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Knowledge-intensive Services and Competitiveness of the Forest Cluster: The Case of Finland

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Abstract

New technologies in the globalized business environment are shaping competitive strategies in unprecedented ways. As important as the race for developing more advanced ICT products is the ability to convert these advances into a higher productivity of the assets in other economic activities. This holds true also for the business services, which assume a major role in the ongoing industrial restructuring, and as a source of competitiveness.

Given these stylized facts this report examines the relations between services, manufacturing, technological progress and organizational factors, which generate competitiveness in industrial clusters. Among manufacturing sectors the forest industry is used here as a special case. Much of the existing literature concentrates on the competitiveness impacts of ICT investments made by the manufacturing sector. Our argument is that even a higher potential can be found in a specific indirect effect, that is, the ICT-based services used as production inputs. The realization of the potential depends on the governance of service transactions.

Any attempt to characterize the changing role of services should also recognize the changing contents of services — or the way they are produced and provided. Technological changes and new forms of competition are forging our understanding of the very nature of economic activities and the factors differentiating industries. While progress towards a service economy is taking place, there are various ways to interpret the change.

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About the Author

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Knowledge-intensive Services and Competitiveness of the Forest Cluster: The Case of Finland

Esa Viitamo

1 Introduction

1.1 Towards the New Economy

The notion that advanced economies had entered a new era in which services have replaced manufacturing as an engine of economic growth became widespread by the late 1960s. The growing role of services reflects the evolving division of labor driven by the search for better factor productivity. In the 1990s, this development was further facilitated by knowledge-intensive information and communication technologies (ICT). Consequently, increasingly service-intensive, globally integrated economic systems have developed.[1]

Aside the debate on the different scenarios, empirical evidence confirms that the change described above is indeed taking place, in some small Organization for Economic Cooperation and Development (OECD) countries in particular. Interestingly, countries with a substantial forest sector — Finland and Sweden — are showing the most rapid growth in communication technologies, while Hungary and Ireland — with the most fundamental structural change and successful foreign direct investment (FDI) policy — have experienced the fastest growth in computer-related industries.

Associated with this development there is a growing interest on the impacts of ICT on economic growth in general and productivity growth in industrial subsectors. For instance, there is some indication that the more countries invest in ICT the higher the share is of the productivity increase that results from these investments. However, there seems to be no clear positive correlation between the size of the ICT sector and the overall productivity level of the manufacturing sector across countries (Colecchia and Sheyrer, 2001).

[1] The recent financial crisis of the ICT sector has also provoked critical assessments on whether the change is sustainable and if the new economy relying mostly on services is attainable in the first place. There are two main grounds for these suspicions. First, due to the high importance of intangibles and the future expectations, the technological core of the knowledge-intensive business services (KIBS) is constantly exposed to speculative shocks. Second, it is intuitively clear that no economic system can survive if based on transactions of services only.

In absolute terms ICT possesses a vast potential to improve the efficiency — or productivity — of production processes, governance structures and logistics in various ways. This enables enterprises to adopt multitude competitive strategies. The direct effects result from investments in new equipment, embedded software systems, and ICT services produced either internally or externally (Knowledge Intensive Service Activities, KISA). The main sources of indirect effects are externally purchased service inputs based on ICT applications (Viitamo, 2000). The point made here is that the indirect effects are central in assessing the actual productivity and competitiveness impacts of ICT.

Besides the permeable role of ICT on all industrial sectors, several other fundamental trends in technological change and in business development also affect industrial developments and the dynamics of industrial innovation. In conceptual developments of businesses, the "product-to-service" concept is expected to become gradually dominant. According to this concept, companies will produce for customers primarily intangible services via products rather than merely traditional tangible products.

1.2 Objectives of the Study

This study, conducted by Etlatieto Oy, is part of the international KISA research activity initiated by OECD. In Finland, the activity is organized and funded by the National Technology Agency (TEKES). The purpose here is to explore the role of services in the forest cluster and how new information technologies, utilized in the production and delivery of services, affect the competitiveness of Finnish forest industries. In doing so, the competitiveness impacts are analyzed in the industrial cluster framework.

More specifically, the objective of the study is to shed light on less explored facets of the service sector contributing to a focused industrial policy design and implementation. We will introduce a new operational taxonomy on business services, which takes into account the alternative settings (internal and external production) and the growth channels and opportunities, accordingly. It will be pointed out that growth is most effective when service-intensity of the production processes and the knowledge-intensity of services can be increased. These two intensity concepts have bearings on the industrial competitiveness, for which we will construct an analytical model. Finally, as an empirical application of the approach, the Finnish forest industry will be used as a special case.

The study is organized as follows. Section 2 gives an overview on the ongoing trends characterizing the global forest industry and the position and structural changes of the forest cluster in Finland. Based on descriptive statistics, Section 3 investigates the role of services in the manufacturing of forest products and the changes in the service-intensity of the production processes. Employment effects of the forest industry on the service sector are also assessed. Within a constructed framework the competitiveness impacts of strategically most important services activities are analyzed in Section 4. Conclusions and policy implications are discussed thereafter in Section 5.

2 Industrial Dynamics

2.1 International Setting

From an international perspective, forest-based industries are facing an increasingly dynamic operating environment, which will essentially alter business practices and organizational structures. Globalization of enterprises and markets is shading away the borders of national forest clusters intensifying the competition between nations and governments on future investments and the location of production.

2.1.1 Globalized Competition

Clusterization with its competitiveness impacts is most pervasive in wider economic and political blocs as the European Union (EU). For small nations in particular, the participation in multilateral arrangements has become imperative to maintain the sustainable competitiveness of the national forest cluster activities. Consequently, policy design and implementation in the intergovernmental level will have a profound influence on the competitiveness of cross-border clusters. This will be manifested in regional specialization and restructuring of the cluster activities.

Globalization proceeds hand-in-hand with the concentration of business activity driven by the maturity of markets in the industrialized countries and the search for new business opportunities in the evolving market economies. While forest industries are lagging far behind, high concentration ratios can be found in several supporting industries of the forest cluster, e.g., machinery building, process control and specific software.

Regarding the acquisitions in the forest industries the most active companies are North American and Nordic pulp and paper producers.[2] Their experience demonstrates the interaction between the liberalized capital markets and the uncertainties of the global business environment. Mistakes in acquisitions and investments programs are immediately reflected by lowered share values encouraging rivals to hostile takeovers. Today's winners may be tomorrow's losers.

Globalization and the growth of multinationals are boosted by the development of ICT and its application in business operations of the forest industry and supporting industries and services. On the market side, eCommerce is changing marketing strategies and traditional distribution channels (Obersteiner and Nilsson, 2000) altering the demand patterns, too.[3] This is fostered by the aging population in the Western world. ICT technologies used in the production processes and production of externally purchased services are changing optimal governance structures. This is reflected in gradual outsourcing of production and service activities in the national forest clusters.

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[2] For example, Finnish, Swedish and Norwegian companies own approximately 50% of the European pulp and paper capacity and the trend is continuing.

[3] For example, on the paper markets printing and writing papers are increasingly substituted for newsprint (Hetemäki, 2001).

2.1.2 Sustainable Competitiveness

Evolving environmental consciousness and striving for a common regulation, reshape the competitive positions of countries and trade blocs and the competitiveness of the forest-based products relative to substituting products. At the same time, the interpretations of industrial competitiveness are increasingly encompassing also sustainability or eco-efficiency. This implies reduced exploitation of natural resources, lower emissions and the ability to translate these actions into higher income through marketing and changed images of consumers.

There are vast challenges and opportunities in adapting to the demands for ecological products and processes. Commitments to international agreements on greenhouse gases, like the Kyoto Protocol, will inevitably change the competitive positions on national forest-based industries. Binding agreements to increase investments in emission reduction may punish countries with eco-efficient energy and manufacturing infrastructures and favor less eco-efficient countries. However, if the neutrality of the closeness of the carbon cycle in the forest sector is included, the countries with extensive forest industries may gain by a better competitive position.

In spite of the low-tech characteristics of forest-based industries, they possess a huge potential in creating sustainable competitiveness, not only between countries but also globally, in relation to other industrial sectors. Forest products are carbon storages and the evolving technologies in carbon scrubbing in combustion processes may even lead to negative emissions. A precondition for that is responsible forest management based on credible intergovernmental agreements. Whilst illegal logging is a major threat for the forest cluster worldwide, evolving ICT-based solutions like remote sensing and Geographic Information Systems (GIS) provide control and verification devices.

2.2 Forest Industries and Forest Cluster in the Finnish Economy

While forest-based industries have been the backbone of the Finnish industrial structure for more than one hundred years, their relative importance in generating export revenue is decreasing. The structural change accelerated towards the end of the 1990s. This resulted from a rapid growth in other manufacturing sectors, electrical engineering and the production of telecommunications equipment, in particular. A similar but less profound restructuring has also taken place in Sweden, giving justification for the term Nordic transformation pattern. In Austria and Canada, where forest-based industries are also of high importance, structural change has been less dramatic or non-existent.

A common feature for forest-based industries of these four countries is a high proportion of the primary sector, the pulp and paper industry in particular. Intensive utilization of economies of scale and scope in the pulp and paper production and saw milling industry, favoring geographically and technically integrated production units, is characteristic of the Nordic countries. For instance, more than 50% of the Finnish sawmill capacity is owned by the biggest pulp and paper producers — the Big Three — Stora-Enso, UPM-Kymmene and M-Real, allied with a smaller company Myllykoski.[4]

[4] The fifth biggest paper producer Ahlstrom Corporation has concentrated in specialty papers.

Compared to the Nordic countries, Canadian and Austrian sawmill industries exhibit stronger economies of scope with the panel industry. Excluding the plywood industry in Finland, panel production is showing a shrinking tendency in the Nordic countries.

High export orientation and international competitiveness are the main characteristics of the Finnish primary forest product trade. In 2000, the shares of wood and paper industries in the total manufacturing output were 4.4% and 18%, while the corresponding export shares were 5.2% and 20.8% (see Table 1). For most paper grades, the exports–production ratio exceeds 0.9. Regarding specialization in the forest products trade, Finland outperforms the rest of the world by all indicators, e.g., revealed comparative advantage (RCA) indexes or exports per capita. Internationalization through exports is reaching its limits and the main strategy of growth has shifted to international acquisitions and mergers. Approximately only 40% of the capacity of the Finnish pulp and paper companies is currently located in Finland (FFIF, 2002).

Table 1: Forest industries in the Finnish economy. Source: ETLA (2003).

	1980	**1985**	**1990**	**1995**	**2000**
Share of employment					
Mechanical forest industry %	2.2	1.7	1.5	1.5	1.4
Chemical forest industry %	2.3	2.1	1.9	1.9	1.7
Forest industry total %	4.5	3.8	3.4	3.4	3.1
Share of the manufacturing sector					
Mechanical forest industry %	8.5	5.0	6.2	5.3	4.4
Chemical forest industry %	14.9	13.8	12.8	19.7	18.0
Forest industry total %	23.4	18.8	19.0	25.0	22.4
Share of exports					
Mechanical forest industry %	13.4	7.1	7.1	5.9	5.2
Chemical forest industry %	29.0	29.1	30.5	25.9	20.8
Forest industry total %	42.4	36.2	37.6	33.7	26.1

The maturity of the industrial activity is also illustrated by employment, showing higher losses relative to other industrial sectors. Between 1990 and 1998 the manufacturing sector lost 13% of the jobs while in the forest sector — including forestry — the decrease was as high as 24%. At the same time, the value and volumes of production have smoothly increased resulting in higher labor productivity. As a result of extensive investments at the end of the 1980s and lay-offs thereafter, the highest peak in labor productivity growth was experienced in the years of recession at beginning of the 1990s. Towards the end of the 1990s labor productivity grew moderately still indicating high international competitiveness.[5]

In 2000, the total employment of the Finnish forest sector was 95,000, which accounts for approximately 3% of the total employment (including the service sector). If all forest

[5] This is the case with the pulp and paper industry in particular; between 1995 and 2001 the highest average growth is shown by Austria with 7% followed by Sweden 6.8% and Finland 6.5% (FFIF, 2002).

related business and non-profit activities are taken into account — i.e., the forest cluster — total employment amounts to double (The Research Institute of the Finnish Economy [ETLA] estimates). This is equivalent to 10% of the gross domestic product (GDP) and 40% of the net export revenue. It should be noted that the forest cluster indicators measure only activities, which are directly linked to wood processing. Hence, all indirect and cumulative effects transmitted throughout the economy are excluded. The indirect effects are discussed in Section 2.3.

Stemming from a multitude of competitive factors the historical success of the Finnish forest cluster is impressive. As analyzed in more detail elsewhere (see, e.g., Ojainmaa, 1994), the main driver is the dynamic interaction between competitive advantages and disadvantages, which encourages innovative entrepreneurship. Along with abundant forest resources the most central advantage is the creation of a favorable competitive and cooperative business climate supported by a successful choice of policy strategies. The given disadvantages, harsh climate and long distances have been overcome.[6] An essential but often underrated factor is the insight and foresight of individual managers.

In international comparison, the Finnish forest cluster is well structured, i.e., it embraces most of the supporting and related business and non-profit activities that are central for competitiveness. Several supporting activities are themselves competitive and in many cases are leaders in world markets.[7] This is the case with pulp and paper machine technology, process automation, software, engineering and electrical equipment. Consequently, there are only few intermediary products in which forest industries are reliant on imports. These include, e.g., saw milling machinery and pigments used in the production of coated papers.

Regarding the competitiveness of the forest industry, it has often been stated that import dependence on certain inputs, e.g., for pigments (Seppälä, 2001), is a sign of weakness indicating a preference for self-sufficiency strategy. A counter-argument made here is that reliance on imports reflects the natural specialization of countries and the ability to utilize the efficiency and gains from the international division of labor should instead be taken as strength enhancing the overall competitiveness. The argument is further justified by the fact that nations are losing the relevance as basic units of cluster analysis.

The potential for expanding the Finnish forest cluster is shifting from the core activities — processing of wood — towards the supporting industries and the associated services. Related to the argument above, the success of the supporting industries proliferates the Finnish know-how internationally strengthening the networking of national clusters. Associated with the globalization strategies of the supporting industries, the distinction between goods and services is becoming increasingly obscure. That is, the share of the intangible component — service — of the deliveries is growing. To a lesser extent this is the case with wood processing industries as they offer logistical services to their customers.

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[6] Long distances in Finland and to the markets.

[7] The point here is that ownership does not matter. For example, pulping and steam boiler technology is currently under foreign ownership, Kvaerner (Norway), Andritz (Austria) and Foster Wheeler (USA).

Another way to illustrate the structural change of the forest cluster is to look into the use of wood-based inputs through the forest value chain. In Figure 1, the percentages indicate the share of output in the supplying industry that is needed as an input in the downstream industry. For instance, in 1970 as much as 59% of all inputs in pulp production came from forestry, while in 1994 the share was only 42%. Excluding the by-products flow from sawmills to the pulp industry (see horizontal arrow in Figure 1), the decrease in wood fiber use is also characteristic of the other production stages. This means that forest-based industries have become less wood-intensive, and with respect to raw material flows the value chain is less reliant on the preceding production stages.[8]

An implicit question is: What are the factors affecting this development? Interestingly, much of the explanation goes back to Porterian reasoning. While Finland has been endowed with an abundant raw material base of high quality, raw wood is a scarce resource due to internationally high stumpage prices.[9] Consequently, there has been a push effect for the substitution of other inputs for wood. Or as Porter puts it, competitiveness often results from the disadvantages in the basic factors, which encourages innovations and development of production processes based on more specialized and advanced factors of production (Porter, 1990). This reasoning is also consistent with the increased use of sawdust as a raw material in pulp production.

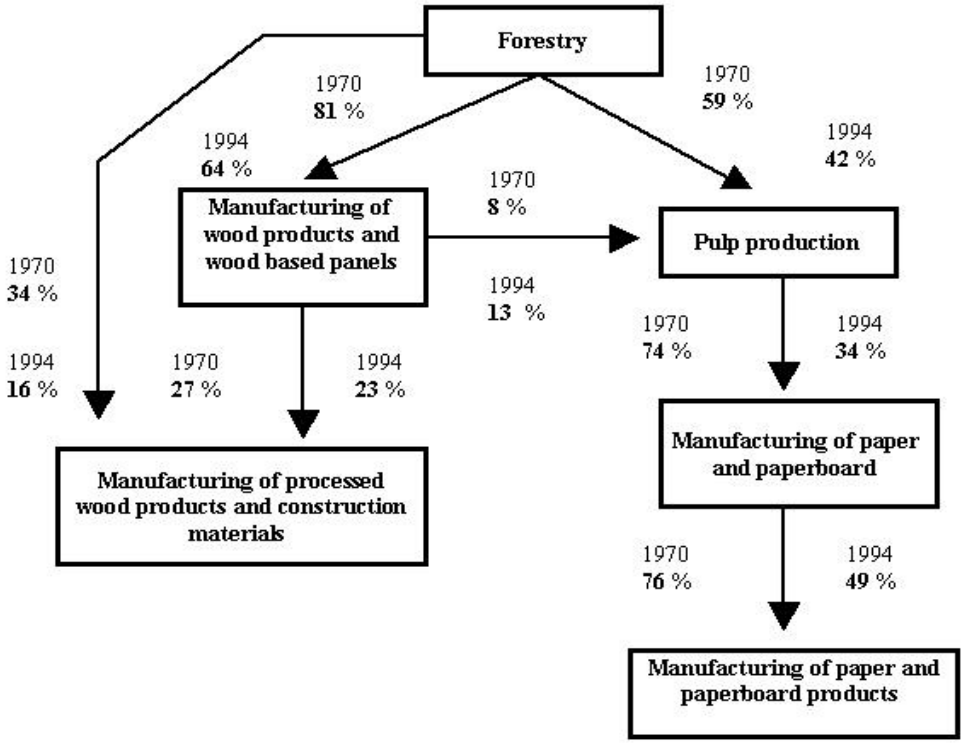


Figure 1: Change of wood fiber contents of the forest sector.

[8] This is hardly a Finnish sequence only, and with country-specific characteristics it reflects technological developments in general.

[9] The reasons can be found in history; dispersed ownership of forests and the bilateral negotiation system on raw wood markets.

A related explanation is the consequent strategy to increase the value-added content of forest products. In particular, this is characteristic of paper production, which focuses on printing and writing papers and coated grades. The production process of these paper grades needs more chemicals and fillings compared to the papers with lower value-added content.[10] In the mechanical forest industry, higher value-added content has also been the goal of the industry, and an explicit objective of industrial policy. The importance of this policy becomes pronounced as competitive pressure from the East European countries becomes stronger.

Related to the substitution of production inputs there are two other tendencies, which will be discussed in more detail in the next subsections. First, in all inputs purchased by the forest industry the share of the intangible inputs has increased, i.e., the production processes have become increasingly *service-intensive*. Second, the growth of the share of services in the input procurement is affected by outsourcing service activities. That is, in-house service activities are replaced by externally purchased services. In general, outsourcing is the primary mode of corporate strategy, which strengthens the service sector and innovative competitiveness of the forest cluster.

Associated with the structural and strategic change of forest cluster activities, the analytical approach and methodologies are also facing a revision. Clusters are not only seen as bundles of interdependent industries with mutual spillovers but the focus is shifting to the ability of business relationships to generate innovations for the maintenance of future competitiveness. In other words, it is not the transaction of tangible or intangible goods but information and innovation linkages, which are the basic determinants in defining clusters and the actual source of industrial competitiveness.

The interpretation of a cluster as an innovation network has its origins in the beginning of the 1980s, as national innovation systems (NIS) were evolving into a separate theoretical framework for the design of technology and science policy (Roelandt and den Hertog, 1999).[11] Innovation activity consists primarily of production and exchange of intangible inputs and outputs characteristic of the business activities in services industries. Consequently, the service sector, which already accounts for over two-thirds of the GDP in developed countries, has gained a prominent position in the new cluster approach and policy. According to the findings of innovation studies (OECD, 1999; Miles, 1998; see also, Leiponen, 2000), knowledge-intensive business services (KIBS) have a central role in producing and disseminating state-of-the-art information.

What is the relative importance of the cluster linkages for the innovation activity? This is depicted in Figure 2, which highlights the similarities and differences between the

[10] For example, in the 1980s and 1990s several newsprint machines were upgraded to produce super calendered (SC) and light weight coated (LWC) papers.

[11] One definition of NIS is that of Metcalfe (1995): *NIS is a set of institutions which jointly and individually contribute to the development and diffusion of new technologies and which provide the framework within which governments form and implement policies to influence the innovation process. As such it is a system of interconnected institutions to create, store and transfer the knowledge, skills and artifacts which define new technologies*.

transaction cluster and the *innovation* cluster for Finnish forest industries.[12] As pointed out in earlier innovation studies (OECD, 1999), large companies with more resources tend to rely more on internal innovation activity than do small and medium-sized enterprises (SMEs). Knowing the company size in the pulp and paper industry, the high score in internal innovation activity supports this kind of reasoning. In this respect, the innovation and transaction clusters seem to be equivalent, since companies are vertically integrated with long internal value chains.

As seen in Figure 2, the greatest divergence between the clusters — in Porterian sense — is in the relative importance of demand conditions, with concentrated customer industries in export markets. While the associated transaction volumes are also high and the innovation patterns vary by country, this divergence demonstrates that NIS are highly interdependent and that the main determinants of competitiveness may lie outside national borders. Moreover, a look at supporting and related industries indicates that *informal* linkages between cluster companies are of considerable importance.

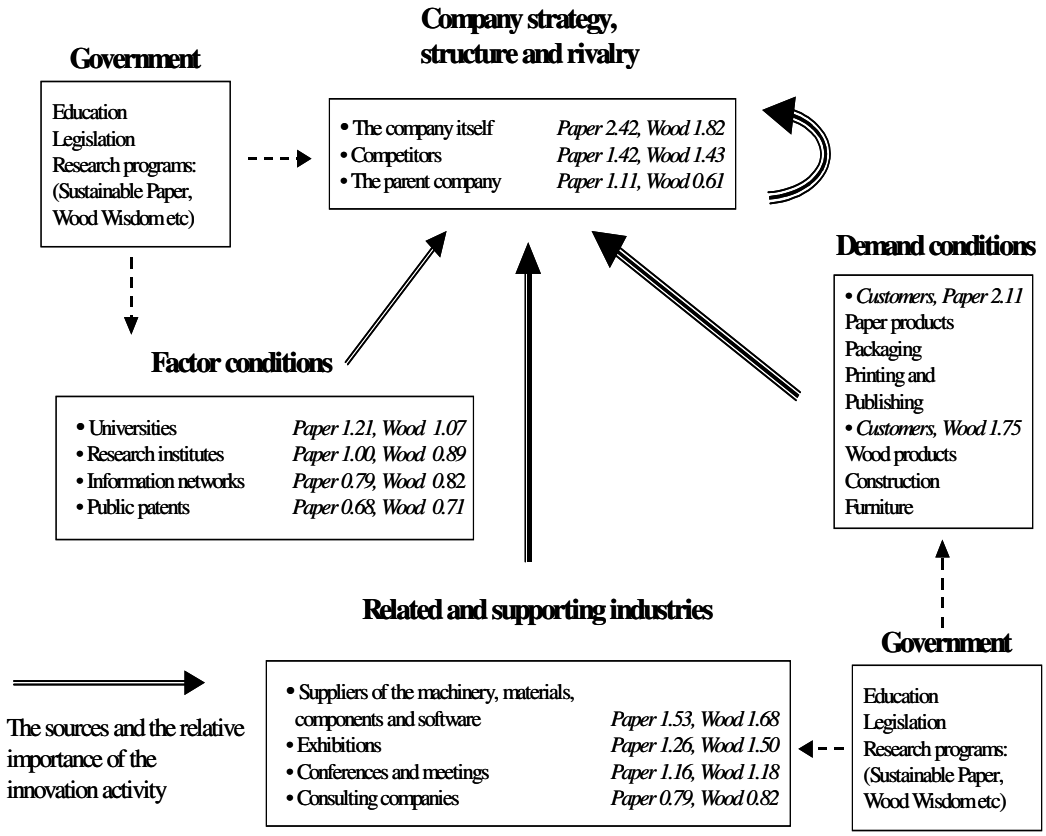


Figure 2: Innovation cluster of the Finnish forest industry. Source: Statistics Finland (1999).

[12] In 1997, Statistics Finland conducted an innovation survey of Finnish industries. Respondents from the companies in the sample were asked to rank alternative sources of innovation by importance (0 = no importance to 3 = very important). The mean scores are shown in Figure 2. It is interesting to note that although the point of departure of this survey was not explicitly the cluster framework, the innovation sources are consistent with Porter's diamond model.

3 The Role of Services — Statistical Evidence

The growth of national economies and employment in Western industrial countries is increasingly based on the service sector, which currently accounts for some 65% of the GDP. Consequently, industrial policy design services are seen as a major vehicle in reaching socioeconomic objectives, and job creation in particular.

3.1 A Conceptual Digression

Broadly understood, services are immaterial outputs supplied by producers (individuals) to the users (individuals). Unlike physical commodities, services cannot be traded on secondary markets, i.e., production and consumption take place simultaneously. In spite of extensive research and political debates on the importance of services, there is no general agreement on the definition per se. There are two interrelated conceptual and statistical problems.

Suppose a manufacturing company decides to outsource the cleaning activity of the mills. That is, instead of keeping hired cleaning workers the cleaning is purchased externally from a specialized supplier. If the workers are employed by the cleaning company to do the same job, nothing but the incentives and probably the costs of the cleaning has changed. Another interpretation is that the service sector has expanded, while the manufacturing sector has shrunk. This implies that a necessary condition for a service is that it is somehow transacted between independent parties.

The other difficulty, also affecting the actual size of the service sector, is caused by the convergence and inseparability of intangible and tangible components of the services and goods. Take, for example, a software company producing and selling program applications to customers with specific needs. The solutions have to be tailored, the personnel for customers have to be trained, the software has to be updated, etc. The marketing is more cost-effective if the software company offers the software and the services as standardized packages possessing the characteristics of a commodity.

The manufacturing sector is experiencing a similar change. In the metal product industries and in machinery building in particular, the growing share of the turnover is generated outside the manufacturing activities. In the forest cluster, the supporting machinery industries are facing a transformation to engineering houses, hence entering the markets of specialized service companies. The change proceeds in two ways: first, as the business is becoming increasingly global it is profitable to outsource the production of components to local workshops. What finally remain are the core competences of engineering and technical design. At the same time, these companies integrate deeper into the maintenance and spare-part services to generate more value-added and smoothen the impacts of investment cycles.

The examples above are not problematic as such if the interpretations and structural changes are recognized and taken into account. In reality, however, this is not the case. For the classification of industries and the construction of official industrial databases, the inseparability problem and outsourcing cause biases underestimating the size of the sector

producing business services. More importantly, by only focusing on the external services gives wrong signals to policy makers on growth opportunities as a whole.

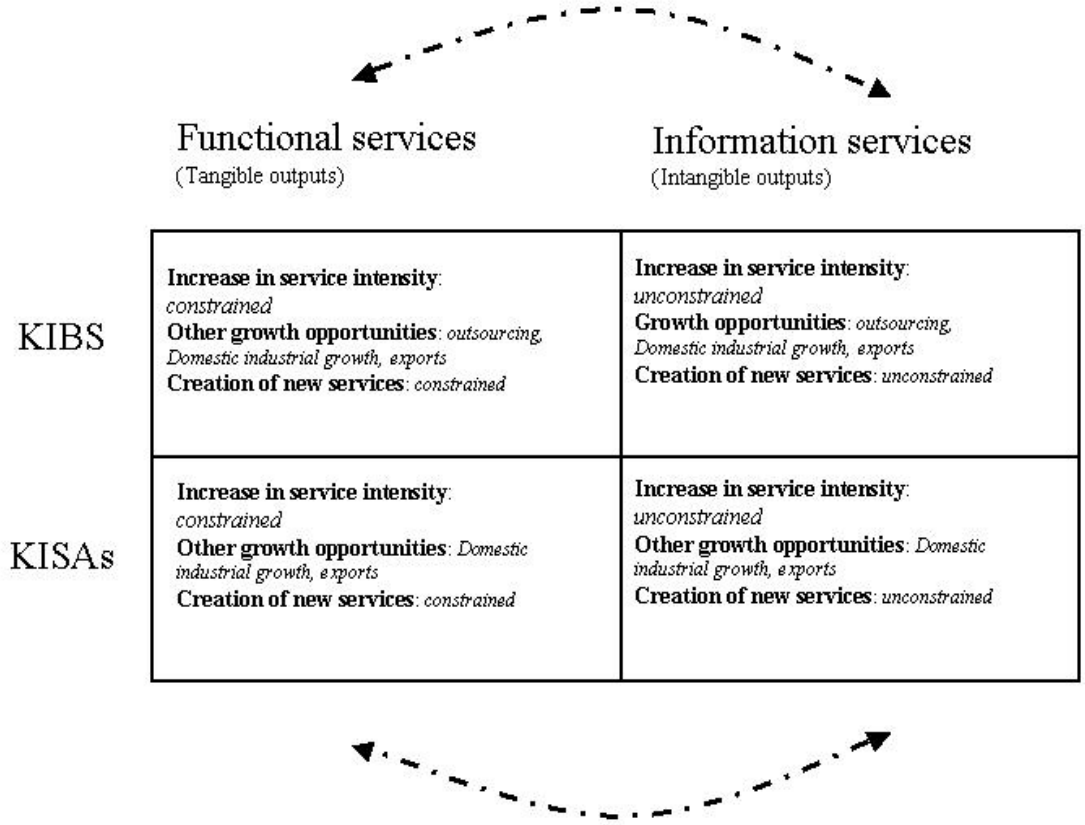
In this respect, illustrative examples are the concepts of KISA introduced by the OECD and KIBS. While the former encompasses all service activities independent of the governance of the transaction, the latter includes only services based on market transactions. If the KISA, or more generally known as SA, approach is used, it is intuitively clear that the business service sector producing *tangible outputs — functional services*[13] — can only grow as the manufacturing sector expands or if the exports of services increases. That is, outsourcing is neutral and fundamentally new business service activities are difficult if not impossible to create. It is just a matter of pricing and the availability of different technologies to produce a specific service. In contrast, the KIBS approach assumes that the business service sector with tangible outputs can grow through outsourcing of in-house services.

The reasoning is of course sensitive to the type of services in question. In contrast to functional services, there is substantial growth potential for services with intangible outputs — information. This holds true for KISA and KIBS. In addition to domestic demand, exports and outsourcing in the case of KIBS, there is a high growth potential in the service-intensity in the manufacturing and service sector as well. This stems from extended opportunities in transforming the input expenses to a higher value of revenues, even when the physical properties of the products are unchanged.[14] In this case, services are not substituting other inputs but they complement the available set of inputs.

Through innovation processes and the increase in factor productivity, information enhances the dynamics of the production function and, compared to functional services, the coefficient of information inputs are less fixed, enhancing the overall flexibility. Another characteristic of information is the possibility to create completely new services based on new information that was inaccessible in the past.[15] This assumes that the expenses of collecting data — internally or externally — is lower than the increase in the revenues, which is increasingly easier to meet with the advances in ICT. The typology of knowledge-intensive services and their associated properties are depicted in Table 2. The arrows indicate that between the extremes the output contents of services encompasses usually both tangible and intangible components, i.e., through the indirect effect of information, functional services have the potential to become more innovative and productive.

[13] The term refers to services whose output is visible and tied to a specific business operation. In contrast, services producing invisible or intangible outputs are called 'information-based services' here.
[14] A concrete example is the purchase of information on the future development of markets.
[15] As with a functional KISA one can argue that all information on past or a prognosis on the future potentially exists, so no new services can be created. The difference here is, however, that the transformation of information into services necessitates a systematic collection and processing of data so that information is available for a transaction.

Table 2: Typology and characteristics of knowledge-intensive services.



3.2 Supply and Use of the Business Services

In the standard industry classification, the majority of the knowledge-intensive services belong to a larger category called business services.[16] In general, private services can be divided into three subsectors. First, there are services that are knowledge-intensive by their very nature like research and development (R&D) services, computer and related services, and consulting services. The second group consists of services with lower inherent knowledge-intensity but high overall knowledge-intensity through the application of ICT. Examples are several traditional engineering services, logistics and marketing services. The third category may be called basic services with the lowest overall knowledge requirement, like retail trade or cleaning. For these services, the possibility of utilizing ICT is also most limited.

3.2.1 Supply Structure

The main characteristics of the business services are that they are mostly used as inputs for other business sectors and they are transacted on markets. This is also the case with traffic and postal and communication services. In this respect, these services differ from

[16] By definition, business services are equal to private services excluding trade, hospitality services, logistical and communication services, and finance and insurance services.

other services, which are mostly directed to final consumption (private services) or based on non-profit production (healthcare, education, etc.).

In contrast to the majority of the service industries, a high proportion — 28% in 1995 — of the total supply of business services is provided by other industries, the manufacturing sector in particular (ETLA, 2003). In this regard, forest-based industries are in a dominating position. The highest service turnover is shown by printing and publishing[17] followed by the pulp and paper industry, which together account for more than one-third of the total external supply.[18] Compared to publishing and printing, the business services provided by the pulp and paper companies consist mainly of internal corporate services and maintenance services with lower knowledge-intensity.[19]

Following the taxonomy presented in Table 2, those business services influenced by all factors of growth (upper right corner), have also shown the highest growth rates (see Table 3). This is strongly related to the economic recession at the beginning of the 1990s. For example, instead of hiring a permanent work force and investing in new machinery and equipment companies started to lease them after the downturn, which led to a growing demand for leasing services. Other forms of outsourcing followed, e.g., in the computer and maintenance services. As with technical consulting and the marketing services, these services are more boosted by domestic economic growth.

Table 3: Fastest growing business services in the 1990s. Source: Statistics Finland (2000).

Code (TOL)	Service category	Change in turnover 1993–1997 %
73103	Technical research and development	741
74502	Lease of workforce	444
724	Databank services	404
7121	Lease of other road transport equipment	389
73102	Other R&D on natural sciences	283
7482	Packaging services	206
743	Technical testing and analysis	192
74409	Other advertising services	149

As argued in the previous section, the highest growth potential is possessed by the information services due to their intangible character and non-specificity. Table 3 supports this, where technical R&D and databank services are ranking high. Although computer and related services are not showing the highest growth rates they are exposed to similar growth factors than the *pure* information services. In contrast, the expansion of the computer and related services is more induced by the exports demand. At the end of 1990s, the computer

[17] Publishing and printing is, by its very nature, closer to a service activity.
[18] Nokia-driven manufacturing of communications equipment is placed third.
[19] As may be expected, the services provided by the publishing and printing industry consist mainly of marketing and related services.

services — including software production — showed the highest surplus in the trade across all of the service categories (BOF, 2000).

3.2.2 Forest Sector Demand

Regarding the long-term structural change of the forest sector, the decrease of the relative importance of wood (see Figure 1) is associated with a growing proportion of service inputs, i.e., *higher service-intensity*. Looking at the forest sector as a whole, the highest service-intensity is found in forestry, which like the printing and publishing industry, is closer to a service activity. A closer look reveals, however, that the change in the service-intensity is bigger for the downstream activities of the value chain, i.e., there is a positive correlation between the value-added contents of the sub-industry and the growth of the service-intensity (see Table 4).

Table 4: Change of the service-intensity in the forest sector. Source: Statistics Finland (1970; 1994).[20]

	Forestry	**Primary wood**	**Secondary wood**	**Pulp**	**Paper**	**Paper products**
1970	33.8	8.1	7.4	9.8	3.1	4.5
1994	48.3	20.2	18.2	15.5	13.5	21.8
Change %	43	149	145	55	335	384

Apart from outsourcing and the real increase of service-intensity, the higher shares of services also reflect the change in relative prices of inputs. That is, companies have to pay more for the same amount of service than before and this increase has been higher for services than for physical inputs. A plausible explanation is that the value-added contents — knowledge-intensity — of the purchased services have increased. This becomes evident by looking at the change in the composition of purchased inputs.

In Figures 3 and 4, displaying the development of the relative importance of service inputs, focus is on the services with the highest shares on average in 1994. Forestry, showing a relatively stable pattern, is the most dependent on trade services while the secondary woodworking sector is more trade-intensive than the primary woodworking sector. The latter shows moderate dynamics, with increased shares of business services and road transport. With respect to knowledge-intensity, these services balance each other. The biggest changes have occurred in the secondary woodworking sector with the highest growth of the business services. To conclude, *knowledge-intensity and its long-term growth correlate positively with the value-added contents through the value chain.*

Similar to forestry, the most stable development in the chemical forest industry is shown by the pulp industry with the distribution of services equivalent to the primary woodworking industry. Following the pattern of the mechanical woodworking sector

[20] The input-output statistics of 1994 provide the latest comparable data showing the long-term development.

the share of business services grows towards downstream processing.[21] Furthermore, as with the woodworking industry and forestry, it is noticeable that the change in the knowledge-intensity correlates positively with the value-added contents through the value chain. In this respect, the pulp and paper industry has shown a more dynamic development.

There is also a clear concentration of the distribution towards the four service categories by 1994. For paper, and to a lesser extent the pulp and paper products, this is affected by the shutdowns of product group-specific marketing association by the mid 1990s. External marketing services, included in other services, became gradually useless as the companies were big enough to internalize the marketing activities.

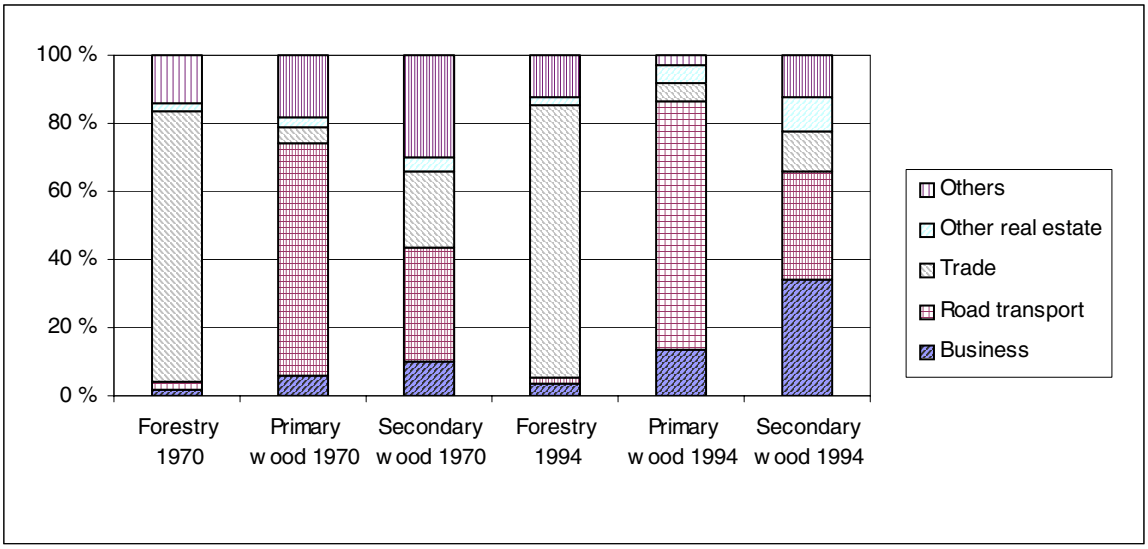


Figure 3: Distribution of service inputs in forestry and the woodworking industry. Source: Statistics Finland (1970; 1994).

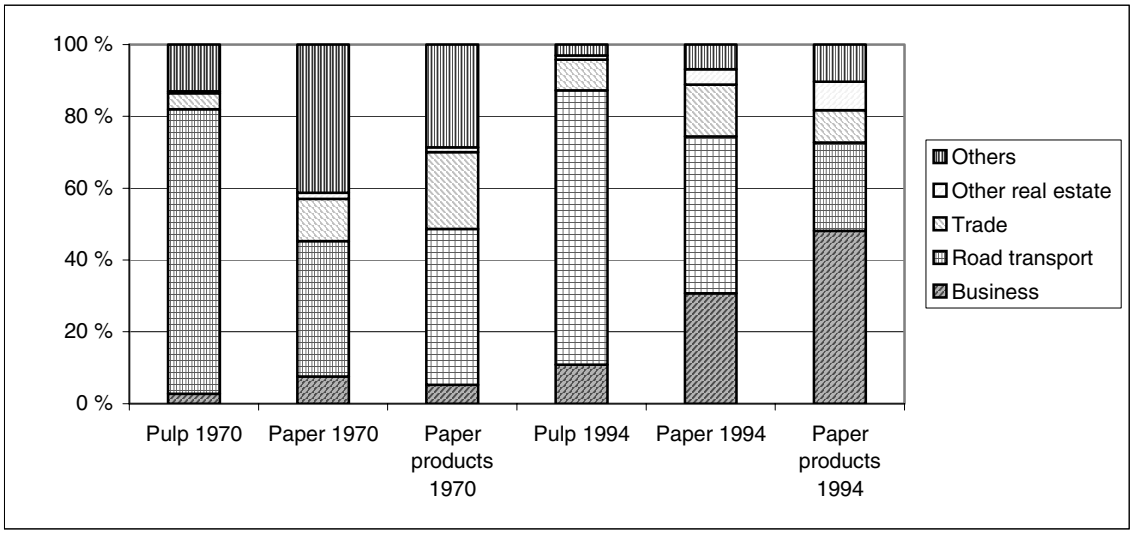


Figure 4: Distribution of service inputs in the pulp and paper industry. Source: Statistics Finland (1970; 1994).

[21] With the exception of paper production in 1970.

3.2.3 Comparison Across Industries

Among the manufacturing industries, the pulp and paper industry was the biggest single user of external services until the end of the 1990s.[22] The second biggest user was machinery building followed by the publishing and printing industry. Illustrating the overall structural change of the Finnish economy the manufacturing of telecommunications equipment displaced the pulp and paper industry in 2000, while machinery building held third place. This is conveyed by industrial statistics, which breaks down the expenses of the external services for the entire manufacturing sector.[23]

While in absolute terms the forest-based industries together incur the highest service expenses, they show intermediate service-intensity to be somewhat higher than in the manufacturing sector on average.[24] As indicated in Figure 5, the highest service-intensity is found in the printing and publishing industry for which the biggest cost category is the *out-contracted labor work.* In contrast, the lowest intensity is exhibited by the manufacture of wooden packages.

In Figure 5, the service-intensity is compared to the knowledge-intensity — or degree of innovativeness (KI %) — measured by the ratio between the expenses of the most knowledge-intensive services and the total service expenses. The former consists of R&D services, computer and related services, and the licenses for patents. Although the correlation between the two indicators is low (-0.2) there are some distinct patterns. The industries with the highest service-intensity rank typically low by the knowledge-intensity, while the low service-intensity is associated with all levels of knowledge-intensity. The in-between knowledge-intensity varies between low (the majority of forest-based industries) to moderate (the manufacture of paper products). A notable exception is the manufacture of communications equipment, which shows a knowledge-intensity of 70% that is due to substantial R&D inputs.

To conclude, by their external use of services the forest-based industries can be classified as a medium-service-intensive and low-knowledge-intensive sector reflecting limited innovation opportunities through the purchase of service inputs. This is, however, the direct effect of ignoring only the cumulative impacts through innovative supporting industries. For example, machinery building is one of the most important sources of external innovations for the pulp and paper industry (see Figure 2), which shows knowledge-intensity of 18%.[25]

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[22] The ranking is based on the nominal value of service procurement.

[23] It must be noted that the classification of services in input-output tables is different from that used in the other industrial statistics. The advantage of the latter is more updated data and more disaggregated industry classification.

[24] This is a ratio between service expenses and total expenses, Serviceint %.

[25] In this respect, the indirect effect of R&D expenses is of special interest. For instance an input-output analysis across OECD industries (Hatzichronoglou, 1997) reveals that the overall R&D intensity — consisting of direct and cumulated effects — correlates negatively with the level of the direct R&D intensity of the industries. For forest-based industries, all belonging to the low-tech category, the ratio between total effects to direct effects is 0.75.

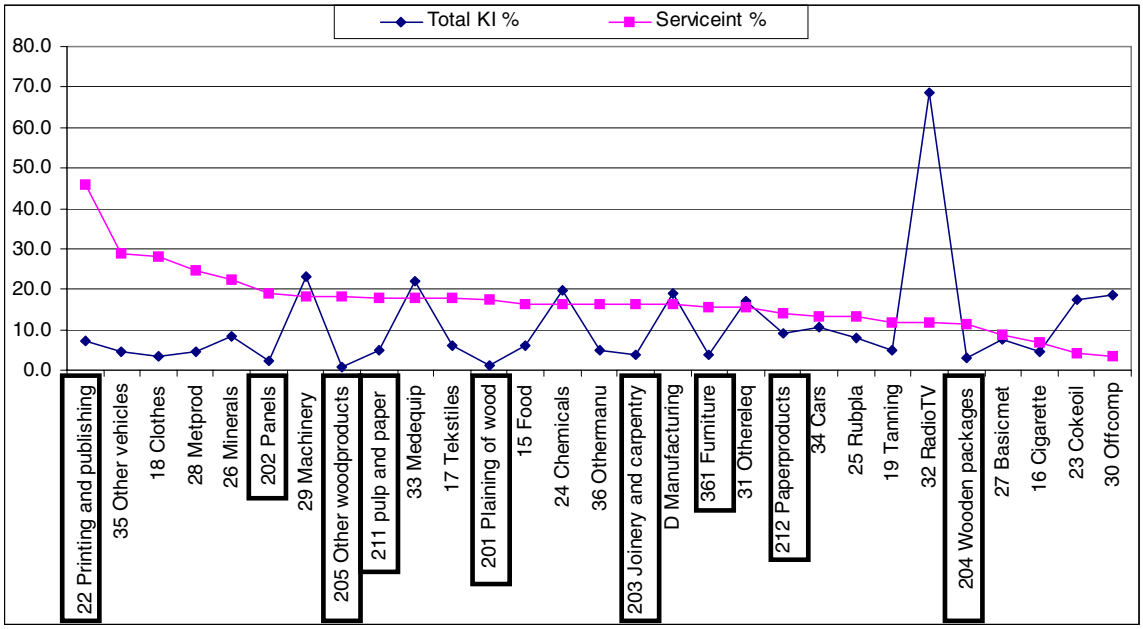

Figure 5: Service- and knowledge-intensity of the Finnish manufacturing sector. Source: Statistics Finland (2000).

Regarding service-intensities, more detailed information is provided by the degree of specialization in the use of single service inputs. In Figure 6, specialization is measured by dividing the share of the service in a sub-industry by the corresponding share in total manufacturing. As such, the specialization ratio also highlights the characteristics of the production functions.

Besides the high specialization in the contracting services by the printing and publishing industry, there are also other industry specific patterns. Equivalent to the other process industries, pulp and paper production is highly specialized in reparation and maintenance services accounting for almost one-third of the total expenses of the manufacturing sector. This also holds true for the logistical services, which are of special importance to the woodworking and pulp and paper industries as well. Consistent with the IO-statistics in Figures 3 and 4, the relative importance of the logistics decreases the closer the production stage is to final consumption. It is the opposite for marketing services, as one may expect.[26]

The characteristics of the forest-based industries can be demonstrated by a comparison with the high-tech manufacturing sector, particularly the manufacture of telecommunications equipment (TCE). The biggest difference is shown by R&D expenditure, for which the TCE sector is almost ten times more specialized than the manufacturing sector. Patent expenditures with a specialization seven times higher is followed by the computer and related services nearly three times higher than in total manufacturing. Accordingly, maintenance and logistical services are far below the share in the forest-based industries, of which the manufacture of paper products is the most similar to the TCE sector.

[26] This gains further support if the furniture industry is included and if the woodworking industries are broken down to primary and secondary production.

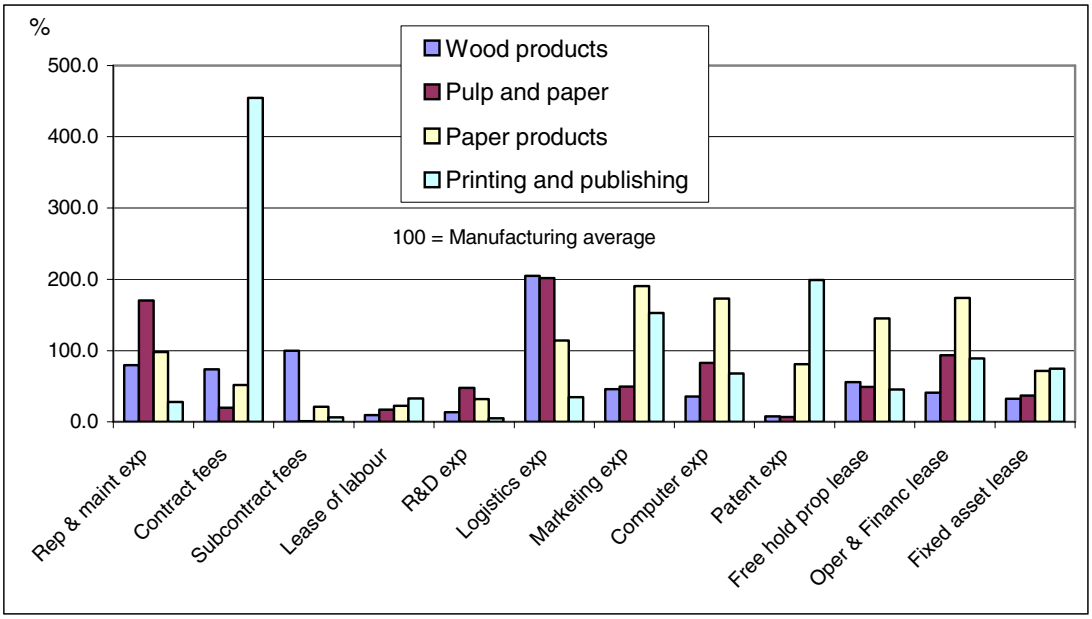

Figure 6: Specialization of the forest-based industries by the service expenditures. Source: Statistics Finland (2000).

More generally, the specialization pattern in the service expenditures can be taken as an indicator for the differences between high-tech and low-tech industries. While the former are distinctively specialized in innovative services — TCE, chemicals, medical equipment, etc. — for the latter it is the opposite. To use Porter's classification of factors of production, the distinction is made between the specialized and advanced inputs and the basic and general-purpose inputs. According to Porter's reasoning this is just what makes the high-tech sector more competitive and a real source of national prosperity in the long run.

3.3 Employment Effects

As noted earlier, the service sector has gained a prominent role in enhancing economic growth and employment in industrialized countries. From the perspective of labor policy, the promotion of services is seen to be justifiable due to their higher labor-intensity compared to the manufacturing sector. The focus in this section is on the impacts of forest-based industries on employment of the service sector. Keeping in mind labor policy targets, the core question here is how the demand for service inputs in the forest sector is channeled to employment respectively.

Referring to the taxonomy on the knowledge-intensive services in Table 2, the employment of externally produced business services can be affected in the following ways: by outsourcing, demand induced growth of the economy, exports and a higher service-intensity of the production processes. The last option is workable especially for information services. In this analysis, the focus of interest is on the demand induced effects since they provide a simple illustration on cluster mechanisms and hence the possibilities and limitations for labor policy.

It is assumed here that the coefficients of the service inputs are fixed, i.e., there are no changes in the service-intensity in production technology in the short run, in this case 1990–1998. Hence, the change in the production volumes in forest industries is reflected proportionally in the service demand and employment if the labor productivity of services remains constant.[27]

The analysis is based on the IO-tables of 1995 and industrial statistics (Statistics Finland, 1995; 2000), which enable the calculation of direct and indirect employment effects. The latter, describing the total effects through input-output linkages in the economy, is given by the Leontief inverse matrix (see, e.g., Hatzichronoglou, 1997). The prices for 1995 are used to obtain real changes in the values of the production of forest industry products. For simplicity, the forest sector is divided here into three sectors, forestry, the mechanical wood industry and the chemical forest industry.

In spite of the high service-intensity of *forestry* its absolute use of services is relatively low, which is also reflected in the employment figures (see Figure 7). The small difference between the total (direct and indirect) and the direct effects follows from the fact that the use of intermediate inputs is generally low and concentrated on trade.[28] Regarding the ability to employ, forestry is however performing relatively well, since at the same time the labor productivity of trade has shown only a slight increase. Only 2.5% decrease in employment in the service sector can be contrasted with 40% reduction in forestry itself. At the same time, production grew by 20%.

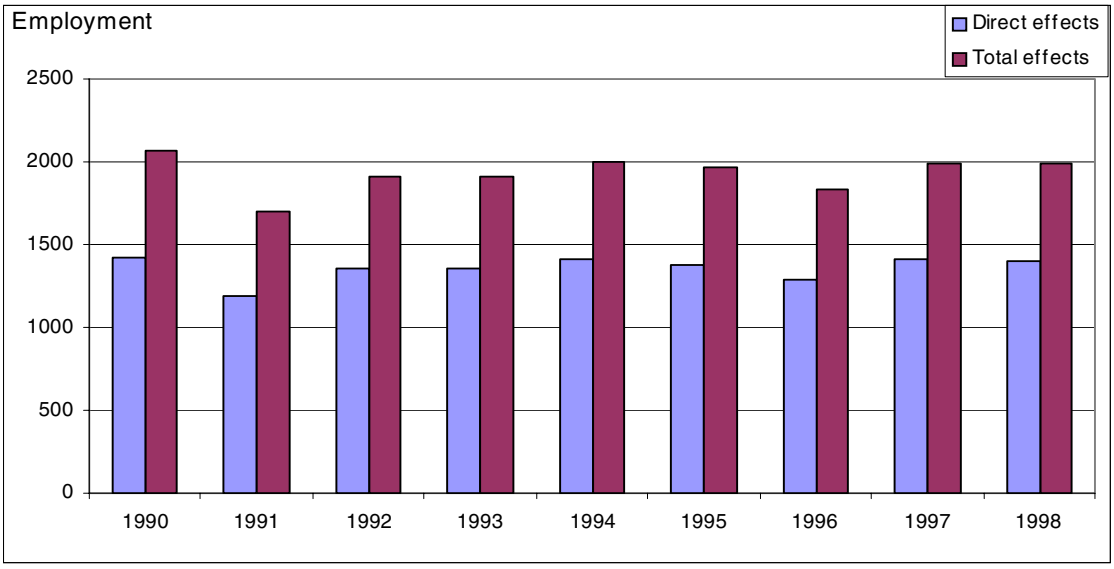

Figure 7: Employment effects of forestry on the service sector.

[27] Labor productivity is measured here by the ratio between values of production and number of employees.
[28] The share of trade of all services for direct use is as high as 65% but only 33% of the total use. This is because direct effects exist only for half of the service categories.

Compared to forestry, employment effects are much stronger for the woodworking industries[29] and total employment is approximately twice as high as direct employment (see Figure 8). This results from a higher volume of inputs in general and more diversified use of services. Of the all service categories, road transport and business services account for 60% of the direct effects and 40% of the indirect effects for which trade assumes the highest share of the employment.

A further comparison with forestry shows that the ability to employ has decreased much more in the woodworking industries. Whilst the value of production grew by 30% in the 1990s, employment decreased by 4.5% resulting from the productivity growth of business services and transportation. By the end of the 1990s, however, employment showed an upward trend.

As expected, employment effects are strongest in the pulp and paper industry with extensive input linkages within the forest cluster and across the other industries. This can be seen in the high difference between the total and direct employment effects (see Figure 9). Total employment in the service sector corresponds approximately to current employment of the pulp and paper industry itself, showing a decreasing trend in the 1990s. The distribution of the effects is similar to the wood working industries but the share of business services is higher for the pulp and paper industry. In spite of the decreasing ability to employ in the 1990s, the absolute change has been positive.

To summarize, growing labor productivity in the forest sector associated with a rapid increase in production volumes is changing the employment structure of the forest cluster. As the development of process technology, automation and information technologies will constantly reduce employment throughout the value chain, the supporting industries — especially services — are getting higher weight in sustaining overall employment. A gradual outsourcing of service activities is strengthening the tendency.

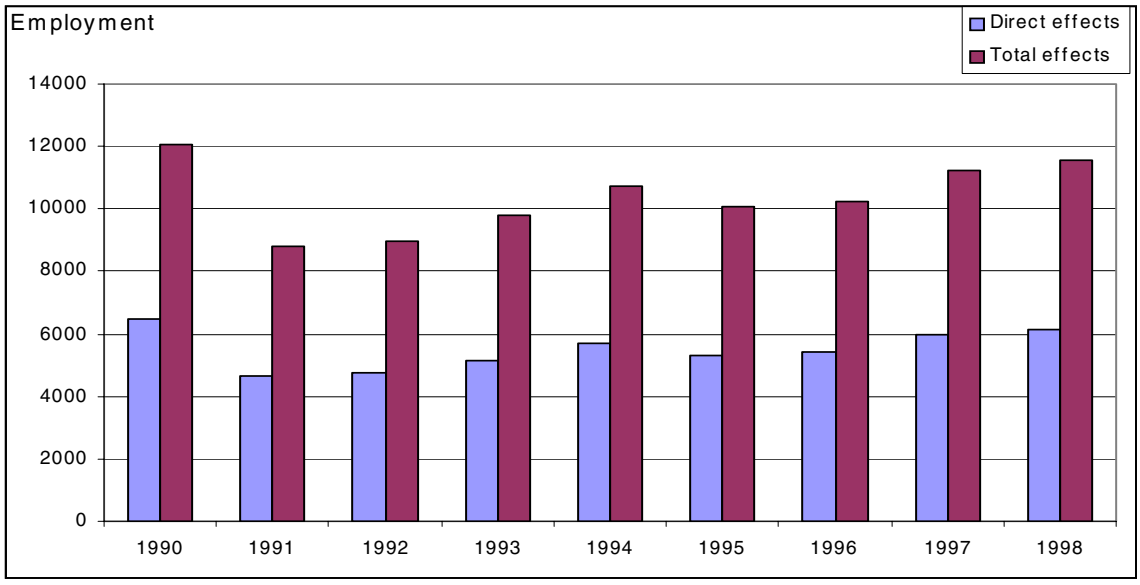

Figure 8: Employment effects of the woodworking industries on the service sector.

[29] Only timber and panels are included here because the data on processed products is deficient.

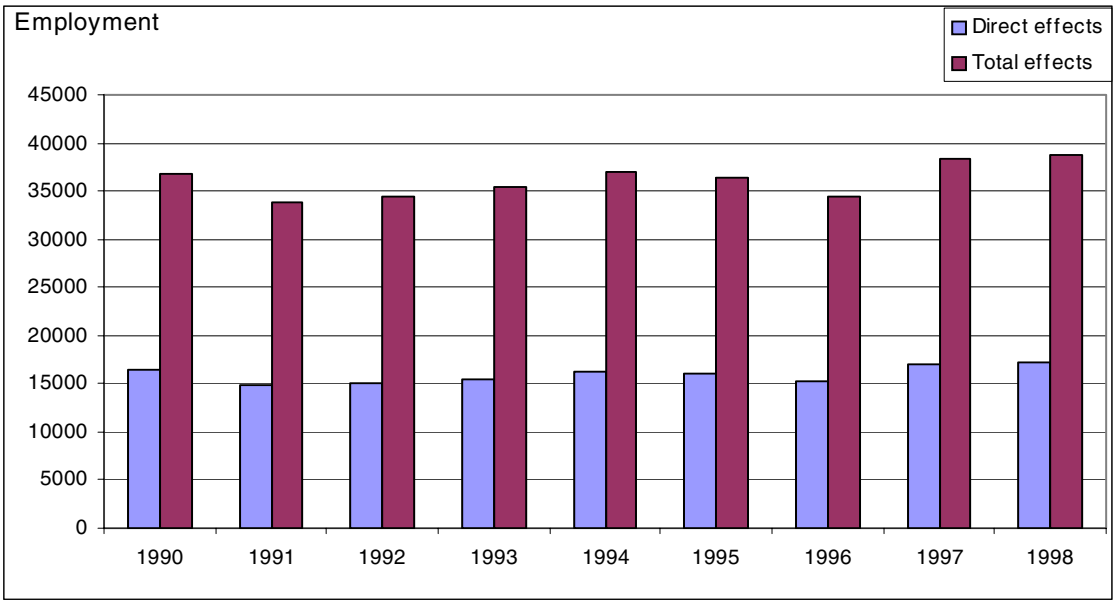

Figure 9: Employment effects of the pulp and paper industry on the service sector.

A counterforce for this tendency is, however, growing labor productivity in the central supporting services industries, business services and, to a lesser extent, the logistics. An essential factor in explaining productivity growth is the growing application of new information and communication technologies, which increase the economies of scale and scope in the production of the services. As a consequence, the knowledge-intensity of functional services is increasing and the differences between service industries are shrinking accordingly.

It is assumed here that the production technologies of the forest-based industries are given without any changes in the factor proportions. If that assumption is relaxed to allow an increase in service-intensity — consistent with long-term development — the employment effects presented here may be underestimated. Similarly, IO-tables ignore maintenance services, which, as shown above, are of high importance.

However, these deficiencies do not alter the main policy implications. Beside the downstream processing in the woodworking industries, the forest sector itself is incapable of creating new employment. Because of the growth in productivity the opportunities are also limited in the service sector. With the taxonomy presented in Table 2, two complementary options remain. First, exports of forest-based services should be facilitated. Second, industrial policy should aim to increase the information contents of the existing functional services and to facilitate the creation of new information-based services.

4 Competitiveness Analysis

The notion that the innovation approach is replacing the pragmatic transaction relations approach in the analysis of clusters, bears not only a change in the conceptual

framework but also reflects an endeavor to identify the real sources of industrial competitiveness. In doing so, the new approach possesses two characteristics. First, it stresses the dynamics of competitiveness — the importance of cooperative and competitive interaction fueling innovative processes and competitive performance. Second, the innovation approach links the traditional macro perspective to the micro level analysis trying to explain how the evolving innovation practices in single cases shape innovation cultures of clusters and nations.[30]

4.1 Analytical Framework

In combining the innovation approach and the cluster analysis, it is essential to note that innovation activity cannot be isolated from its institutional context. The eventual competitive outcome is highly dependent on company strategies, business environment in general, and the organizational flexibility. They interact with the innovation-induced technological change. With the focus on industrial clusters, it is assumed here that the overall innovativeness and competitiveness is determined by three industry specific determinants; technology, characteristics of markets and corporate strategies and organization of the transactions (see Figure 10).

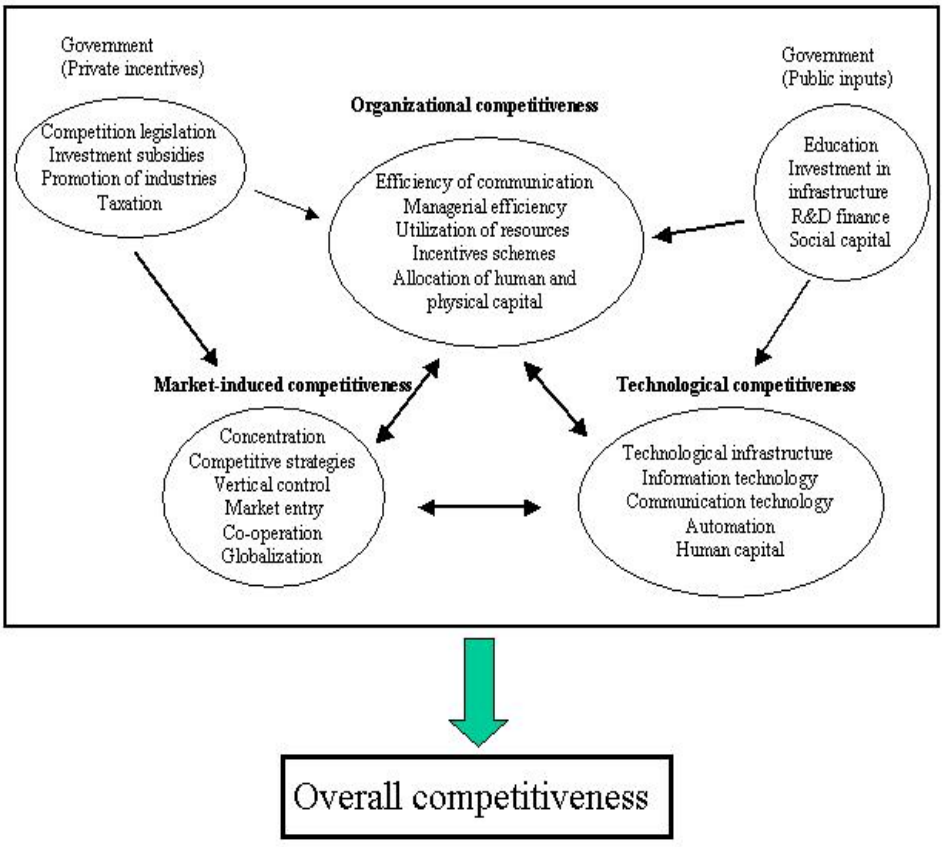

Figure 10: Determinants of competitiveness impacts of services.

[30] This may be called a combined bottom-up and top-down approach.

4.1.1 The Model

The *technological* component of competitiveness refers to the available *tools* in producing the services and transferring them to the user. Basic technologies, which are often industry specific, are machines and equipment used for the physical production of services. For services with lower knowledge-intensities, in particular basic technology is different from the *supporting technologies*, ICT and automation, which are used in designing, communications and delivering the services to the transacting parties. The most central sphere of technology is *knowledge and skills*, i.e., the ability to utilize the available technologies. In maintaining the technological capabilities, the role of education and R&D is central in giving grounds for the supportive actions by government.

Market-induced competitiveness refers to the economic performance resulting from structural characteristics of the markets and strategies of enterprises accordingly — in this case service enterprises and forest industry enterprises. For instance, a concentrated market structure on either side may lead to inefficiencies through vertical control and horizontal collusion. On the other hand, fierce price competition may also be destructive even if there are otherwise favorable conditions for innovations. To quote Porter (1990), a central factor is the sophistication of demand for services.

Related to market-induced factors, organizational competitiveness is determined by the ways that service transactions are governed along the continuum between markets and hierarchies (Coase, 1937; Williamson, 1985). Brought onto the operational level, the problem reduces to the outsourcing strategies by the forest industry. Organizational competitiveness is manifested in the efficiency of communication, utilization of economies of scale and scope, incentives, etc. As with market-based competitiveness, government can influence the creation of optimal governance structures.

The point is that while all the determinants influence each other, changes in technologies and, to a lesser extent, the competitive environment are more exogenous factors. Intensifying competition in the global forest product markets, boosted by new information and communications technologies, forces the forest industry companies to adopt cost-reduction strategies, e.g., outsourcing of service activities. With the market-based push effects, there is a pull effect in the form of changing supporting technologies. Technological progress and integration is shifting the comparative advantage in producing the services from the user industry to specialized service suppliers. In other words, there is growing economic pressure to transform internal KISAs to KIBS.[31]

Further accumulation of knowledge and upgrade of technological base strengthens the comparative advantage of specialized service suppliers also increasing their knowledge-intensity. This holds true not only for the explicitly defined KIBS but also services with lower knowledge contents. As a feedback effect, outsourcing and evolving economies of scale and scope in the production of services intensify competition within the service sector, which further encourages innovation.

[31] This is also applicable for SAs to BSs.

4.1.2 The Services

The model stresses the systemic nature of competitiveness, pointing out the forces and mechanisms through which the determinants create competitive potential, with ideal responses. In the real world with imperfect markets, there are impediments for these forces to be effective as indicated below. Since the frictions cannot be overcome by market forces only there is justification for selective policy measures by government. In the empirical analysis below the focus is on specific service activities that are most critical for the competitiveness of primary forest industries.[32] Figure 11 illustrates the services and their linkages to the activities within the forest industry.

Transportation and warehousing — more generally *logistical services*[33] — and *maintenance services* are by the standard definition, low-knowledge-intensive services. As indicated by the statistical overview, their importance is manifested in the high proportion of total service expenses. In contrast, computer and related services (CRS) and technical consulting and engineering are characterized by higher knowledge-intensity but remarkably lower cost impacts.

There are other inherent differences, too. As maintenance and transportation costs depend more on the volumes of production, the associated strategy is cost minimization. For CRS and engineering services, a higher proportion of the costs are fixed investments, which are less sensitive to the level of production.[34] Instead of cost minimization strategy, the quality and value-added received from the services are more important objectives.

As conveyed by Figure 11, CRS form an *umbrella* for the functional service entity, which is distinctively production-oriented. This is consistent with the technology-based strategies and frequently stated competitive advantages of Finnish forest industries; remoteness from the markets has to be compensated by an efficient production and logistical infrastructure. While the logistical efficiency is of special concern for Finland, the composition of the services reflects the characteristics of the Nordic forest clusters in general. Consequently, it is intuitively clear that the composition of the most competitive services may look completely different, for example, in Central Europe or the USA. That is, there are lower requirements for technical and logistical services but higher demand for marketing and related consulting services.

[32] The qualification of the services as most important is based on statistical assessment and the survey study of interviews with industry experts (Viitamo, 2000).
[33] For logistical services, the focus is on the transportation chain from forests to shipping ports.
[34] As a result of technological development and outsourcing, there are specific areas of continuous service provisions.

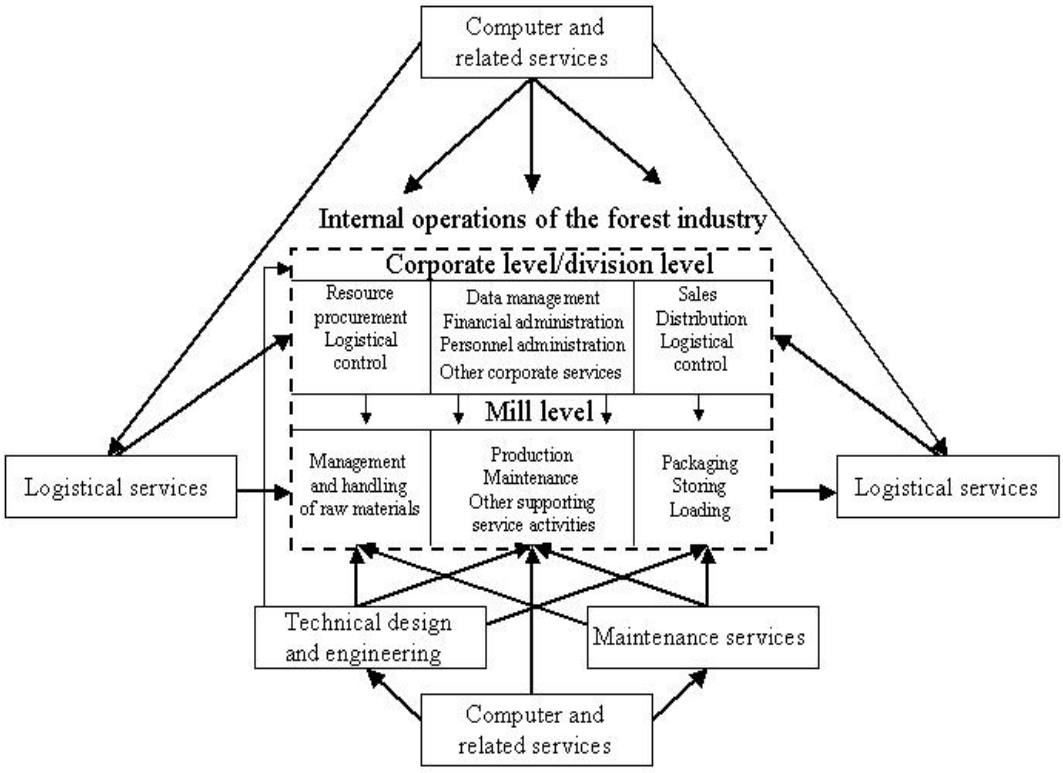

Figure 11: The most important services for primary woodworking industries and the pulp and paper industry. Source: Viitamo (2000).

4.2 Technological Standard and Characteristics

In international comparison, the technological standards in service production are high in Finland. Historically, this has resulted from an innovative combination of imported technologies with the development of domestic technologies suitable for country specific conditions. Much of the progress is also attributable to public investments in education and R&D. As with the development of process technologies, the key drivers have been the disadvantages of the country and consequent strive for the substitution of advanced factors for expensive basic factors.

As a result, more important than basic technologies is the development of supporting technologies — ICT and automation — in the production and supply of services. Supporting technologies are one example of a successful change from import dependence to the emergence of domestic manufacture and accumulation of knowledge. Through the growing knowledge-intensity of services, the expanding ICT cluster is also strengthening international competitiveness of the forest sector.

4.2.1 Logistical Services

Logistical expenses account for the biggest share in the cost structure of the Finnish forest industry. Therefore, even marginal changes in the unit costs bear significant

effects on the competitiveness on export markets. The part of the logistical chain locating in Finland is the most critical and hence the potential for improvements through domestic actions is high.

With the globalization of business activities the importance of logistics is increasingly recognized. In the revised supply chain, strategy logistics is seen as an integrated process where the value added of the products grows as the spatial state of the products is changing to another. The objective is to minimize the logistical costs relative to the entire supply chain.

During the last forty years or so the productivity of the basic technology in logging and mill transportation has experienced a substantial increase; employment has dropped from 60,000 to below 10,000 while the number of trucks has fallen by a third. In contrast, the unit carrying capacity of transportation equipment almost tripled during this time period.[35]

Finland is one of the leading producers of harvesters and wood handling equipment. Harvesters are equipped with the state-of-art ICT applications, which are also increasingly used in logging trucks. Digital maps, wireless communication and global positioning systems (GPS) are widely used to decrease the overall transaction costs between the logistics enterprises and the wood procurement units of the forest industry. This is enhancing the efficiency of the entire raw wood chains.

For actual efficiency, the decisive role is held by the logistical control systems of forest industry companies, which built specific software applications, and optimize the wood procurement with the needs of several mill sites simultaneously. The state-owned railway company, VR Cargo providing equivalent services, possesses a higher responsibility in controlling wood deliveries.[36] VR Cargo is also upgrading its data transmission connections with the biggest forest industry companies.

As with wood transportation, the unit carrying capacity for finished products is growing. The majority of Finnish innovations are concentrated on handling cargo and containers in particular. Through the widespread utilization of robotics and telematics in loading and unloading activities, labor productivity is increasing. VR Cargo is developing a fully automated loading system for paper rolls reflecting a more general tendency. By increasing the on-line information of the material flows and diminishing the overall transaction costs, the new technologies aim to minimize manual work and hence the incidence of human errors.

While new technologies, applied for eCommerce and company specific electronic customer networks, are bearing changes in market strategies, there are also more concrete and predictable developments in the operations of the logistics itself. An example is the scenario presented by the Finnish Association of Logistics (FAL, 2000):

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[35] In general, the whole logistical chain from forests to mills has experienced a transformation from labor-intensive manufacturing to mechanical service activity. This is not, however, taken into account in industrial statistics. While road transportation is classified in services, harvesting is not, although together they form an integrated business chain sharing equivalent technological and business characteristics.

[36] This is mainly because of the bigger size of the company and delivered quantities.

Information technology will define the logistical solutions, reserve the space for cargo, and combine transportation flows and search for return freights. Telematics will control the on-line routing for road transportation. The development of the material flow control will result in decreased warehousing and increased terminal-based arrangements, respectively. The concentration of material flows enables more large-scale application of robotics and automation. The use of storage and material handling automation will increase in all sites. A flexible small-scale service production will develop strongly and may replace large-scale production around 2010.

4.2.2 Maintenance Services

The other cost-intensive service activity, maintenance and reparations, consists of a heterogeneous group of tangible and intangible production inputs. According to the most general definition maintenance services encompass all activities aiming to maintain and improve the functional properties of the manufacturing equipment and management as well. Within the service industry, maintenance is divided into three categories. Mechanical maintenance of process equipment and buildings are the least knowledge-intensive and also the most labor-intensive service activities. In this respect, the opposite is the maintenance of electrical and automation systems. Finally, outside the production activities, maintenance services are also needed for administration and management.

When the direct costs of maintenance are substantial, so are the direct and indirect effects of maintenance on the operational costs and long-term profitability of the business, too. In this respect, the effectiveness of maintenance is more on future operations. From the perspective of the forest industry, the objective is to maximize the rate of functionality, which measures the extent of losses caused by *unanticipated* breaks and non-optimal assemblies and adjustments.

Besides the high cost-intensity, the importance of maintenance activities is reflected by the growing need to improve the functionality as competition is becoming more intense and global. This has brought about considerable revision in conceptual thinking and strategies accordingly (see Figure 12). The objective of evolving proactive maintenance is to maximize the overall productivity of the investments through their life cycles.[37] According to the new approach *equipment and its maintenance form an integrated business entity, the profitability of which depends on the total management of available resources.*

Apart from the increased competitive pressure of global markets the knowledge-intensity of maintenance services are fostered by the complexity and advances of production technologies. This is the case with the pulp and paper industries, in particular.[38] As the control of paper machines is increasingly based on embedded software the share of automation and electrical maintenance is growing respectively.[39]

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[37] The share of proactive maintenance is approaching 50% of all maintenance costs in the Finnish manufacturing sector.

[38] For new paper machines, the share automation of total investment costs has risen from 5 to 30% in the 1990s.

[39] In the 1990s the share has grown from 18 to 29%.

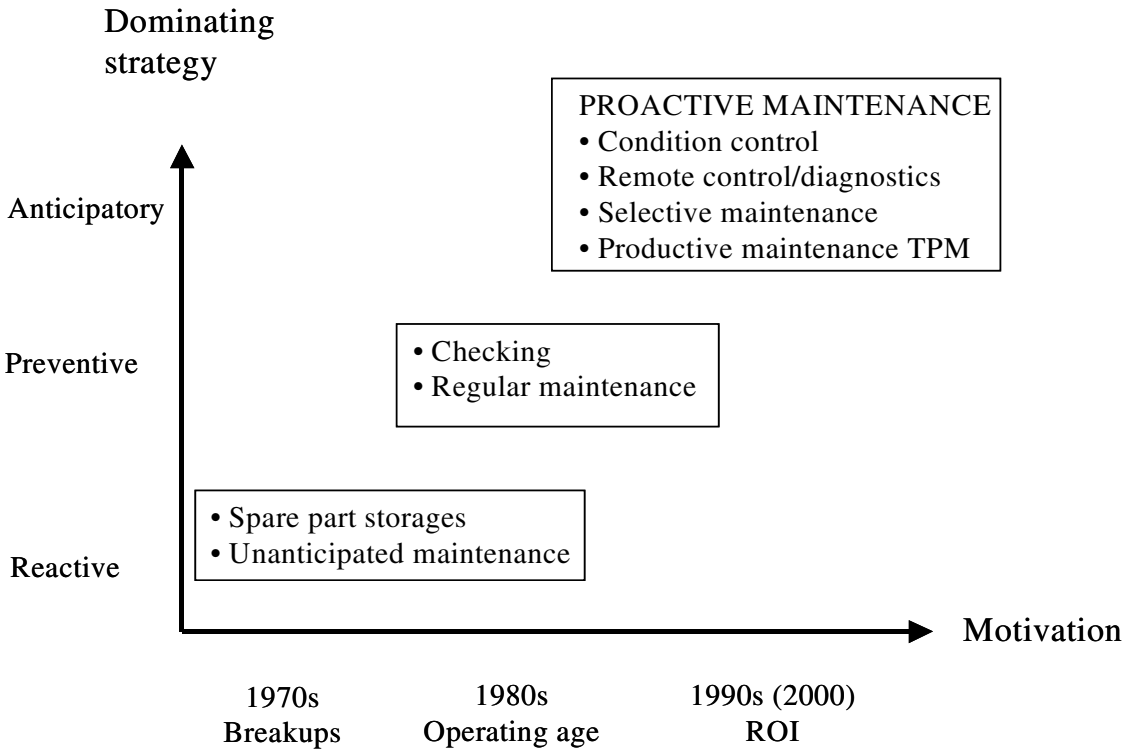

Figure 12: The dynamics of maintenance operations.

Computer-aided technologies are extensively used also in the design and documentations of maintenance blurring the distinction to other service industries, especially engineering and consulting. Data flows between maintenance and forest industry companies are transmitted wirelessly, which enables lower spare part storages and transaction costs. Following the advances in measurement techniques, there is a growing demand for information on the functional state of the machinery.[40]

The essence of proactive maintenance is remote control and diagnostics where measurement information is available online in the data networks. This makes the service markets spatially independent. With internet-based spare part deliveries the new communications technologies support a global business scope. An example is the Future Care concept of Metso Corporation, the leading paper technology producer in the world.

Parallel to increasing knowledge-intensity, the maintenance services are facing a strengthening business orientation; services are commoditized and marketed as branded packages. New technologies and technological convergence increase the economies of scale and scope in the service production favoring outsourcing and increased concentration on the supply side. According to expert assessments only 25% of maintenance know-how is currently industry specific.

[40] This is a concrete example of growth possibilities for information services discussed in section 3.

4.2.3 Technical Design and Consulting

Among the investigated services, technical engineering and consulting — or more generally engineering services — have belonged to the spearhead industries of the Finnish forest cluster for decades. In general, engineering services comprise all activities related to the design of investment projects and their execution as well as consulting services. According to the taxonomy presented in Section 2, consulting, i.e., selling knowledge possesses the highest growth potential in the long run.

As with the majority of service industries, technical engineering forms complex links between industrial clusters. This occurs in two ways. First, there are distinct economies of scope across industries, i.e., the engineering companies are typically supplying several manufacturing sectors. Second, there are cumulative effects through the input-output relations, which are illustrated in Figure 13.

Although the historical success of the Finnish engineering know-how is indisputable, there is a growing pressure for reorientation driven by the globalization of forest industries and the emergence of ICT-based tools in providing engineering services. As the center of gravity moves away from green field investments to replacement investments, the requirements on design and project management increases accordingly. At the same time, environmental issues and energy efficiency are getting higher priority and setting the guidelines for the entire planning process.

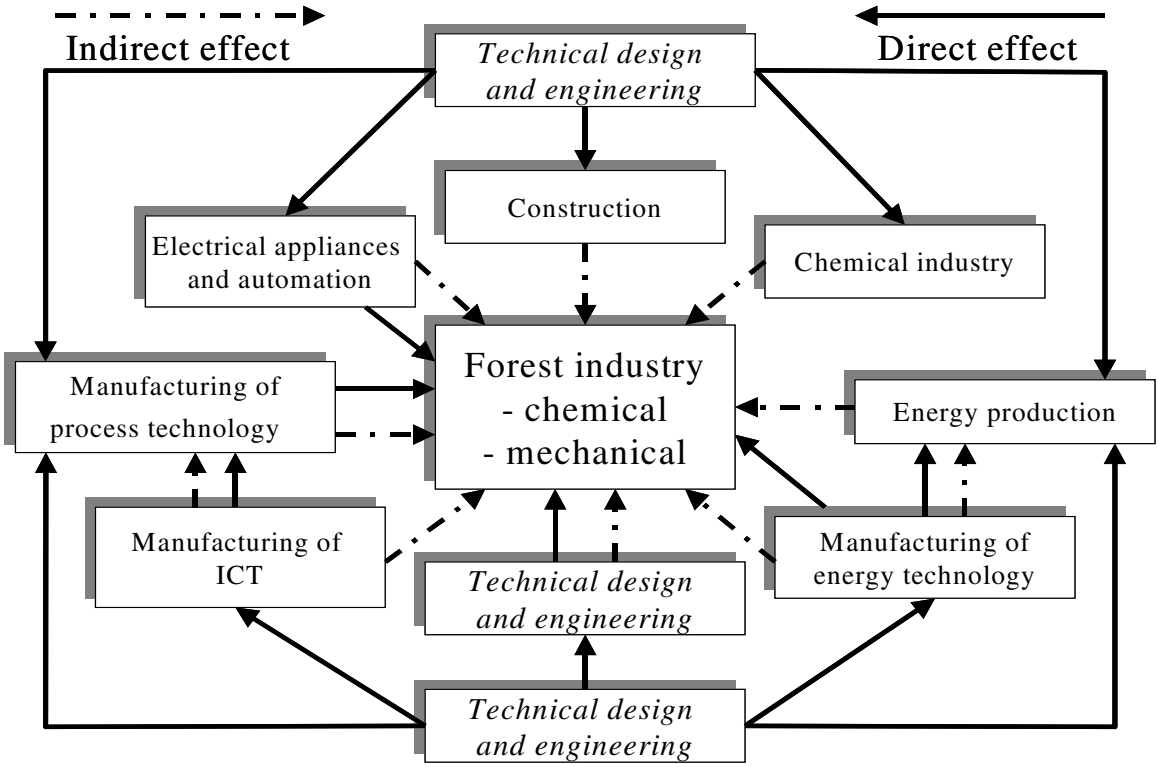

Figure 13: Cluster *linkages of the engineering services.*

As with maintenance services, the growing rate of automation in the production processes is reflected in a higher knowledge-intensity of the engineering services. This is strengthened by the development of the supporting technologies. A switch over to computer-aided design (CAD) programs is speeding up the design process and thus diminishes the risks of human errors. Similarly, with improved accuracy, the application of three-dimensional (3D) modeling enhances the efficiency of producing drawings. Simulation of the processes is a central task in modeling, for which engineering companies are developing or purchasing specific software.

In the forefront of technological progress is *photogrammetry*, where pictures on the production facilities are transmitted digitally to engineering companies for 3D modeling and documentation. ICT is integrating the information systems of the services companies and their customers diminishing the importance of geographic proximity. The growing processing capacity of computers enables the handling of still larger customer specific data flows favoring more extended outsourcing.

4.2.4 Computer and Related Services

Compared to other services, CRS are conceptually more obscure. This results from the diversity of services and the difficulty in separating the outputs of hardware from those of software and other intangibles like databank and consulting services. The inseparability is also characteristic of the converging computer and communications technologies.

While data management expenses are as low as 1% of the turnover of the forest industry, information technologies bear a substantial potential for the increased competitiveness throughout the value chain. With rapid technological progress, the opportunity set is ever-expanding. From the competitiveness point of view, the indirect effects, i.e., the application of ICT in the production the other services raising knowledge-intensity and innovation potential of the whole business service sector, are more essential however.

In the long run, the main characteristics of technological change have been the diminishing size and growing intelligence of computer systems. A current trend for data processing and software services is a change over to the server-based data network systems, which improves the cost-efficiency of information infrastructures. The transfer of software services to extranets improves the efficiency further; customers pay only for the effective use of software, which is by definition real service. Hence, technological change is implicitly associated with the outsourcing of services.

Other distinct trends are the *convergence* and *standardization* of technologies. While new opportunities in transferring data are merging information technology with communications technology, the proliferation of embedded software in communications and process automation is extending technological integration to the mill level operations, too.

Standardization implies that tailor-made software design is replaced by industry specific or more general software, for which service companies are developing modular applications for various corporate activities. Being constructed on the same platform,

modules are compatible and standardized. An example is the Enterprise Resource Planning (ERP) systems, which may comprise all administrative and mill level activities. The markets of ERP systems are growing rapidly and the solutions are well suited especially for multinational enterprises.

While the domestic manufacturing of computers is a relatively small-scale activity, the key areas of technological standard, know-how, and communications technology make the Finnish ICT sector highly competitive internationally. Among the spearhead products, are software packages for the process industries and service sector as well as the wireless communications equipment and systems. Together they form the technological platform for the competitiveness impacts of services.

4.2.5 Opportunities and Obstacles

The advances in supporting technologies with the growing competitive pressure from globalized forest products and technology markets are the main drivers of the dynamics of competitiveness. Besides the direct impacts on the productivity of the services, the application of ICT implies a higher potential for innovations, upgrading and a more diversified supply of services. In spite of the general advances, there are some areas where, by removing the bottlenecks, competitiveness impacts could be further enhanced. While this gives justification for some correcting policy measures, certain threats for future development still remain.

While the extended application of state-of-the-art technologies is raising the knowledge content of cost-intensive services, logistics and maintenance services, there is much room for upgrading the skills and knowledge base of the workforce itself. This is mainly attributable to the speed of technological change and the aging of the workforce, which is increasing the gap between technological possibilities and the willingness and ability to utilize it.

The strategic importance of maintenance services is increasingly recognized by the government, which has launched multidisciplinary R&D projects and education programs. The situation is more aggravated in the logistics necessitating more governmental support for education and promotion campaigns. The upgrading of skills is needed not only on the operational level but also managerial skills are often deficient. This is especially the case with the SMEs in raw wood transportation. Deficiencies can be found even in the basic infrastructure, i.e., road and railway networks, which need improved maintenance and extensions.

For technical engineering and consulting, governmental actions are generally sufficient. Nevertheless, there are signs of growing difficulties in recruiting a new work force. This is because industries like the manufacture of electronics and telecommunications equipment are competing on the same labor markets and are capable of offering more attractive career opportunities. Hence, as with logistics, aging is becoming a severe problem that needs more promotional measures by the industry and the government.

Another obstacle is related to finance. In order to participate in publicly funded research programs, engineering companies are often, by funding rules, forced to cooperate with big equipment manufacturers, which are able to reap most of the economic benefits

from the projects. This leads to incentive problems hindering the commercialization of otherwise competitive innovations by the engineering companies. An inherent problem is also the difficulty to patent knowledge.

Governmental support and collaboration with the manufacturing sector has played a major role in raising the technological standards of ICT and related services. This is augmented by the accumulation of knowledge within the forest industry facilitating the development of industry specific technical solutions.

While the overall development has been impressive, there are some factors bringing uncertainty on future development. The most important obstacle in the near future is the availability of a qualified workforce. In contrast to the engineering services, this is not because of the unattractiveness of the industry but is due to the deficiency of the educational capacity to meet the growing demand for labor. As a result, recruitment from abroad is increasing.

A potential threat in the long run is the structural developments of the ICT sector itself. In Finland as well as in Sweden, the ICT sector is dominated by the development and manufacture of consumer appliances, where cost efficiency and mass production is increasingly the driving force for competitiveness. With the growing vulnerability to market uncertainty, the chosen strategy may weaken innovativeness and the progress of industrial applications in particular.

4.3 Organizational and Market Induced Competitiveness

Of the two other determinants of competitiveness, the mode of governance of the service transactions defines the level of organizational efficiency. In theory there is an array of organizational forms with associated efficiency implications, but here the focus is on the general make-or-buy strategies. In particular the main issue raised here is whether governance structures are sensitive to changes in market structures and technologies.

As noted in Section 4.1, extended application of new technologies in the service production is transferring the competitive advantage from internal to external service procurement. This happens in two ways. First, the raising knowledge-intensity and complexity of the services favor specialized and independent production. With the revised incentives entrepreneurship adds to the innovativeness strengthening knowledge-intensity further. Second, the standardization and convergence of technologies increase the potential for economies of scale and scope in the supply of services, which makes outsourcing a cost effective strategy.

For market-induced competitiveness, which refers to the impacts of industry structures and associated strategies on both sides of the transaction, there are two principal sources. Competition on forest product markets determines the properties and level of induced demand for services as well as the extent the forest industry possesses the possibility of exerting monopoly power on service enterprises. The latter is co-affected by the structure and strategies of service industries.

For the past two decades or so the tendency in the manufacturing sector has been a gradual outsourcing of services activities, i.e., transformation of KISAs to KIBSs. The forest sector, however, is lagging behind by pace and scope. The reasons for this can be reduced to two major factors, the conservatism of corporate management and defensive trade union policy. For the latter case, outsourcing is opposed by the trade union because it is regarded as weakening its negotiating power in relation to the employer.[41]

4.3.1 Logistical Services

For the raw wood and mill site transportation services the strategy of the forest industry has been entrepreneurial outsourcing, where market-based incentives have led to a higher cost-efficiency. Transforming responsibilities to entrepreneurs could further generate these efficiencies and utilize scale economies.

The fact that the market structure of entrepreneurial logistics is close to perfect, competition gives full negotiating power to the big pulp and paper corporations that are able to define the fees and technical standards of transportation services. Such an absorption pricing strategy prohibits the development of business standards and, hence, also indirectly the long-term competitiveness of the forest industry. The most effective counter strategy for service companies would be to increase company size by horizontal and vertical integration within the logistical chain.

In comparison with raw wood logistics there are more organizational frictions in the transportation of finished products. Many upstream activities located at mill sites could be efficiently outsourced[42] and reorganized but this is hampered by trade unionism. Regarding the logistical chain as a whole, there are inefficiencies attributable to conflicting interests of the parties and inconsistent communication practices. Organizationally, more efficient alternatives would be a hierarchical system where successive stages are set under a common ownership or a decentralized system based on a closer companionship.

Also, the market structure of transporting finished products is competitive but the industry is more concentrated and there is more room for differentiation. Therefore, price competition is less fierce and the distribution of the negotiation power between the forest industry and service companies is more balanced.[43] This is facilitated by the fact that the companies are central actors in the logistical chain through which the forest industries provide service-containing products to their customers.

The ownership of the pulp and paper industry on port operators and the formation of company and mill specific *logistical tubes*[44] are blocking competition within harbor business activities and thereby the realization of overall logistical gains. Restructuring of ownership towards more centralized and independent port operations would result in an improved market and organizational efficiency.

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[41] This is mainly the case in the pulp and paper industry.
[42] For example, there are number of railway terminal activities located within mill sites.
[43] This is especially the case with VR Cargo, which dominates the transportation of paper rolls to harbors.
[44] This is a professional term for established logistical chains between mills and harbors.

The realization of the needed changes is, however, highly conditional on the market structure and strategies of the forest industry itself. First, the big companies with a global scope are utilizing internal scale economies in developing their specific logistical infrastructure. This is not optimal from the point of view of the forest industry located in Finland.[45] However, as the relative strategic importance of the home country diminishes, there are better conditions for collaboration between companies and mills. Some pooling of interests is indicated by recent joint research projects.[46]

4.3.2 Maintenance Services

Contrary to the pulp and paper industry, outsourcing of the logistics and maintenance services is based more on profitability assessments by the management and the owners. However, there is much underutilized potential in the joint procurement of maintenance services and utilization of the associated economies of scale. For organizational innovations, the panel industry is showing the way. In cases where the panel production is reorganized by management buy outs (MBO),[47] strengthened entrepreneurial incentives are manifested in the concentration on core businesses and outsourcing of maintenance and other supporting service activities.

For the pulp and paper industry the major obstacle for the organizational adaptation is the trade union policy, which strives to maintain in-house maintenance activities. Depending, e.g., on the age of the production units, there are differences between companies and mills however. Given the institutional restrictions the current tendency can be characterized as an evolutionary process (see Figure 14), where organizational innovations move slowly to market based governance structures. Moreover, a viable future scenario is the extension of further outsourcing to production processes and operations of entire mills.[48]

Due to organizational frictions the market potential for maintenance services is high.[49] As a result, an array of different business concepts and companies exist that are competing for the gradually opening service markets. The maintenance units and companies owned by the forest industry are competing with full-service companies[50] focusing on the entire manufacturing sector. Additionally, the equipment manufacturers are increasingly entering their niche markets as they are compelled to search for new business opportunities. A fourth smaller group consists of local workshops acting typically as subcontractors for the leading companies.

[45] More generally, the advantage of Finland is no longer equivalent to the advantage of the forest industry as it used to be twenty years ago.
[46] Examples are KETJU and VIPRO projects funded by the National Technology Agency.
[47] MBO has been successfully applied in fiberboard and chipboard industries.
[48] This is, e.g., a prediction and stated objective of Metso Corporation.
[49] In this respect Finland is no exception.
[50] Examples are ABB Service and Fortum Service.

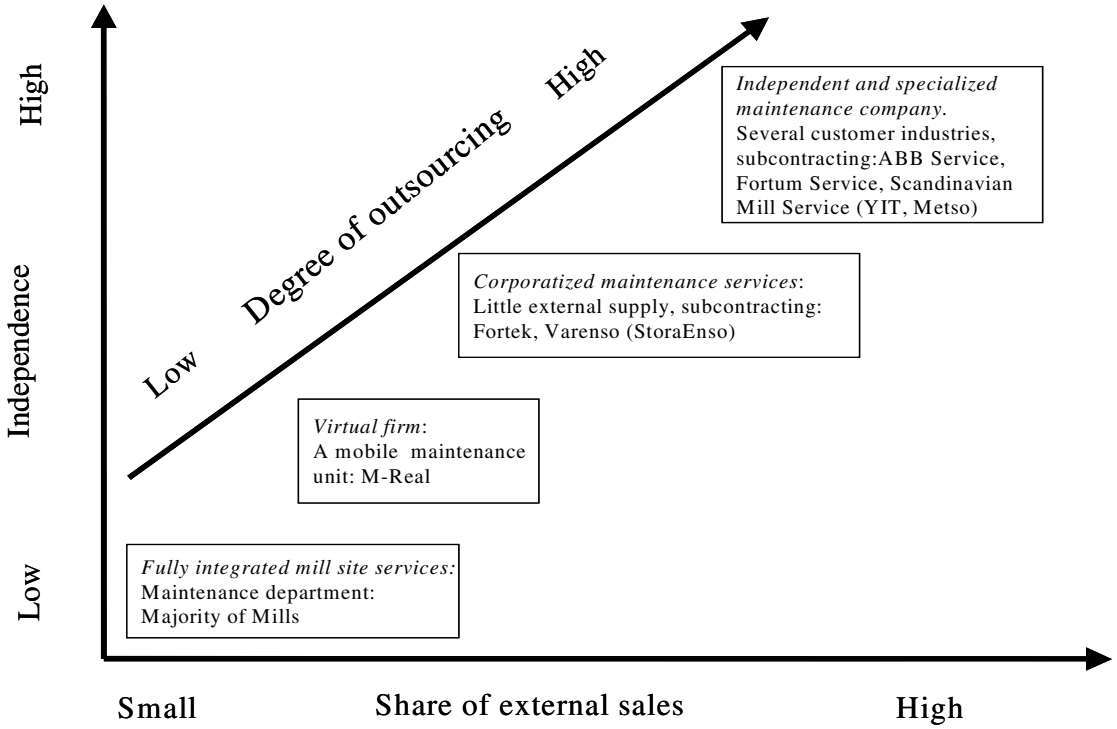

Figure 14: Organizational evolution of the maintenance services.

Regardless of the concentration of the external service markets, competition is fierce and innovative especially among the full-service companies. Innovativeness, which is partly fueled by organizational frictions, is manifested in the commoditization of services with different levels of coverage. Business orientation and better opportunities in exploiting the scale economies across industries are shifting the competitive advantage from internally to externally procured services. The quality of the demand of the forest industry is however highly attributable to the growing complexity of the processes, high technical skills of the internal service departments, and high sensitivity of the profitability to technical disturbances.

As a result of the inflexible labor markets and high concentration of the pulp and paper industry, the relative negotiation power of maintenance companies is weak. Another obstacle for promoting the full-service concept is the conservatism of corporate management itself. Due to the lack of collaborative traditions it is difficult to see the benefits from the companionship, which typically materializes only in the long run. In addition, the idea that maintenance could be a business activity based on win-win relationship is still relatively strange within the pulp and paper industry.

4.3.3 Technical Engineering and Consulting

Similar to maintenance, the development of engineering and consulting services to a separate industry has resulted from the gradual outsourcing of the internal service activities of the forest industries. In contrast to the latter, however, the process for the former has been a more evolutionary adaptation to the changing working environment.

This has occurred even though the occasional resistance by middle management of the deepening integration of the engineering companies into the production processes.

Currently, the strategy in the forest industry is to transfer ever-larger engineering assignments to suppliers forcing engineering companies to diversify into new, related service activities. This also is changing the subcontracting relations and intensifying competition between services companies and equipment manufacturers, which are outsourcing production and assembling activities.

What follows is a gradual convergence of these two supplying industries. Technological progress and changes in competitive strategies reshape the division of labor across the core industries depicted in Figure 15. Two simultaneous processes exist. As companies are increasingly technically integrated through information networks and computer systems they seek new business opportunities by balancing between internal and external services.

Technical engineering and consulting for the pulp and paper industry in particular, has been one of the spearhead business areas of the Finnish forest cluster for decades. Although few companies dominate the market, competition among them is intense and cooperation occasional only. While fierce price competition is sustaining operational efficiency, opportunities for development of business practices are therefore limited.[51]

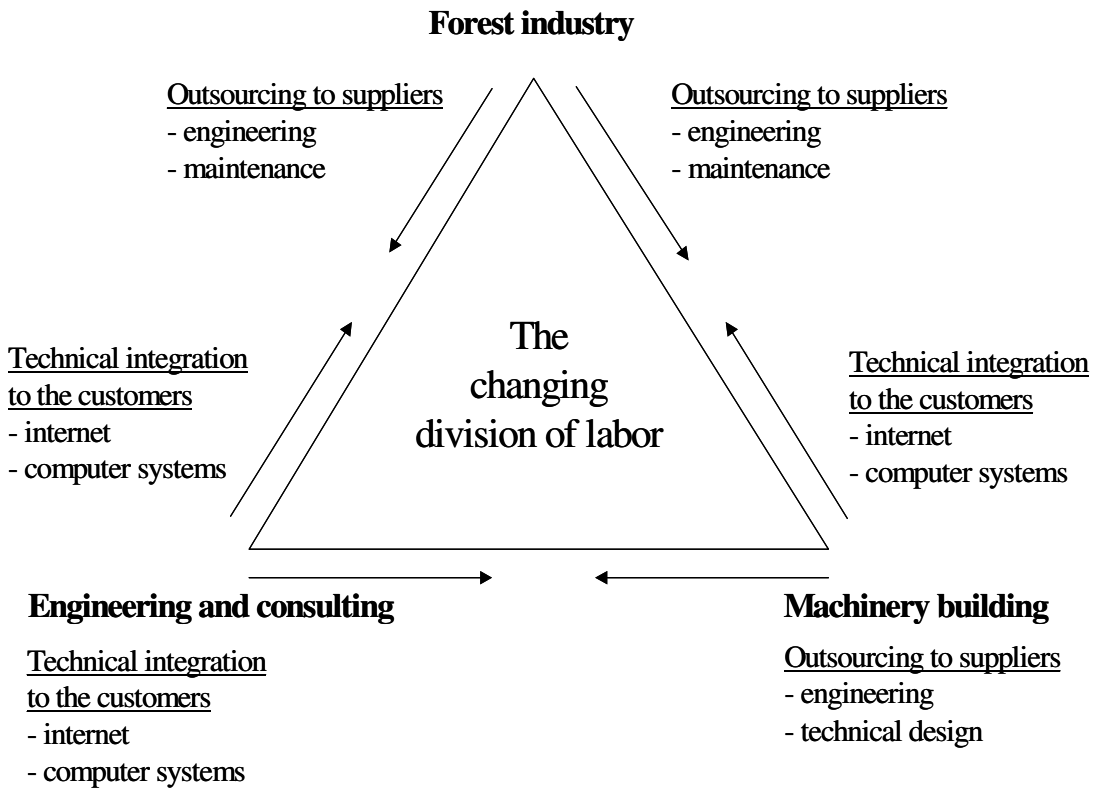

Figure 15: Restructuring of engineering and manufacturing activities.

[51] A good example of destructive price competition can be found in the Finnish steam boiler industry in the 1980s.

Business relations between the forest industry and engineering companies are well established and there is a long tradition of solving technical problems in close collaboration. From the perspective of engineering companies, the demand of the forest industry is exacting but lacking innovativeness. That is, functionality and references are the main criteria for selecting technical solutions. Due to its concentrated market structure, the forest industry possesses negotiation power, which also impedes a more innovative collaboration.

From the perspective of the forest industry, the international competitiveness that the engineering industry affects has a two-edged sword. That is, state-of-the-art knowledge is continuously available and can be transferred to new mills purchased, e.g., abroad but, at the same time, knowledge is leaking out to competitors thereby shrinking the technological lead of the Finnish forest industry companies. Nevertheless, information leakages and spillovers are the main drivers of cross-border cluster formation, for example, in the EU.[52]

4.3.4 Computer-based and Related Services

With the common technological characteristics the structural development of computer-based and related services (CBR) has been similar to that of technical engineering and consulting. The impetus towards a wider outsourcing of the services took place in 1984 as Enso Gutzeit corporatized its computer department, forming currently the core of TietoEnator's forest industry business segment (see below).

Of the competitive determinants in Figure 10, technological development has been the main driver for growing outsourcing. That is, the complexity of ICT and the need for upgrade knowledge, anticipation of future trends and the maintenance of high utilization rate of assets are shifting the competitive advantage from internally to externally provided services. This is further facilitated by a lower company specificity of the software, the emergence of large software packages (ERP) and higher frequency of transactions[53] creating scale economies in the production of services.

While the forest industry is no exception in these respects, the shift towards externally provided services has proceeded more slowly than in the manufacturing sector on average. A partial explanation is the outdated view that in-house computer service activities are one of the company specific assets creating competitive advantage and should not be outsourced.[54] A more plausible explanation is the risks associated with extensive outsourcing, which is also exposed to counter arguments. Namely, if the only change is, say, a partial transfer of in-house personnel to the service companies the risks are few but the potential for efficiency gains is high.

Nevertheless, with their outsourcing strategies the big forest companies differ substantially, reflecting different corporate cultures and historical backgrounds. The most advanced outsourcing strategy — extended applications of the ERP-concept and

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[52] According to expert assessments, the technology gap is already closed. This is demonstrated by the fact that the biggest and most productive pulp and paper mills are located outside Finland.
[53] A change from a discrete to a continuous flow of transactions.
[54] This view is typically adopted by the computer service personnel, who try to justify their positions.

utilization of data network services — is adopted by M-Real. To a lesser extent, an equivalent change is also taking place in sawmill and panel industries. According to a future scenario of the computer service industry there will be a widespread changeover from internal KISAs towards ASP-based KIBS[55] in the whole forest industry.

Regardless of the fluctuating forest product markets the demand for computer-based and related services is constantly growing. In the conceptual framework presented in Table 2 the growth of external demand is boosted by industrial growth, substitution effect, outsourcing and complementary nature of information. Supplementary factors are the growing value added in forest products and international mergers.[56]

Although the service market in Finland is dominated by few multinational enterprises, typically diversified to all industrial segments, competition among them is intense. Moreover, they face competition from smaller domestic and often more specialized software providers. As computer services form an umbrella linking all other services (see Figure 11), the distinction between service activities is diminishing enhancing competition further.

Technological convergence is also vertically reshaping competition. While the leading companies supplying process automation are expanding upwards to the mill systems increasing competition in a bottom-up direction, the software companies are moving from corporate level ERP-systems deeper into production processes. This may be called top-down competitive strategy.

Among all of the industry segments, the forest industry can be assigned a special strength of the Finnish CBR service industry. The leading domestic company is TietoEnator Corporation, which is also well established in international markets.[57] In general, the integration of process automation and ERP-systems facilitates the growth of a new knowledge-intensive service industry in the Finnish forest cluster. The competitive edge is demonstrated by the fact that technology leaders in the forest industry have located their product development activities in Finland.[58]

As with other services, the concentration of the Finnish forest industry has strengthened the negotiation power on the demand side of the markets. As a result of technical progress, however, this has partly leveled off by a growing dependency on fewer suppliers. From their perspective, the Finnish and also the Swedish forest industry is more innovative even though the forest industry in general is more conservative relative to other manufacturing and service sectors.

In the forest industry there is a deep-rooted view that information technology is primarily a device for overall cost reduction. While the application of new technologies aims to substitute technology for labor, the objective is also to minimize costs incurred

[55] In the Application Service Provisioning (ASP) concept, software is available in the servers connected to the data networks of the customer companies. Licenses are then replaced by the purchased time for using the services.
[56] In the latter case, merging the purchased production units to existing capacity usually necessitates an upgrade of data transmission infrastructures.
[57] A supporting factor is that the forest industry is a niche market, which is not attractive to big multinationals.
[58] These companies are Metso, Honeywell, ABB, SAP Finland and TietoEnator.

by data processing and services. Much less attention is paid to the opportunities for increased productivity, the creation of value added and innovations as company specific assets. This would necessitate a closer collaboration with service companies.[59]

5 Conclusions and Discussion

5.1 Policy Options

Growing interdependence of national economies and the evolving information societies in the industrialized countries are bringing about substantial changes in the business environment. While an array of new competitive strategies has emerged, governments are facing a common policy dilemma: how to balance between the promotion of high-tech industries offering superior growth prospects with high uncertainty and the traditional manufacturing sector associated with lower growth opportunities but more predictable economic outcome. As indicated by international statistics, countries differ by pace and extent of restructuring, and Finland shows a distinct ICT-oriented industrial strategy.

Independent of chosen manufacturing policies, there is a common endeavor to strengthen the service sector, which currently accounts for 60% to 70% of the GDP in industrialized countries. In the following paragraphs the general pattern of Finland shows a structural anomaly, that is, a high proportion of non-marketed or public services in the total service production. This is also characteristic of Sweden. Consequently, the share of marketed services (business services) in the GDP is predominantly lower than in the EU and the USA. Although the productivity growth of marketed services in Finland has been high in international comparison (Mankinen *et al.*, 2002), their lower share in the GDP indicates that there is a high potential for outsourcing and increased exports of services.[60] This creates a major challenge for the restructuring policy.

Based on KISA and KIBS concepts the study provides a supplementary taxonomy on service activities. The purpose is to give more insight on the characteristics of services and their growth opportunities, which also supports industrial policy design. For the functional services with low knowledge-intensity the growth is constrained, since service-intensity of production processes tends to be fixed.[61] For these services customer industries apply primarily cost minimization strategies. In contrast, through better substitutability and complementarities with other inputs, information services possess higher growth potential. They bear the potential for increased value of the final products enabling differentiation strategy.

For the KISA or more generally SA approach, outsourcing is growth-neutral, since it does not differentiate between internal and external services. In reality, outsourcing is

[59] Probably the best example is the collaboration between TietoEnator and Stora Enso.

[60] Regarding the long-term productivity growth of manufacturing, Finland out-performs the leading industrialized countries. The major problem is low productivity of public services. Therefore, increased privatization and outsourcing of supporting services is called for.

[61] In the long run there may be substitution towards services, which reflect the changes in the relative prices of inputs and a more efficient use of physical inputs.

motivated by improved quality and cost efficiency of services facilitating, for example, exports. In this case, neutrality is relaxed. Moreover, on the user side the changeover to external procurement may release resources for growth in core businesses. For the KIBS or BS approach, which is the basis for most statistical analyses, outsourcing is seen as increasing the business service sector. Consequently, there are three policy implications stemming from the reasoning here.

First, any policy measure targeted on the manufacturing sector also influences the services. If economic activity in manufacturing grows, so proportionally does the volume of internal KISAs and the induced demand for external services, KIBS. If the primary objective is to increase the relative size of the service sector, the innovativeness and information contents of the services have to be enhanced. This is facilitated by the application of ICT in designing, producing and transacting the services, which also improves the competitiveness of manufacturing. Finally, the increased complexity of technologies associated with the growing knowledge-intensity encourages outsourcing further, which from the statistical point of view reduces the biases in assessing the actual size of the business service sector in the economy.

5.2 Potential of the Forest Sector

In spite of the fact that economic growth, employment and welfare are increasingly reliant on the production of services (private and public), the engine of sustainable growth is still the innovative and cost efficient manufacturing sector (see, e.g., CEC, 2002).[62] For business services in particular, domestic manufacturing industries offer an established home market, which — through the Porterian demand effect — facilitates the penetration further into the export market (Porter, 1990). The restructuring of the manufacturing sector and simultaneous outsourcing of service activities reinforce the interdependency and positive externalities.

In this respect the forest sector is of special interest. With its considerable size in some countries, e.g., Austria, Finland and Sweden, the forest industries form a solid market segment for service enterprises. On the other hand, the low-tech nature of wood processing leaves untouched much potential in utilizing competitiveness effects through the innovativeness of services. Unutilized competitive potential also exists in outsourcing. As pointed out above, the operating environment of business enterprises[63] is altering as a result of globalized competition and technological advances in process technologies and ICT. While these push-and-pull effects have encouraged a growing external procurement of services, the forest industries are lagging behind due to inherent rigidities of the industry.

According to the security-based explanation of the forest industry, outsourcing is restricted because of the capital-intensity of production, that is in-house activities are needed as insurance[64] to secure the availability of services and to prevent and minimize the losses caused by abrupt breaks in production processes. More plausible explanations

[62] In the international division of labor some countries may specialize in services but for larger economic areas like the EU specialization is impossible.
[63] Manufacturing and services.
[64] This includes the premium caused by the cost inefficiency in providing the services.

are the permanence of industrial cultures and inflexibilities of the labor markets.[65] Either way, the forest sector and primary processing in particular, possesses high potential for direct outsourcing, which releases resources for the strengthening of core businesses.[66] Figure 16, where mill site employment in the chemical forest industry is broken down to production and supporting service activities, illustrates the potential.

Regarding the forest cluster as a whole, the dynamics of transaction relations are not confined to manufacturing vis-à-vis services only. The integration of external and internal data transmission networks of the cluster enterprises enables a more efficient execution of make-or-buy strategies on services and fosters competition within and among the supporting industries. This makes the KISA approach more workable in assessing the growth of the service sector.[67]

Besides the growth of the KIBS sector, manufacturing suppliers are also entering service businesses in search for more secured income flows. To a lesser extent this is also the case with the forest industry as companies try to increase the value added of their supply and increase the switching costs of their clients. Most notably this concerns logistical services purchased from service companies, customer specific product design and information services on the properties of the products.[68] As with supporting services the forest industry, to a growing extent, is delivering their services through the data networks.

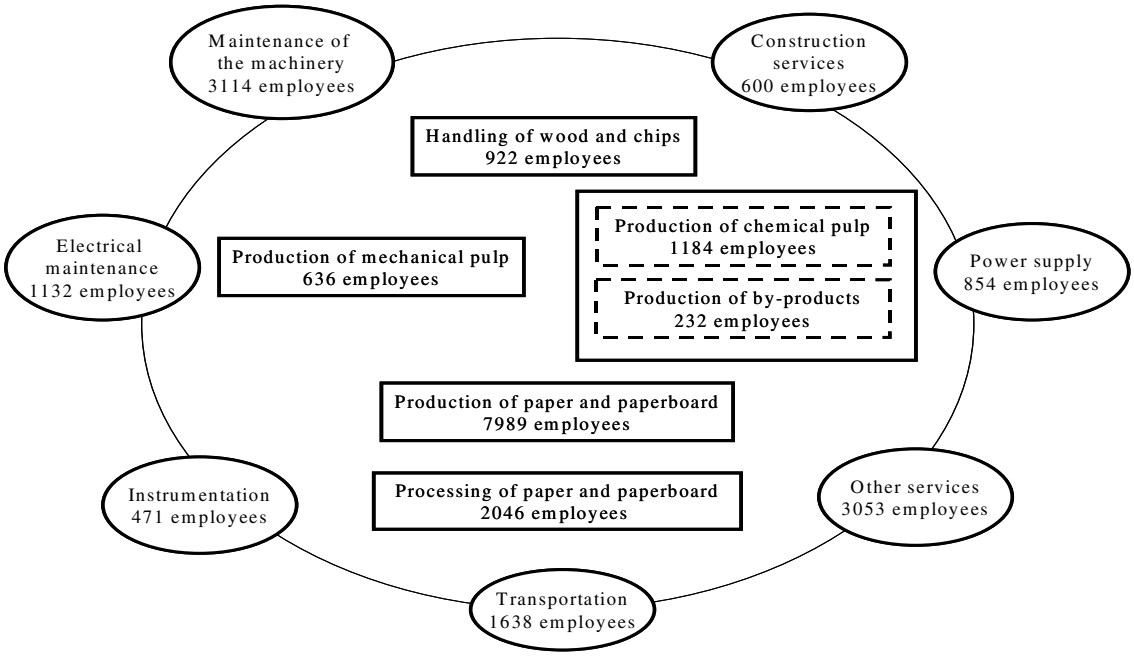


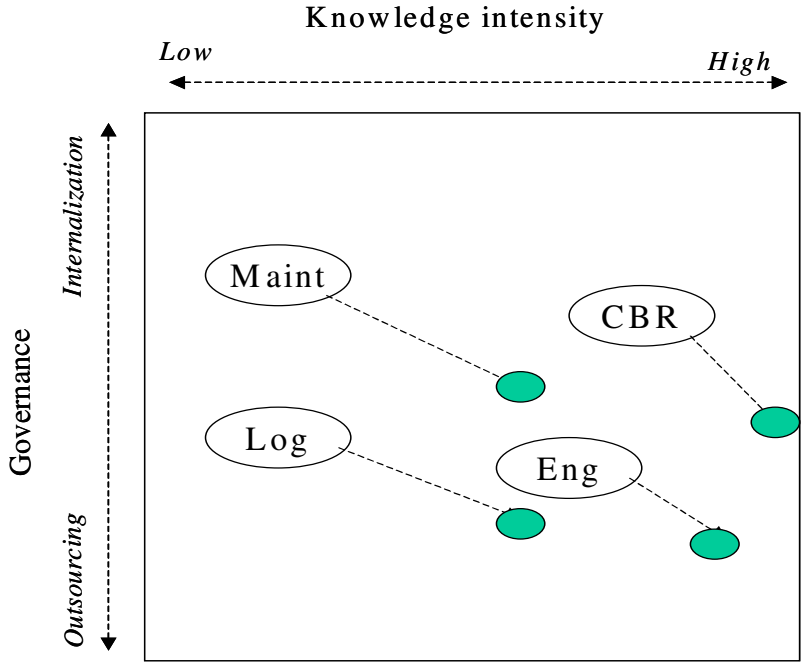
Figure 16: Production related employment of the Finnish pulp and paper mills in 1998 (FFIF, 1998).

[65] In the 1960s, the Finnish forest industry companies tried to produce all of the services needed and demanded by the employees in production processes. Employee demands included health care, education, day care, shops, etc.
[66] Unexploited is also the complementary use for innovative KIBS.
[67] In this respect the lower-right corner in Table 2 becomes most appropriate.
[68] The higher the value-added of the products, the more viable are the design and information services.

Based on Table 2 (see Section 2.1) the main dimensions of the investigated services are presented in Figure 17, where the y-axis measures the degree of outsourcing and x-axis the overall knowledge-intensity. The services are plotted on the box to illustrate their relative positions and current development paths. The degree of outsourcing and knowledge-intensity is predicted to grow for all services. Because of the different starting points and potential, there are differences in pace and direction. Characterized by a higher inherent knowledge-intensity, the changes in CBR and engineering services tend more towards external procurement, while it is the opposite for the cost-intensive services. This is based on an assumption that the organizational frictions, while still effective, will gradually vanish as competitive pressure from the forest product markets increases. As a result, the differences between the services are also shrinking.

For competitiveness analysis, the forest industry in Finland is used as a special case. The locational factors have shaped the core of the competitive edge and the relative importance of supporting services in Finland, this also hold true for other countries and regions. Through the differing product and marketing strategies, an equivalent pattern is supposedly found in the other Nordic countries, Sweden and Norway, and to a lesser extent also in Canada.

In contrast, for regions with shorter distances to markets the center of gravity is away from production related services to marketing services. The regional differences are reinforced by a different product mix, e.g., in the Central European countries, which are more specialized in higher value added products. Besides an increased importance of marketing services the growing value added contents of the product mix also implies a higher knowledge-intensity of the purchased services.[69]



Legend: Maint = maintenance services; Log = logistical services; CBR = computer-based and related services; Eng =engineering and consulting services.

Figure 17: The dynamics of the investigated services.

[69] This is conveyed by Figure 6 in Section 2.2.

5.3 Towards a Comprehensive Analysis

Discussions on industrial competitiveness have centered on the issue of measuring economic performance and the choice of appropriate indicators and their relations. To put it another way, the availability of statistical data has shaped our understanding of competitiveness and dictated the dimension to be measured. While this is of major concern for any policy design, another problem is finding out the correct causality between the indicators.

The first step out of the stalemate is to recognize that like productivity, competitiveness is a function describing the relation of available inputs to possible outputs. That is, equivalent to factor productivity measuring the technical efficiency of production function, competitiveness, though in a broader sense, measures the economic efficiency of the decision-making unit. This partly explains why factor productivity is commonly used as a direct indicator for competitiveness.

The second step is to characterize the structure for the competitiveness function, i.e., to find out the relevant input and output indicators, which is a much more demanding task than for the production function; there are many factors affecting each other implying that analysis has to be simplified depending on specific issues to be investigated. In this report, a heuristic model on the relations of key input variables is applied. Interestingly, the reasoning here is consistent with the recent communication of the EU Commission on the future competitiveness of the European manufacturing sector:

> *ICT is a general-purpose technology… It has also facilitated new forms of organization such as outsourcing and the tight inter-linkage between industry and services underlined by the above analysis*. To continue, *it is the combination of ICT,*[70] *managerial*[71] *and organizational techniques*[72] *and a skilled labour force that gives rise to significant competitiveness improvements. Technological and organizational change must therefore be accompanied by constant upgrading of skills of labour force — including in positions that are traditionally regarded as low-skill — hence the importance of life-long learning*[73] (CEC, 2002).

As the demand for services is influenced primarily by market-induced and organizational determinants, all policy measures directed to them should enhance the volume and quality of service demand and hence the size and employment of the service sector.[74] The supply conditions of the services are affected through supporting technologies in producing the services giving grounds for effective technology policy, respectively. For the Finnish policy agenda, the major implications are as follows: regarding market-driven technological progress[75] and profit-seeking strive to apply the state-of-the-art technologies, and Finnish business services show a high performance.

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[70] Technological competitiveness.
[71] Market-based competitiveness.
[72] Organizational competitiveness.
[73] This is related to the notion that the application of new technologies and associated upgrade of skill base lead to higher knowledge-intensity throughout the service sector.
[74] The business service sector in particular.
[75] That is the advance of a technological standard resulting from private interests and profit maximization.

For the improved realization of the competitive potential, there are three areas to be changed:

- Revision of governance structures and an increase in organizational flexibility is needed. This would not only remove the obstacles for external procurement of services but also reorganize publicly produced services.[76]
- Revision of corporate strategies of the forest industry is needed to create more innovative and creative transaction relations on the service markets.
- Regarding technological competitiveness, the government should be more active to secure the availability and development of the skill base in the long run.

The conceptualization of services and the competitiveness model introduced in this report is a first step towards a more operational approach. This is needed to better understand the product-service systems within industrial clusters. In doing so, the report contributes to subsequent Finnish KISA projects, which apply a micro-level approach to innovation processes of the Finnish forest industry.[77] In combining case studies on the role of services in single innovations processes with the related models on strategic management, these projects produce bottom-up information for the refinement of the analysis here. The ultimate goal of the Finnish KISA projects is to construct a comprehensive cluster model applicable to other OECD countries and other industrial clusters as well.

5.4 Industrial Classification Revisited

A fundamental issue raised here too, is the conceptual distinction between manufacturing and services, bearing major implications on industrial policy per se. Does such a distinction really exist and if not does sectoral policy design make any sense? Or, what if the manufacturing and service activities are inseparable? According to the analyses based on current industrial classification, the answer is clear: the distinction exists and therefore sectoral policies are needed.

The implication of the KISA approach is that the traditional cut-off approach is unsatisfactory if the objective is to find out the real characteristics of industrial structures. The grounds for the argument are not only on the output side, i.e., that services are increasingly commoditized and manufacturing is integrating to the services, but one could also look into the other aspects of production processes. Either way, as technological progress enhances the heterogeneity of business activities, they should be seen to be more as a continuum based on specific variables.

For instance, an alternative is to look into the strategic *importance*[78] of capital and labor for the production processes, which is illustrated in Figure 18. The importance refers to the extent that capital and labor influence the production process and the physical

[76] Examples are various public monopolies, like harbors in the logistics chains.
[77] These projects are conducted by Finnish research institutes, VTT Technology Studies and SC-Research.
[78] Here, importance of input is different from input-intensity, which is measured in values or volumes.

properties of outputs (commodity or service). The industries with the highest labor dominance are located in categories A and E, which encompass most of the public services, too. The categories next to them may be called capital-dominated manufacturing and capital-dominated services. For the latter category, which has evolved from the labor–dominated services, the growing capital-intensity has contributed to superior factor productivity (Mankinen *et al*., 2002).

The highest capital dominance and the lowest importance of labor is shown in the process industries in category C, service-based manufacturing. Similar to category D, the actual production process is executed by basic and supporting technologies (ICT),[79] while labor is used mainly for control and supervision to provide operational services. As a result of increased capital-intensity and automation, this category evolved from category B. Being a form of KISAs, supervisory services are produced mostly internally, but as the services are increasingly standardized, there is a growing interest in the possibilities to externalize them, too. Examples can be found in energy production; as manufacturing industries, e.g., the pulp and paper industry, are selling out power plants to energy companies, another applied strategy within the power industry is to outsource only the operation of the plant creating markets for operational services.

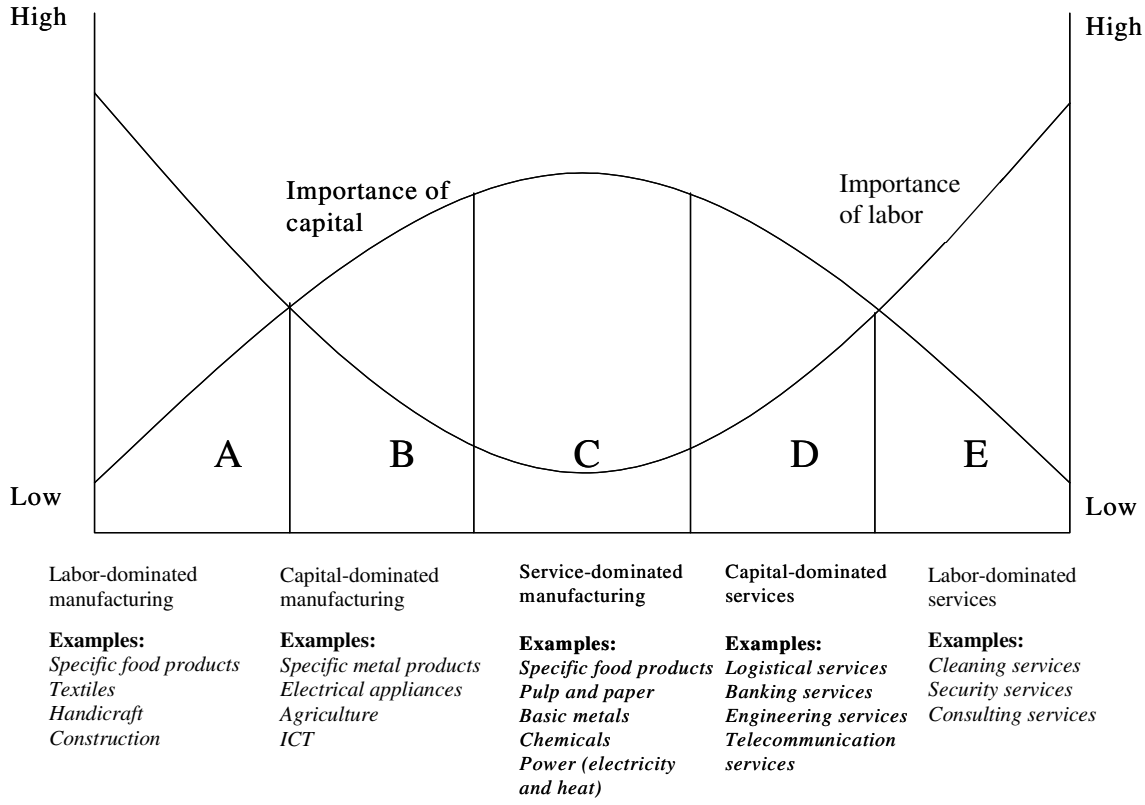

Figure 18: Continuum of business activities.

[79] See the model in Section 3.

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