)
Telecommunication (hardware, services)	22.8
Information Technology (hardware, services and software)	19.8
Print Media (magazines, books and advertising)	14.5
TV, radio, online services	3.8
Advertising Agencies	1.2 (Gross margin)
Sound and Video Recordings	1.2
Digital Services	1.0
Movie Theatres	0.3
Total	**65**

Sources: EITO (European Information Technology Observatory), Finnish Centre for Statistics; Mass media statistics, Uusmediatoimiala Suomessa 1999, Markkinointi & Mainonta: 100 Largest Advertising Agencies.

16 Adopted from the following reports: Laura Paija (2000a), ICT Cluster – The engine of knowledge-driven growth in Finland, ETLA Discussion papers No. 733. Laura Paija (2000b), Industrial network relationships in the Finnish ICT cluster. Working paper presented at 'The OECD cluster focus group' workshop 'Do clusters matter in innovation policy.' 8-9 May 2000, Utrecht.

17 In 1998, the turnover of the ICT cluster was about EUR 17.2 billion. With a turnover of EUR 7 billion generated in Finland, Nokia's contribution to the cluster sales was 40%. Nokia also accounted for an even larger share of cluster exports. Approximately 76,000 people were employed in the cluster, of which around 3% (21 000 persons) worked for Nokia's Finnish subsidiaries.

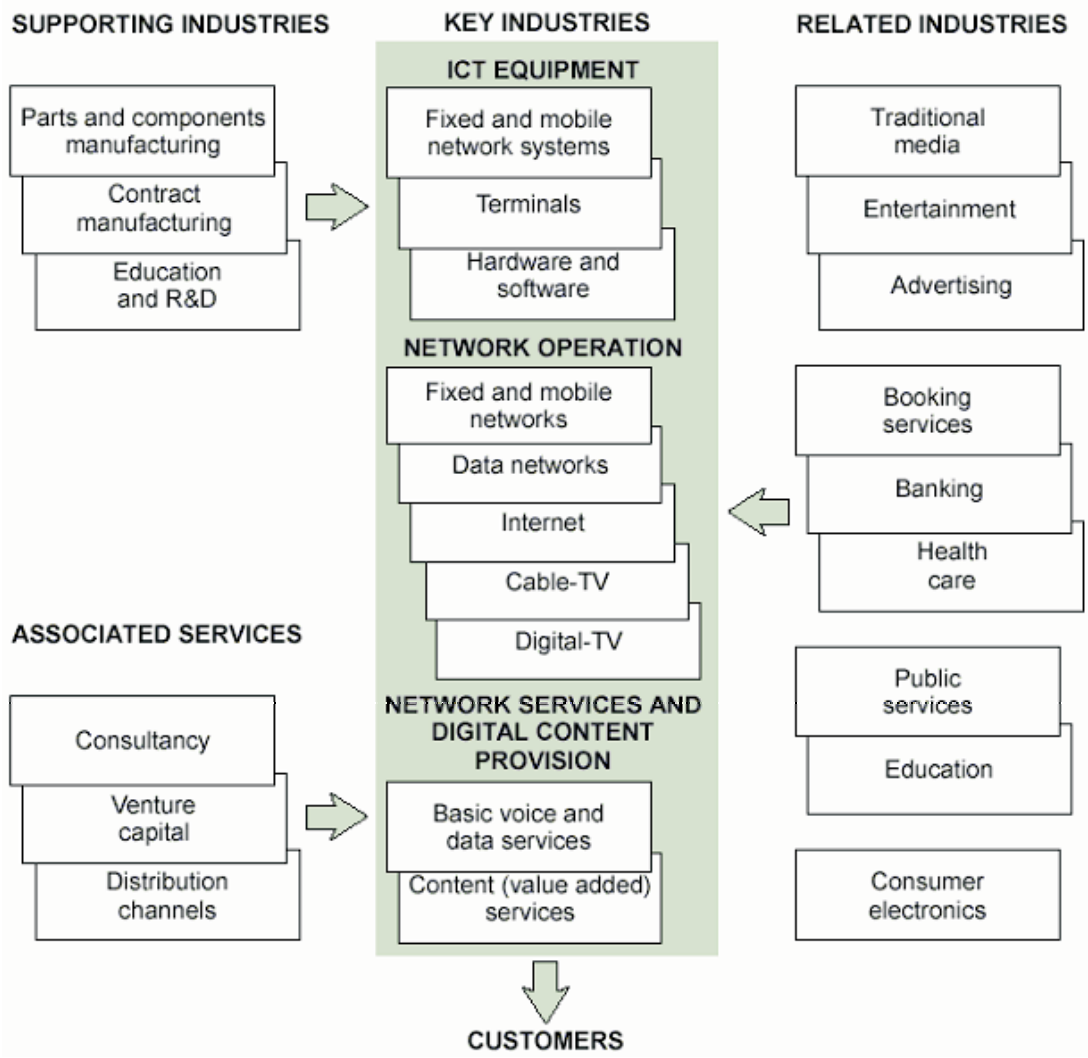


Exhibit 34. ICT cluster chart. Source: Paija (2000a)

environment. The report refers to a number of examples to underline these developments:

> *"Soon, for instance, both terminal suppliers and operators will compete in providing the same technical solutions, such as user authentication or service access, for example through mobile portals. In addition, cluster actors merge vertically to take hold of a wider range of the value chain. Examples are mergers among content providers, packagers, distributors and service provides; or, business consultants, IT integrators and new media. A number of firms in different fields of the communication industry were affected by a global wave of cross-sectoral mergers."*

KIBS and ICT. Toivonen (2001) has also described tendencies of convergence and blurring boundaries for KIBS in the area. Software firms have been reported to have at least some common expertise in technical services or financial services. New media producers are related to marketing communications and the software business. As Mika Uusi-Pietilä, former Managing Director of Tietovalta, points out, new media can be viewed as a synthesis of many fields of expertise. There is a distinction between functional services from a visual and technical perspective and contents services. The field is at the crossroads between technology and arts. A team in the new media business ideally consists of a project manager, script writer, graphic designer, software engineer, and a sound designer. Interaction between the team members is crucial.

Issues regarding intellectual property rights have led to legal services acquiring software skills. However, Toivonen observed in her study that the most typical phenomenon is the blurring of borders between management consultancy and a variety of business services.

> *"The software industry, marketing communications and new media, as well as the financial services, consider their core activities to be an integral part of the business strategy, and therefore by necessity to include some kind of management consultancy."*

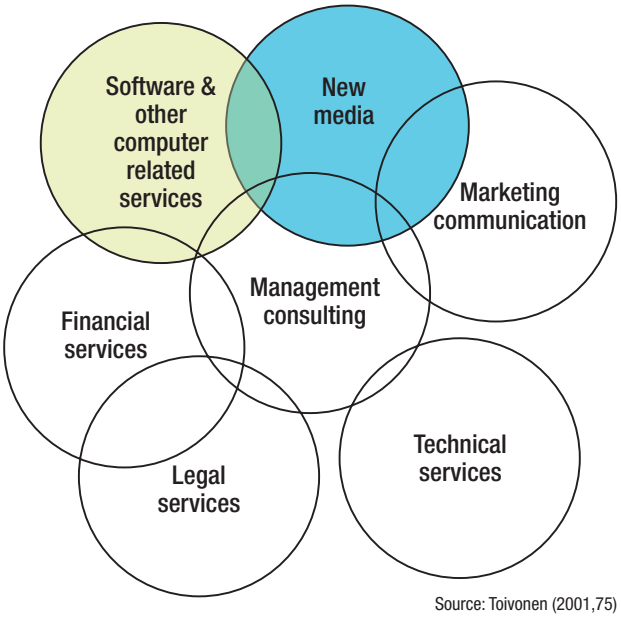


Exhibit 35. Converging KIBS.

Services enabled by technology. Software has become part of many different product-service systems. By the end of this decade, the software industry is expected to have become the fourth main sector, at a similar level to metal, forest products and electronics.[18] Technological changes in this area have become a strategic matter in many instances. This has the effect that the boundary between business management and information technology consultancy has become increasingly unclear (Exhibit 35). Software plays such an important role that firms need advice as to how systems are integrated so that their strategic fit is warranted. In this sense, technology has not only enabled but also necessitated new services in the consulting area. As a result, ICT companies have strengthened their positions in the consulting business over the past few years. This was achieved through mergers and acquisitions and adding management consultancy to ICT solutions (OECD, 1999; Toivonen, 2001).

As an Infocom consultancy describes (Exhibit 36):

> *During the last couple of years, the traditional brick-and-mortar industries also have started taking advantage of the newly established communications infrastructure and virtual communities. These traditional actors include branches such as trade, finance, insurance, travel, and transportation industries. A great deal of their processes can be transformed into flows of digital information that support the physical activities. The digital, "weightless" part of the processes then takes advantage of the Infocom environment.*

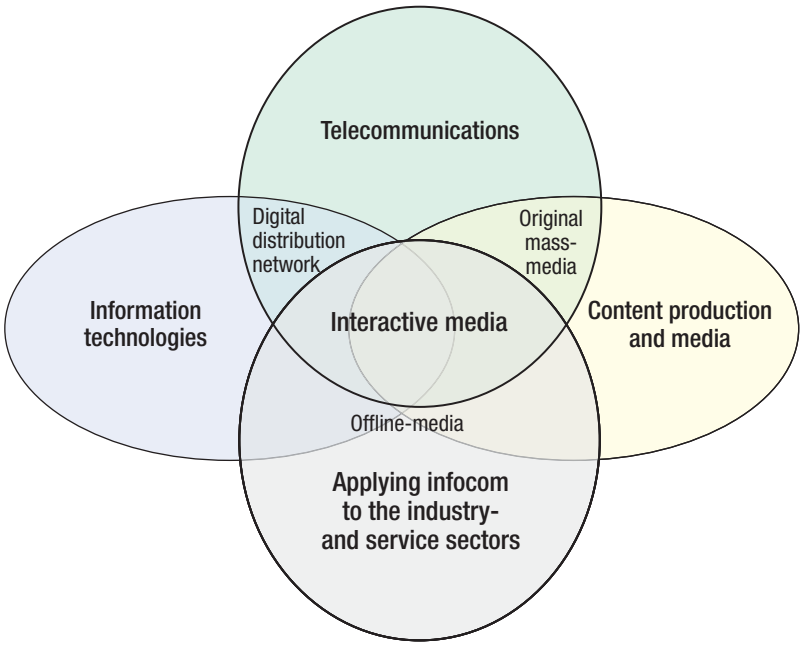


Exhibit 36. The Infocom Industry.

18 The drivers of this development were described in the statistics section: Finland is one of the most ICT-intensive countries worldwide, leading in terms of the use or density of internet connections, the mobile phone density or the general attitude towards new technology. Weaknesses are seen in connection with changing the position into a really large-scale business, i.e. an insufficient amount and quality of training (despite the improvements of recent years), the deficit in international funding, and international expertise as far as marketing and sales skills are concerned. See Timo Korhonen: The software industry. Contribution to: Corporate views of development in different knowledge-intensive business service sectors, in Toivonen, 2001.

Apart from these developments, the enormous impact of ICT becomes visible in most of the other cluster descriptions. For instance, in logistics, ICT facilitates not only the tracking of shipments but also the integration of the entire supply chain by facilitating integrated solutions. Similar developments can also be observed in a variety of fields, such as the forest cluster and potentially the steel sector.

However, consultancies in the field highlight the future importance of content and services production for the development of the Infocom cluster:

> *"Content will ultimately determine the technology platforms that will survive in the market. One of the most interesting questions from the point of view of the Infocom cluster is, what kinds of virtual services will there be real demand for - such willingness to pay for these legitimates the investments made in the technology and infrastructure."*

4.2.3 The Logistics Cluster

Recently, the magazine *Industry Week* carried out a survey of managers, to establish which logistics and distribution strategy will have the greatest impact on their company over the next three years (Drickhamer, 2002). The participants rated strategies such as network restructuring, collaboration with supply-chain partners, new information technologies, and outsourcing as equally important. Roughly one-quarter of those surveyed reported that they will be making structural changes to their distribution networks (28%), adopting new IT applications (26%) and redoubling their supply-chain collaboration efforts (27%). A significant portion (15%) also expects to turn increasingly to outsourcing. The magazine concludes that in the absence of a single, clear strategy, managers will be pushed to make progress on all fronts.

KIBS and Logistics. The survey also showed that two out of five respondents have no idea what their total costs are. This suggests that there is considerable potential for consulting and other knowledge-intensive business services. As indicated already in the section on the ICT cluster, these are often interwoven with the introduction of ICT solutions that facilitate information-sharing. In logistics, ICT solutions have been developed that allow information-sharing across the entire value chain so that cost, warehousing and transport information is accessible at any time, and is integrated with the accounting systems of the logistics operator.

Another trend in logistics is an increasing customer orientation within the firms. Increasingly, logistics performance should be evaluated from a customer perspective rather than from a cost focus alone (Cooke, 2001). Here, there are trends to be observed in offering package solutions where the customers are served starting from the translation of documentation to after-sales software. The logistics service provider Done Solutions can be taken as a example for this development.

In many instances, a company alone cannot offer such a range of logistics services. Consequently, there has been a tendency towards mergers, as in the case of Done, and acquisitions, as well as the formation of strategic alliances. The strategic alliances that FedEx formed with Ariba, a provider of resource management solutions, the management consultants of KPMG, and accounting software maker SAP are a good example of this trend.

Technology-enabled services. The case of FedEx also illustrates how technology enables the provision of new services. The company promotes the idea of a paradigm shift in supply chain management. FedEx argues that a demand-driven rather than a supply-focused strategy will lead to long-term benefits. One of the underlying ideas is to learn from customers how to better customise and configure products so that unique demands can be met on time. This presupposes information-sharing between all of the firms involved. This is where ICT gets involved. Without a common and compatible information technology infrastructure, integrated logistics solutions are not possible. This is because the warehousing operations and accounting and controlling, as well as the tracking systems, are integrated. As integration at such a scale goes beyond the scale of even a large logistics group, strategic alliances needed to be formed with the partners mentioned in the previous section.

Another example of technology enabling or at least improving services is the case of Raflatac. The company recently set up an affiliate that is dedicated to developing and implementing a new labelling technology. So-called 'smart label inlets' will make it possible to give a product and its packaging the 'ability to communicate interactively' with the company. This allows firms to track their products real-time during the production and delivery process.

Bowersox (1991) explored the strategic benefits of logistics alliances. He identified four dominant forces that create a favourable environment for logistics alliances and a growing tendency behind the outsourcing of certain logistics services (Bowersox, 1991:318-319):

- In a number of countries, the political-legal terrain stimulated the development of integrated service practices. In the US, deregulation of transportation and communications in conjunction with a number of other factors generated an environment conducive to innovation. The single market is said to have similar effects in Europe.
- The explosion in information technology has made computerisation cheap, and computers hold logistics alliances together. Satellite communications are used in over-the-road trucks to keep real-time track; cell phones, laser-based bar codes, and radio-frequency transmissions are all commonly used by diverse hauliers.
- An emphasis on leaner organisations makes managers more likely to turn to external specialists to solve prob-

lems or perform tasks. The objective of competing more effectively is viewed as a prime stimulant.

- An escalating competitive environment forces the players to do all they can to become lowest-cost competitors. Efficiency in logistics is seen as particularly important for firms that are doing business abroad. Distribution costs, as a percentage of revenue, are greater for international companies than for their domestic counterparts. Complexity, long lead times for orders, unusual product-service requirements, and differing legal and cultural factors in foreign countries combine to create a much more challenging operating environment. As a result, companies are willing to use qualified external support.

However, some voices in industry see this development as a new way of marketing the service products rather than a change in business models.

4.2.4 The Energy Cluster

The energy-intensity of Finland's main clusters, forest and metal, are responsible for the country's high energy consumption, in combination with the arctic climate, long distances, and a low population. A study in the late 1990s described the cluster as rapidly growing and semi-strong. Increasing the service content of the cluster and exports of power-generation and distribution expertise were seen as possibilities for strengthening the Finnish energy cluster.[19]

Clusters are generally understood to be multi-actor arenas in which not only firms with related activities are to be located but also a number of organisations outside industry. In particular, this is the case for the environment and energy clusters. Public policy has a great impact on the energy system by reformulating regulatory standards. Exhibit 37 tries to illustrate the interrelationship between public policy and the other elements in the energy system. Liberalisation, together with globalisation, is an important driver of the energy markets, creating increasing competitive pressure. While globalisation is manifest as increased transnational merger activity, new international collaborations and technical developments, liberalisation has improved efficiency and reduced prices, and can bring environmental benefits. Yet, questions for both industry and policymakers remain as to how long-term social and environmental objectives can be addressed within a deregulated framework.

Deregulation has also been characterised by most Finnish actors in the field as the central development of the past ten years. The effects of public policy measures can be traced back to the value chain where, for instance, high-voltage transmission was taken out of the energy supply chain.

Services are of relevance to the energy business in many ways, for instance, in areas such as the planning and design of plants or the mapping of emissions. Another service that is to be mentioned in this context is financing - often as a separate business that acquires the required capital. Legal and other design services can be outsourced along with power plants supply logistics. This includes power plants, turnkey agreements and operation services.

Environmental concerns have become increasingly important. Tackling climate change and cutting carbon emissions have become stated objectives of energy policies in many industrialised countries. The richer nations of the world,

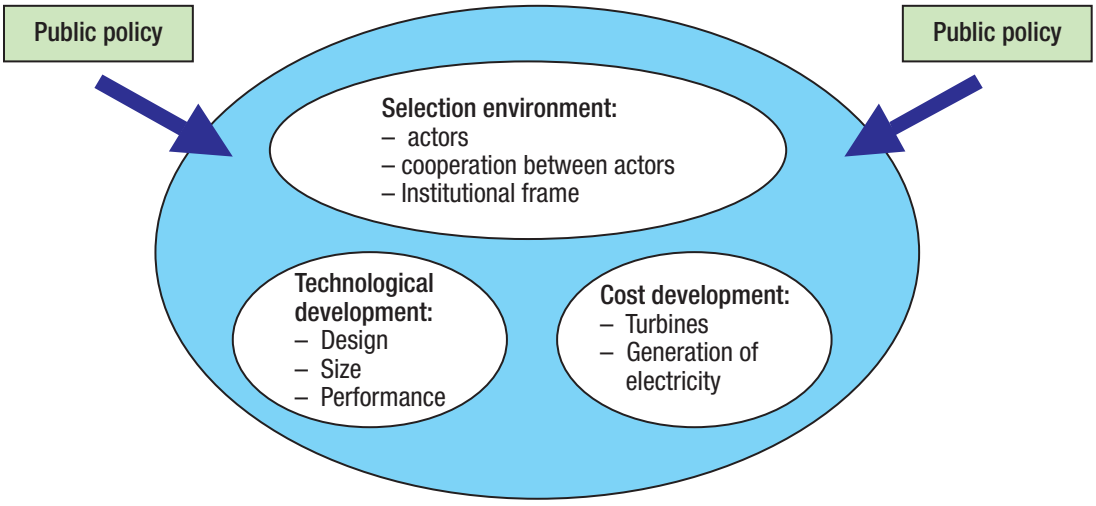


Exhibit 37. The Energy System. Source: ProACT Seminar, 2002

19 See overview in Rouvinen and Ylä-Anttila (1997), A few notes on Finnish cluster studies. ETLA.

Exhibit 38. Key developments by service groups.

Service Groups	Developments based on Company's Perspective
KIBS	*Electrowatt-Ekono:* In the energy sector, services are becoming increasingly important, more so than investments. Technology can be exported but services are still delivered locally. Deregulation of the energy section has increased competition and led to business innovations and improved effectiveness. For instance, there are numerous ways of marketing and selling electricity. Industrial markets are now working rather effectively whereas this is not the case on the consumer side. Business capabilities have developed as a result. There are still many opportunities for further outsourcing within the energy sector.
Manufacturing	*Wärtsilä:* Facility management and servicing are an elementary part of the company's business and a growing source of revenue. Consulting, financing and management packages can be seen as innovative service offers. Service contracts have emerged during the last few years as a new business, now Wärtsila, services 10% of the delivered plants themselves, and there is still potential for growth.
New technology	*ABB:* Production system maintenance is a USD 300 billion business globally, in Finland it is a USD 3 billion business. There is still considerable potential for outsourcing of services. ABB sells axis power instead of motors which do not belong to the customer anymore. ABB can even buy back the motors it has sold to the customer before. Total Motor Management guarantees a certain amount of axis power which is sufficient to run the plant, e.g. in the paper industry. Service concepts also need a supporting technology platform. Mobile technology and new types of sensors enable customer feedback, more intensive interaction, and effective data collection. Tracking/identification technologies will create innovations. The effectivity of services will improve as a result of emerging new technologies. Global service businesses have resources (which need a heavy duty IT system) to develop maintenance services which can improve production effectivity. Also local service provider firms are a growth sector, especially in the B2C services. SMEs will be franchisees that deliver B2B services locally. Large firms are not competitive in decentralised service delivery. Therefore, small firms become members in the networks. This enables seamless data transfer, resulting in improved effectiveness.

currently by far the largest per capita emitters, have committed to reducing emissions of 'greenhouse' gases in the so-called 'Kyoto' agreement. In order to achieve these objectives, governments will be forced to act and promote environmentally friendly energy generation and energy saving. The latter aspect also represents an opportunity for a new type of service business. Energy-saving companies (ESCOs) are based on the idea that customers do not derive benefits from energy consumption but from the service that energy provides, such as heat or lighting, etc. ESCOs offer their customers the service of taking responsibility for the outcome of energy saving investments by financing, designing and installing the equipment; they benefit by taking a share of the energy costs saved (Kivisaari et al., 2002).

Emerging technologies may have a dual impact on the markets. They bring with them both the potential for large reductions in pollution per unit of energy and the need to fundamentally rethink the developed world's traditional technical, institutional and economic approaches to energy supply. This development will be reflected in the technology as well as energy-related policies. Overall, governments play an important role in encouraging technological progress (IEA, 2001). Photovoltaics and fuel cells, or microturbines, for example, could provide very low emission, modular and potentially cheap small-scale power systems – 'distributed generation' close to the point of use, with or without an electricity grid. There are many technological options for reducing emissions - decarbonising fossil fuels, renewables, nuclear. All have problems, so continued development is essential, and the economic, environmental and policy implications need careful consideration.

In addition, for the energy sector, an environment of increasing competition leads to increased outsourcing, which coincides with new business models and value chain configurations (Exhibits 38 and 39). Separating the sales of electricity into a new company is an example of the 'peeling' of everything that can be removed from the monopoly/regulated business – construction, maintenance, etc. Actors focus on core competencies. In this sense, outsourcing can be perceived as a catalyst of change. Firms are forced to take stock of the business processes, and identify and re-define core and non-core activities. However, as Matti Vaattovaara of Ekono states: "More research is needed on networking. There are still many opportunities for further outsourcing within the energy sector. The development requires an understanding of the business process as well as an active supply side and an entrepreneurial drive to push forward new ideas".

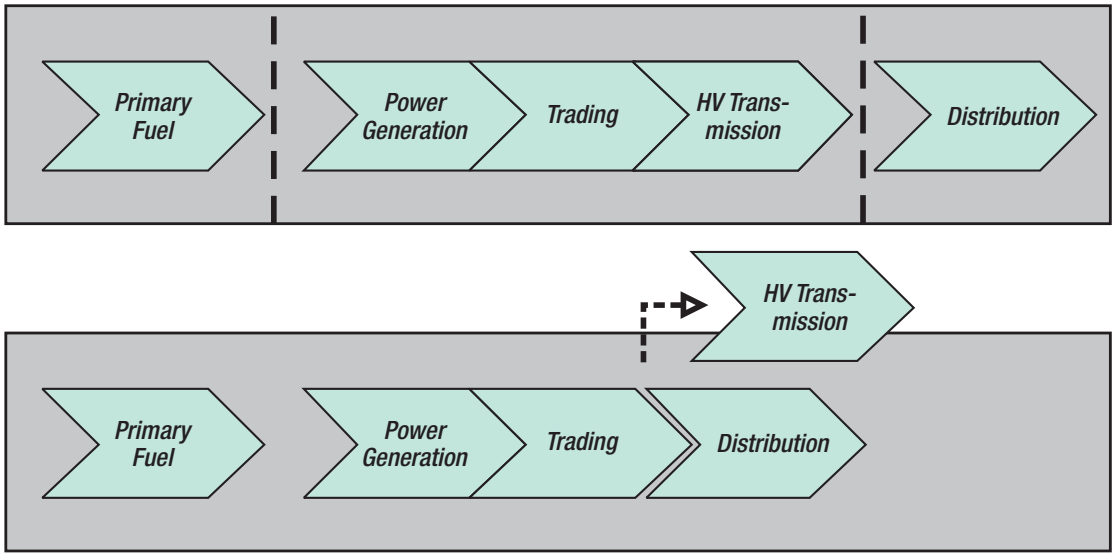


Exhibit 39. Development of the value chain in the electricity cluster. Source: Keränen, 2002.

4.2.5 The Environmental Cluster

To some extent, the environmental cluster can be understood in a similar way to the energy cluster. Here also, public policy can have a substantial influence on innovative activities by setting regulatory framework conditions. Service firms in this cluster benefit from strict environmental regulations and the challenges associated with them. As mentioned at the beginning of the chapter, clusters are not separate systems but overlap with each other. The environmental cluster can be viewed as highly integrated with other clusters since it provides environmental services not only to one specific sector but to a variety of sectors, such as the pulp and paper or chemical industries. Also, ESCOs, which were referred to in the previous section, can be considered as environmental firms, as they try to help their customers avoid wasting energy.

KIBS and the Environment Cluster. Most of the companies that were contacted for this study could be described as knowledge-intensive business services, chiefly in the consulting and environmental audit area. For instance, they provide water and wastewater management solutions to private and public customers (KemWater), or carry out environmental analyses and various standardised tests of samples (see, for instance, Ekolab, a Helsinki-based consultancy). Another company provides distance-control and monitoring services tanks, separators and septic systems (e.g. Labko).[20]

Technology-enabled services. As in many other clusters, information technology has had a considerable impact. New environmental services have been developed based on IT. The online monitoring system for environmental applications in the case study is an example for this. Labko used to manufacture septic and separator systems, closed tanks and control units. Often the experience was that alarms went off unnoticed. The data transfer system that the company developed helps avoid this by providing remote control and online monitoring. Certain readouts can even be sent to mobile phones as text messages. Apart from ICT, sophisticated instrumentation is necessary to conduct environmental analyses. In this sense, they also enable services.

The role of services in manufacturing and technology enterprises. The outsourcing of certain parts of services in water utilities offers established organisations a chance to explore and develop new markets. The case of Kemira Water Services is an example of this development. Here the company, together with the Helsinki Water utility, provides solutions for water and wastewater management. Also, consultancy firms have discovered this area to be an interesting market with promising business opportunities. For instance, another partner of Kemira Water Services in a collaborative project in Haapavesi is YIT. There are several drivers of this development, another one being the process of privatisation that has already begun. A further reason for moving into this area may be that the coagulant market, which is the traditional market of the company, is mature and does not offer any growth potential.

20 Research and development is another KIBS activity. In one of the cases studied, potential difficulties were mentioned with respect to publicly funded research and development projects. Companies offering this type of KIBS may face competition from public-sector research organisations when bidding for Tekes R&D projects. At times, they feel that they are to a certain extent in a weaker position than public institutes because of different budgetary rules. The Appendix contains more information.

4.2.6 The Metal Cluster

This section uses the example of steel and ICT to illustrate how technology can change the mode in which an industry operates. It attempts to show how ICT can facilitate the transformation of steel producers into service-oriented providers of solutions, and radically alter the business model of an industry where firms in the end may even decide to outsource their historical core – steel production.

During the last decade, the steel industry has evolved from government-owned and local, to privately owned and regional. The industry is still fragmented globally. Further concentration will be driven by the need to increase competitiveness, strengthen cost positions, gain improved access to capital and pursue aggressive growth plans.

A study by Arthur D. Little identified four trends to which steel producers are exposed (Exhibit 40):

- The steel industry is consolidating, driven by improved access to capital and aggressive growth plans by major companies;
- Steel customers increasingly demand total solutions and co-development skills from their steel suppliers. The increased value-added processing that they demand must be delivered by steel manufacturers with significantly shorter lead times and with greater technical support;
- Steel manufacturers are forging closer links with key customers through value-added processing and exemplary service;
- The demarcations between distributor and processor and between purchasing and processing are dissolving, while major players occupy a larger share in certain parts of the value chain.

Like in other clusters, cost structures have historically contributed to the manner in which companies organised themselves. As a result, basic production processes, such as iron and steel making, casting, hot and cold rolling and finishing, determined the primary organisational entities, leading to any number of business units. The consequence of such an organisation is that "the end product or applications, such as packaging or automotive processes, determine informal structures superimposed on this one". Exhibit 40 illustrates the structure. However, this traditional model does not allow the steel producer to meet customers' expectations anymore. The outlined trends, especially total solutions, require the steel industry to develop new products and applications. Here, knowledge must be seen as a strategic asset. In order to provide comprehensive solutions, steel producers have to know also about end-users' requirements:

> *"In this changing business climate, the steel manufacturer may come to view its offering not in tonnes of steel but as automotive body sheets, or even door panels. … The customer does not just want automotive body sheets; he wants the complete functionality around steel manufacturing."*

The need for total solutions makes the customer more willing to outsource some of his or her activities. In order to deliver complete solutions, the steel producer needs to build up and integrate competencies in areas outside its traditional skill base. Closer relationships with customers and, eventually, partnerships in procurement, product innovation and development, and marketing are the result of such a development, in addition to becoming involved in areas related to steel:

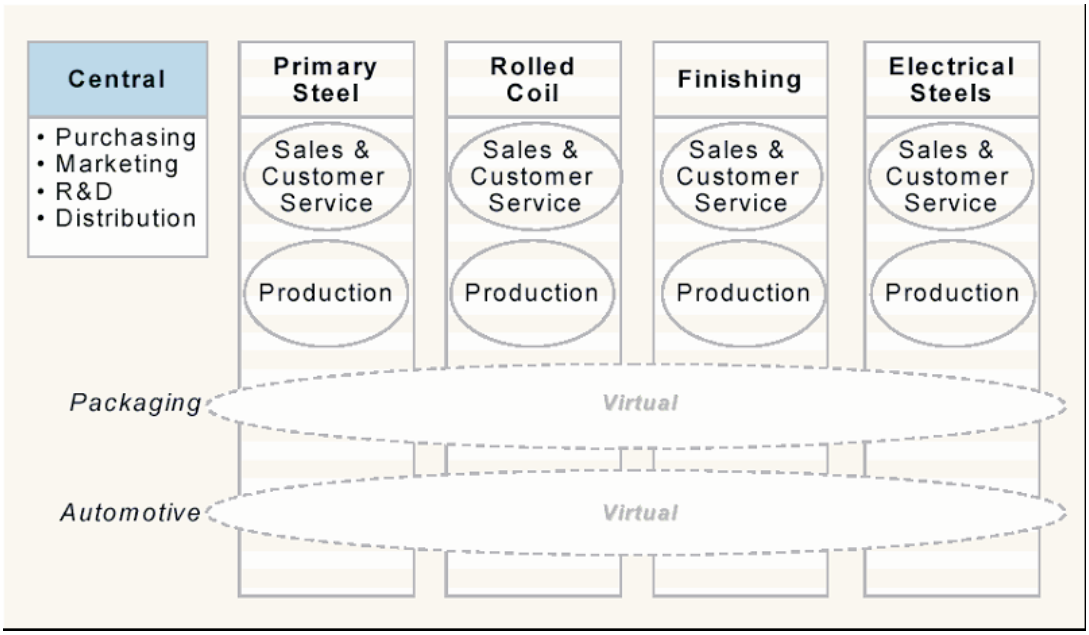


Exhibit 40. Traditional steel producer (ADL).

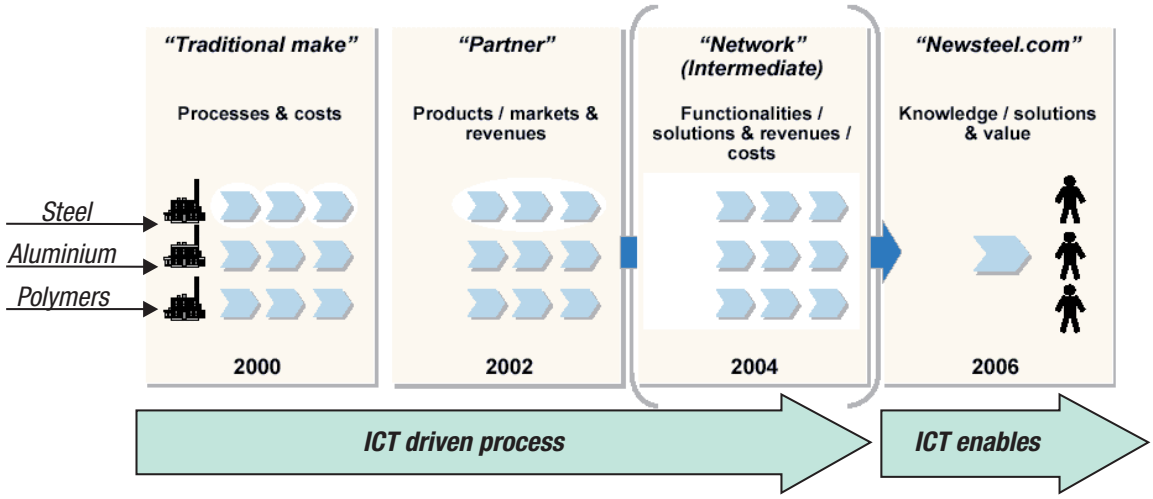


Exhibit 41. New business model (adapted from ADL).

> *"A logical next step would be to create knowledge networks with aluminium companies or design and construction firms. Once parts of the traditional steel manufacturer value chain have become part of industry networks, roles and responsibilities will be altered permanently. It is not inconceivable that in response, traditional steel producers will transfer their production assets to other internal areas or other firms. Development and marketing will then become their core activities. At that point, the steel manufacturer has transformed from a producer of base or special products into a seller of knowledge and solutions."*

The evolutionary nature of this business model is illustrated in Exhibit 41.

4.2.7 Summary

The accounts of developments in several clusters have underlined a number of points:

- The *pervasiveness of ICT integration* in almost all of the clusters studied. ICTs have facilitated the development of new services and are still being integrated. ICT has revolutionised value chains by, at least principally, enabling access to information about any point or process from anywhere else in the cluster.
- *Formation of networks.* ICT integration allows services to be integrated across the value chain. In many instances, actors concentrate on core competencies while maintaining and further developing product offers that range across the value chain to facilitate outsourcing. This requires them to have strategic alliances.
- *Concentration.* An alternative to strategic alliances is to merge with companies that offer complementary services to one company that has a broader coverage of the value chain.
- *Blurring of boundaries.* The move of ICTs into almost all areas of business life also leads to less clear boundaries. Examples of this development were given explicitly in the report on the ICT cluster but there were numerous other examples to be found in the other sections. IT capabilities often have to be matched with specialist knowledge in one area of application in order to achieve and maintain a competitive advantage.
- The *digitalisation of contents* is a complementary development to blurring boundaries.
- *Increasing service contents of products.* Throughout, a number of clusters reports pointed to a higher degree of service contents. For instance, this was the case for the forest cluster, in which consulting and data processing services become more important. In addition, established firms try to develop new service products, such as the operation or maintenance of production processes, that are based on their previous experience of building and operating plants. This was especially illustrated in the energy and environment clusters.

Exhibit 42 summarises the developments that we observed in the various clusters studied. It should be noted that not all important clusters could be reviewed. Clusters do not operate after the same principle. Whereas some clusters tend to be 'absorptive', others are knowledge-intensifying or self-sufficing. We did not study every cluster type, and this should be considered when interpreting these results. Another point to be considered is that firms in a given industry do not all exhibit similar patterns of innovativeness or follow the same business logic. These differences also have to be considered. The next section looks at such issues in more detail.

Exhibit 42. Industry clusters.

Cluster	Value Chain	Service Development Role of KIBS	Drivers	Use of ICT-enabled Services
Logistics	Tendency to extend service offer across the value chain (leading to M&As or strategic alliances)	Service packages, integration across the value chain; cost saving agreements to stimulate outsourcing; increased customer orientation	IT; competitive environment	Pervasive, information sharing viewed as core element of new paradigm, information sharing between all actors in the value chain
ICT	Convergence of networks, terminals and services Integration of software and content producers	Blurring of boundaries; trend towards integration with management consultancy; increasing specialisation of ICT services	Digitalisation of content; Technological development: advanced users	
Life sciences	'One-industry innovation chain'/ 'self-sufficing' cluster style	KIBS as Competence-Levellers (sector specialists and professional services)	Science-driven IT	Bioinformatics Simulation
Environment		Identifying niches, package service offers; standard components	Traditional markets mature; competition; regulatory framework	Use of the Internet for monitoring
Electricity Supply	Re-integration of energy production and distribution	Identifying niches	Deregulation IT	Automation started early; challenges for integration of IPP in the grid

4.3 Innovation Clusters

The introductory section of this chapter reminded us that while an industry perspective can help identify important patterns, an intra-industry view can also provide useful insights. This section reviews the results of a Swiss study by Hollenstein (2000) that applies statistical cluster analysis to a large set of innovation indicators. As the clustering is indicator-based, the clusters that will emerge are not necessarily along industrial boundaries.

The clustering was based on a variety of innovation indicators that were also meant to capture the non-technical aspects of innovation that are much more important in services than in manufacturing. Five clusters were identified. In a second step, the latter were characterised by using five groups of variables, namely: (1) innovation indicators (partly used already for clustering), (2) the firms' position in knowledge networks' (use of external knowledge sources, R&D out-contracting and co-operative agreements), (3) demand- and supply-side determinants of innovative activity (market perspectives, competitive environment, innovation opportunities, appropriability, human capital endowment), (4) some general characteristics of firms, such as size, export orientation, industry, etc., and (5) measures of firm performance. The description of the five clusters showed that they can be interpreted as specific 'modes of innovation' which have an economically plausible interpretation (Exhibit 43).

Exhibit 43. The five clusters and their shares of firms and employment.

Modes of Innovation	Share of Firms (%)	Share of Employment (%)
1	4	18
2	4	2
3	21	9
4	48	63
5	23	8

4.3.1 Mode 1: Science-based, network-integrated high-tech firms

This cluster includes about 4% of the firms, and accounts for almost 25% of employment. The cluster is characterised by firms specialised in ICT, R&D and professional business services. In addition, banking, insurance and other financial services are also included. Moreover, it is more export-oriented than other clusters. The cluster is characterised by highly qualified staff employed in R&D intensive firms that are embedded in an environment that offers technological opportunities and market perspectives. In-house R&D is supported by the intensive use of science-related external knowledge sources as well as many institutionalised R&D co-operations (and research contracts), with domestic and foreign universities as the main partners. The innovation output consists in many instances of products/processes that are new to the industry and are protected by patents (accompanied by granting of licences). The sales share of new products is high (partly due to a significant number of young firms) though sales have to be realised in a very competitive environment (primarily non-price competition). While labour productivity is distinctly below average, growth performance is better in terms of sales (about average) and very strong with respect to employment.

4.3.2 Mode 2: IT-oriented, outward-looking developers

IT/R&D services, together with banking/insurance/other financial services, shape this cluster of outward-looking and information technology-oriented developers.[21] The cluster is characterised by a highly qualified labour force as well as high investments in development and information technology, yet expenditure on research is relatively low. The cluster is small, accounting for 4% of the population and 2% of the workforce.

Product and process innovations dominate the cluster; they are of high technical standard and, in many instances, new to the industry. Patenting and licensing are common and encompass technology-oriented inventions, which are characterised by a high IT content as well as a strong potential for cost reductions. The cluster firms are intensive users of manifold sources of external knowledge (suppliers of software and investment goods, universities, competitors and other firms of the same enterprise group). Outsourcing does play an important role. Among the more formal knowledge links, out-contracting of R&D (at home as well as abroad) and the use of licenses are of higher importance than more far-reaching co-operations. Medium-sized and export-oriented firms are distinctly more common in this cluster than in services as a whole. The value added per employee in this cluster is on average higher than in the others; growth of sales and employment, however, is lower than in services as a whole.

4.3.3 Mode 3: Market-oriented, inward-looking incremental innovators

This cluster of incremental innovators with both an internal and a market focus is distributed across industries. Business services and the wholesale trade are overrepresented in this cluster. Only a few firms are active in transport and telecommunications. The cluster accounts for 21% of the total population and 9% of employment. The innovation input is rather low. Innovative activities of the firms profit strongly from very favourable market perspectives. The firms generate primarily incremental product and process innovations; the IT content is high.

The innovation output is of high value in economic and technological terms and is successfully brought to the marketplace despite strong competition. The networking is described as rather weak; only market-oriented knowledge sources (users, software suppliers) and easily accessible knowledge sources (fairs/exhibitions, computer-based networks) are of some importance. The cluster is also characterised by (very) small firms with average export orientation accounts. The labour productivity of this innovation mode is high, whereas growth of sales and employment are not more than average.

4.3.4 Mode 4: Cost-reducing, value chain-oriented process innovators

This cluster is by far the largest one. It comprises 48% of the firms, and 63% of employment. Large firms are somewhat over-represented in this cluster, very small ones distinctly under-represented, and export orientation is rather low. The cluster is characterised by strong price competition and only average market growth. The focus of innovative activities in this cluster is on process innovations (and corresponding cost-reductions), which are predominantly incremental. Innovation input concentrates on IT- and innovation-related follow-up investments, all components of which seem to be of high relevance (machinery, external knowledge, training, marketing). The technological and economic significance of innovation output is high. However, it is frequently based on further developments of already existing products/processes.

The firms' own innovative activity strongly benefits from a wide (primarily informal) network which spans the value chain - from suppliers (of software in particular) at one end to users at the other, with strong links to different partners in between (consultancy firms, competitors/firms of the

21 Retail trade, hotels/-restaurants and real estate are underrepresented in this cluster. These services are generally characterized by a rather low innovation intensity.

same industry, fairs/exhibitions, computer-based networks, professional conferences). Institutionalised co-operation (R&D contracts, R&D co-operation) is only of average importance. Labour productivity is average, but the growth of sales and employment is much higher than in all other clusters with one exception (employment growth in cluster 1).

4.3.5 Mode 5: Low-profile, inward-looking innovators

This cluster comprises 23% of firms and 9% of employees. It is dominated by small firms, which have an over-proportional share, and most of them produce for domestic markets. Other firms in this cluster include personal services, real estate, hotels/restaurants, retail trade and transport. This group is characterised by a low or only moderate innovation intensity. Also, the (average) economic performance (level, growth) is low. (Process) innovations appear quite marginal. Other characteristics of the cluster include weak demand perspectives, strong price competition, low appropriability and innovation opportunities, and relatively poor human capital endowment.

Firms in this cluster have to adapt rather than innovate in the original sense of the word. The adoption of novelties generated elsewhere was found to be the most important form of innovation. Innovation input is mainly restricted to buying machinery/equipment. The use of external knowledge, which is distinctly below average for almost all sources, is concentrated on suppliers and competitors.

4.3.6 Summary

The previous cluster study has shown that distinctive innovation modes can occur in the same industries. This is not a surprising result in light of case studies.[22] Exhibit 44 presents a summary of the major results. The five modes are put in a certain order. Mode 1 is the most innovative service cluster. It has a high innovation output and is relatively export-oriented and the staff are highly qualified. At the other end, Mode 5 describes services that are transaction-focused and tend to adopt and use innovations rather than create them.

4.4 Discussion

The first section of this chapter has emphasised the importance of KIBS for innovation. This finding is in line with numerous other studies (e.g. OECD, 1999; Leiponen, 2000). Innovation activity consists primarily of producing and exchanging intangible inputs and outputs characteristic of the business activities in services industries. This was particularly so for the life science cluster. The forest cluster also illustrated the increasing importance of consulting and engineering services.

While we tried to identify a number of common developments between the clusters, we also noted differences. In particular, the second part of this chapter pointed to differences in innovativeness. KIBS are closely linked to innovation as facilitators. One finding of the statistical review

Exhibit 44. Innovation modes, industry, and innovation focus.

22 For instance, Southwest Airlines is often cited as an example of how carriers can be profitable after September 11. In an industry in which all players provide the same basic service, an operator can make a difference by offering a high standard of service quality.

in Chapter 2 pointed to an unbalanced regional distribution of KIBS across Finland. This raises the question of the extent to which there is a need to promote a higher intensity of KIBS activities in the regions.

However, KIBS may not always be capable of furthering regional development. Whether or not knowledge-intensive business services are of particular use may also depend on the nature of clusters that are predominant in the region. KIBS may suit more science-intensive regional innovation systems rather than regions that fit the learning economy model.

While regions with large university towns certainly rely on a great number of services that are commonly associated with KIBS, the situation may be different for regions that function after the learning economy concept. Here, the effort may be on attracting a large firm. Certainly, this may also involve a certain degree of knowledge-intensive activities but, in this case, the regional infrastructure may not be depending on KIBS as facilitators of innovation and mediators between innovators to the same extent as do science-intensive regions.

Another finding from the second part of this chapter underlines this. We made a distinction between more innovative and more transaction-focused clusters. Naturally, innovation and transaction clusters are not categories that could be clearly separated from each other. Yet actors in these clusters may be differently linked to each other and their business environment. This may be so because transactions tend to reflect business-to-business relations within value chains, whereas innovation clusters are intangible information networks that also comprise many non-profit organisations, universities and public R&D centres, or other institutions.

5 Summary and Conclusions

Our study examined services and innovation in the knowledge economy context from a range of different perspectives. The examination presented covers a range of service and innovation issues, including conceptual approaches to service innovation, a statistical analysis of services, and a discussion on services and industry clusters. These sections are based on existing literature, available statistics and primary interview material with industry experts and researchers.

The overall implication is that there is a need for a better understanding of the service innovation process. Many of the features will not be revealed in the existing aggregate-level statistics, nor in the limited data available on business-level processes. In particular, tacit knowledge transfer, joint problem solving and the incremental nature of service innovation constitute challenges for further research. A combination of well-targeted survey data on business-level issues and in-depth qualitative research are suggested as a method of shedding light on the key features of service innovation.

5.1 Emerging integrative approach to innovation

The evolving division of labour is the underlying development influencing the knowledge society. Complex technological and economic processes, as well as a push towards better productivity, continue to be drivers of specialisation. While businesses outsource an increasing share of their processes, service-like activities proliferate. Typically core manufacturing activities represent a diminishing share of the business processes, and at the same time, the role of core and peripheral services becomes more prominent. In such a situation, the boundaries between products and services become blurred to the extent that we can speak about convergence of the grand sectors of the economy. Even traditional manufacturing develops service-like features, while services 'industrialise' through modularisation, and the increasing standardisation of the processes. The structural changes create a demand for an integrative approach that can address all forms of innovation, whether they are new or improved products, services, processes, organisations or approaches to markets. Traditional innovation models have ignored many 'soft', non-technological dimensions that are essential for service innovations. The currently evolving integrative innovation approach will address technologies that are increasingly pervasive across the industries, as well as various service innovation features that are becoming familiar in manufacturing. The challenge for the integrative innovation approach is the enormous scale of issues and industries that need to be addressed. They face a swath of innovations related to new products, services, processes and delivery modes, organisational issues, and market innovations. In addition, services themselves are an extremely heterogeneous group of activities spanning a large number of industries. Despite the above-mentioned challenges, the potential benefits of integrative innovation models are obvious and are worth pursuing.

5.1.1 Service innovation process

Service innovations need to be seen in the context of the evolving division of labour. Under such conditions, the innovation process becomes distributed in nature and many innovation-driving contributions (information and knowledge) come from suppliers, buyers and external experts. In comparison to traditional manufacturing-related innovation, this situation is changing the balance between internal and external knowledge acquisition and innovative capability. Service innovation features create special challenges for organisations. Typically they can be characterised as customer-specific solutions, based on new combinations of existing service activities. Hence, service innovations are developing incrementally through an informal process that focuses on joint problem solving with the customer. Tacit knowledge changes play an important role in the process, and often the success of a new service depends on the absorptive capability of the client as well as the innovative capability of the supplier. Proactive service and technology development becomes possible only when sufficient attention is paid to the end-users, who ideally become involved in the new service development process.

Knowledge-intensive service activities have a role as carriers, shapers and communicators of innovation. New-technology-based KIBS are of particular interest in the context of the innovation process since they rely heavily on the professional knowledge of scientists, engineers and other experts. This type of knowledge-intensive service provides information and knowledge to KIBS users, intermediate inputs to the client's own knowledge generation, and specialised knowledge for other technical functions. Knowledge-intensive services can influence innovations across the industries and they represent a rapidly growing sub-

sector of services. Their growth reflects increased demands for specialised knowledge and such specialised services are also playing a prominent role in knowledge accumulation and transfer. Specialisation and distributed knowledge production are also creating a demand for integrative services that can solve problems created by the decentralised knowledge markets.

5.1.2 Drivers and barriers of service innovations

The heterogeneity of service activities and related innovations also offers room for a wide variety of service innovation drivers. Even if customer interaction represents a major source of service innovations, *technology push* is also a key driver of innovations. In particular, ICTs as a generic technology have a central role, since they enable numerous new types of services and delivery modes. *Regulatory changes* have a significant impact on new service development. Deregulation and increasing competition have created a flow of new services in the affected industries. Industries affected by increasing regulation create an equally robust market for new types of consulting services as the complex regulations and their impacts need to be interpreted. Increasingly *systematic development of new services* is beginning to emerge as a service innovation driver, because more attention is given to modularity and scalability of services. *Industry champions* are setting an example for the business community in terms of a highly effective industrial system, based on the balanced development of the core product technology, sustainable revenue logic and service development. Typical *barriers to service innovations* include lack of competition, over-supply of services, an unfavourable business cycle, rigid industry structures and shortages of skilled staff. A lack of resources and funding, as well as the general characteristics of services, such as intangibility and context specificity, can also slow down innovations.

5.1.3 The impact of services on industry cluster development

The industry cluster studies illustrate the importance of KIBS, particularly for those sectors that are science-based. Various factors play a role in this development. In some instances, KIBS are industry-specific, in other cases they are not but they do provide support via their expertise in an area that is relevant to players in the cluster. The life science cluster described various types of professional services and illustrated how they contribute to the functioning of the innovation chain. The rise of KIBS goes hand in hand with an overall increase in service intensity. This development can be related to a number of factors. One of them is certainly the fact that established markets do not offer considerable growth potential anymore, or that markets become so competitive that manufacturing firms begin to develop 'total solutions' for their customers. Technology-enabled services are also important. The integration of ICTs facilitates new services or at least allows new combinations of existing services. This pattern was evident in most clusters under examination.

The cluster analysis has illustrated that distinctive innovation modes can occur in the same industries. The following categories were identified in a statistical analysis:

- *Science-based, network-integrated high-tech firms.* The segment is characterised by firms specialised in ICT, R&D and professional business services. Firms are more export-oriented than other groups and are characterised by highly qualified staff. These are R&D intensive firms that are embedded in an environment that offers technological opportunities and market perspectives. In-house R&D is supported by an intensive use of science-related external knowledge sources.
- The *IT-oriented, outward-looking developers* segment is characterised by a highly qualified labour force as well as high investments in development and information technology, yet expenditure on research is relatively low.
- *Market-oriented, inward-looking incremental innovators.* These firms are incremental innovators with both an internal and a market focus. The innovation input of the segment is rather low but the innovative activities of the firms profit strongly from very favourable market perspectives; the IT content is high. The focus of innovative activities is on process innovations (and corresponding cost-reductions), which are predominantly incremental.
- The *low-profile, inward-looking innovators* segment is dominated by small firms that have an over-proportional share, and most of them produce for domestic markets. This group is characterised by a low or only moderate innovation intensity and a low average economic performance level. Firms in this cluster tend to adapt rather than innovate in the original sense of the word.

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Eiglier, Pierre	University of AIX-en-Provence
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Appendix A

Customer involvement in service provision

Concept	Meaning
Interface	Physical or virtual point of contact between a customer and a service provider (or its technical system)
Interaction	Exchanges of information, knowledge and civilities, performance of sales and after-sales activities
Co-production	Extensive and balanced interaction (essentially operational)
Servuction	The process of creating a service by linking up various elements: the customer, the physical medium, contact personnel, the service, the system of internal organisation, other customers
Socially regulated service relationship	Manifestation of new forms of the social regulation of relationships between producers and consumers
Service relationship	'Mode of co-ordination of the actors on the supply and demand sides' for services or for goods. Operational relationships (Co-production) + social relationships for the control and regulation of the action programme

Adopted from: Gallouj, 2002: 39.

Appendix B

The mechanisms of use of knowledge transfer channels in manufacturing and services

Channel	Manufacturing	Services
Suppliers	Suppliers are a source of knowledge embodied in machines and/or related to machines usage and maintenance.	Suppliers of ICT-related capital goods are especially important in services, as much innovation in services is mediated by ICT.
Foreign direct	Access to new/complementary local knowledge and skills in gained by establishing presence abroad.	In services this channel is even more important than in manufacturing due to specificity of the mode of service delivery.
Licensing	Both the technology supplier and the technology recipient gain access to each other´s knowledge (more technological in nature in the case of the latter and more local market-related in the case of the former).	Franchising as a form of licensing is a transfer channel in non-technical services. Licensing as such is more relevant for Software industry than for other services.
Links with academy	Technical expertise from academy is most relevant for manufacturing	Health, banking and logistical services often innovate with the help of academic Knowledge; other services are less likely to Use academic research on a wide scale.
Training	Training is important, but not to the same extent than in services. Manufacturing companies do not accentuate training in interpersonal skills. Technical skills are a priority.	This channel is more important for services due to employees´ direct involvement with customers in most services.
Intracompany strategic knowledge management	Intranet and technologies alike enable efficient communication amongst employees, exchange of message and data files, participation in computer conferencing and so on.	Service firms practice intra-firm knowledge and information exchange by electronic means to the same extent as manugacturing firms.
Producer-consumer two-way knowledge transfer	Producers often train customers to use complex equipment. Consumers´ knowledge can be involved at the design stage for an individualized order.	This channel has a greater importance in services as compared to manufacturing. since consumers are often both “co-producers” and “co-innovators”.
Knowledge intensive business services	Manufacturing firms use KIBS and TKIBS in general rather extensively.	KIBS in a broad sense can be seen as useful for all types of services, whereas T-KIBS are mostly needed in technical services such as computer, engineering and others.
Human capital mobility	This is a transfer channel for diffusion of tacit knowledge which is valuable in itself and also for spread of innovative codified knowledge.	This channel is of great importance for services as well: tacit knowledge in terms of interpersonal skills and know-how generally are crucial for many services.
Patents	Due to “disclosure” requirement patents become a means of knowledge transfer from inventor to the public(other firms and so on).	This channel is less important for service industries. Software is so far the only Service industry where patents are a channel of knowledge transfer.
Internet	Manufacturing firms use Internet to receive information and knowledge about suppliers, competitors, potential customers and regulations.	Service firms use Internet for the same purposes and to the same extent. An additional function of online service delivery is present in services (this can coincide with knowledge transfer as in online consultancy, for instance).

Source: Cowan et al., (2001).

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