Knowledge-intensive Service Activities in the Finnish Forest and Related Engineering and Electronics Industries (Forenel) Cluster

FINAL DRAFT

Ed. Jari Kuusisto

This report presents the results of three related research projects each addressing the role of KISA in innovation in the Finnish forest industry and related engineering and electronics (Forenel) cluster. The study is made of four elements that complement each other:

- Forest-Engineering-Electronics cluster description, (ETLA) Hernesniemi, H. and Lindström, M
- Evolving Forenel Cluster and the role of KISA (ETLA) Hernesniemi, H. and Lindström, M
- New business models and the role of KISA (SC-Research) Juntunen, A.
- The role of KISA in innovation process (VTT) Hyvönen, J.
The paper at hand analyses the role of knowledge intensive service activities (KISA) in the forest and related engineering and electronics cluster (FORENEL) in Finland. The KISA project is conducted under the auspices of the OECD Group on Technology and Innovation Policy (TIP) subordinated by the Committee on Science and Technology Policy (CSTP). The lead countries in the project are Australia and Finland. Other participating countries include: Denmark, Ireland, Japan, Korea, New Zealand, Norway, and Spain.

The mandatory studies of the KISA project include analysis of KISA within the Health Care Services and in the Software Industry. Within the KISA project this research represents optional industry studies that participating countries can take up based on their national interest and importance. Finnish forest cluster is highly important since it employs in Finland alone some 170 000 people and its main products have significant, between 25 to 40 % share of global markets.

This study focuses on the KISA role in renewing the ‘old’ backbone of the Finnish economy, Forest industry, or more specifically the Forenel cluster. The project has been funded and coordinated by TEKES. The research has been conducted in collaboration with three research institutes - Etlatieto Ltd, SC-Research and VTT Technology Studies. The analysis is based on 64 personal interviews with experts and business practitioners, Finnish innovation database (SFINNO) and statistical data. The main rationale for the joint project is to combine the most relevant aspects and associated resources to investigate a complex interaction between innovations processes, new business opportunities based on KISA and industrial competitiveness. The purpose is to find out how these processes work within the Forenel cluster and to identify development opportunities which could enhance the future competitiveness of the related industries.

Paris January 22nd 2005

Jari Kuusisto
EXECUTIVE SUMMARY

This report presents the results of three related research projects each addressing the role of KISA in innovation in the Finnish forest industry and related engineering and electronics (Forenel) cluster. The study is made of four elements that complement each other:

1. Forest-Engineering-Electronics cluster description (ETLA)
2. Evolving Forenel cluster and the role of KISA (ETLA)
3. New business models and the role of KISA (SC-Research)
4. The role of KISA in innovation process (VTT)

Overall the aim of the project is to provide further understanding on knowledge intensive service activities, their current use and role in the innovation processes. The specific emphasis is on KISA contribution to the renewal of mature industries, such as the investigated forest industry in Finland. To certain extent the significance of knowledge intensive services in innovation has been recognised. However, there is a need for deeper understanding of the processes through which KISA can influence the development. This understanding needs to be developed on cluster-, business model- and individual innovation process levels. Besides shedding light on the role of KISA in innovation processes, the following analysis can contribute to innovation management and public policy development in the area.

The significance of Forenel cluster to Finnish economy

The Finnish Forenel cluster consists of organisations that are more or less directly dealing with wood in its various forms. Directly forest industry – wood and wood products; pulp, paper and paper products – employs approximately 70 000 people in Finland, and accounts for 5% of Finland’s GDP. As other major actors in the cluster are taken into account (forestry, engineering, chemical engineering, transportation, business services, printing) it is estimated that the cluster employs up to 170 000 people in Finland alone. It can be argued that the overall competitiveness of the Finnish Forenel cluster industries is reflected in their export figures. Overall the share of Finnish forest products of the world’s exports in the printing and writing papers is around 25%. In the area of related machinery production, the share is even higher; in forest tractors 25%, paper machinery 30% and pulp machineries 40%.

Especially in the late 1990’s and early 2000’s the rate of internationalization of the forest industry has been rapid. As a result of direct investments abroad, about 60% of total capacity of the Finnish paper industry is now located outside Finland. In addition, electronics, machinery and chemical engineering are increasingly in foreign ownership. It can be argued, that at present the Finnish forest industry is more anchored to knowledge base of the cluster than the Finnish ownership as such. Besides the cluster as a whole, individual businesses, research institutes and universities located in Finland contribute this knowledge base.
Although the Finnish forest cluster is among the most competitive ones in the world, the future success cannot be solely based on following the path of technological innovation. It can be argued that the core of the industry’s competitiveness is shifting to new type of competences. This is due to increasingly free international trade, expansion of the overseas production capacity, development of information and communication technologies as well as the shifts on the demand for its products.

**Innovation activity and KISA in the Forenel Cluster**

Traditionally, the forest industries have been rather resource based and low in knowledge intensity – at least when measured by their share of knowledge intensive service procurements (such as R&D, computer and data processing, and ICT related services) of all service procurements. This implies limited innovation potential through the use of expert services. However, much of the influence of knowledge-intensive services and innovations come to the forest industry via suppliers, in particular from the machinery and engineering industries. The argument, that suppliers of equipment, materials, components and software, have had a profound influence on the technological development of the forest industry, is well founded. At present the Forenel cluster can be described as a highly knowledge intensive business area and increasingly so in the future. The drivers of this change include: increasing complexity of products and systems, rapid technological changes (e.g., ICT, bio- and process technologies), and extensive outsourcing of various activities. Pulp and paper industry is increasingly outsourcing services to specialised service providers and machinery manufacturers (ICT, project management, consultancy, logistics, technical design, engineering, and maintenance).

**Identified KISA-activities within the Forenel cluster**

*Customer and end user related KISA are an emerging area which seems to gain importance while solution selling and life-cycle services are taking a more prominent role in the business.* KISA within the Forenel cluster can be divided into *up-stream- and down-stream services* in relation to the paper and board producers. Services in the upstream (e.g. service and maintenance) are typically closely connected to the manufacturing firm, and hence, more or less part of the production process. On the contrary, the down-stream services (e.g. logistics and sales) are far less connected to the manufacturing firm, and the production process.

The table below presents different types of KISA which can be seen as catalysts of change and they do have a role in the renewal of the industry. Outsourcing signifies the evolving division of labour within the cluster, and many of the KISA do exist as a result of this development. Within the forest industries KISA in the following fields seem to be particularly important: research and development, technical design, ICT, logistics, maintenance, and consulting.
<table>
<thead>
<tr>
<th>KISA</th>
<th>Description of the activity</th>
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<tbody>
<tr>
<td>R&amp;D</td>
<td>Research and development activities related to: forestry, logging, fiber research, chemicals, process development and logistics. Services are provided by: suppliers, universities, research institutes, RTOs, engineering firms &amp; consultants, seed financing public &amp; private, national technology agency, expert networks, piloting with a potential customer.</td>
</tr>
<tr>
<td>Service, maintenance and facility management</td>
<td>Plant maintenance, servicing &amp; plant level R&amp;D. Key service providers include: equipment suppliers, chemical suppliers, facility management firms, industrial service firms, service and maintenance joint ventures, local and regional service suppliers including educational institutions.</td>
</tr>
<tr>
<td>Expert services</td>
<td>A wide variety of techno-economic, environmental and forestry-related services mainly supplied by: engineering firms and Forest industry consultants, equipment suppliers and their contractors, universities and research institutes.</td>
</tr>
<tr>
<td>ICT-services</td>
<td>Process control and automation, business management systems and global infrastructure mainly sourced from: IT-equipment suppliers, software developers, software service firms, and telecommunication operators.</td>
</tr>
<tr>
<td>Marketing, logistics and customer interface related services</td>
<td>Solutions selling, integrated systems and marketing services mainly supplied by: research institutes, consultants, a wide variety of experts providing specific knowledge for projects requiring cross disciplinary knowledge, experts from customer firms.</td>
</tr>
<tr>
<td>New business venturing</td>
<td>Business incubation and new business venturing type of services provided mainly by: innovation units, inventors, SMEs, business development experts, legal experts (patenting), financing experts and researchers.</td>
</tr>
</tbody>
</table>

Typically KISA activities that are sourced from external experts are relatively specific in nature. Forest businesses are very keen to maintain the overall control of key processes in-house. Effective management of highly complex techno-economic entities, such as paper mill, is one of the core competences of the industry. Cluster- and value chain analysis provide tools for more detailed analysis of such complex systems.

**Features that characterise KISA and their role in innovation and new business model development in the Forenel cluster**

1. **Outsourcing, networking and co-operation between organisations**

The competitiveness of the forest industry is becoming more dependent on a combination of contributions made by various forest cluster actors. As a result interviewees recognise the mounting challenge of managing increasing numbers of external experts representing numerous different disciplines. In research and development, the focus is increasingly on developing solutions that integrate different technologies, materials and knowledge. Hence, effective use of external R&D resources and management of cross-disciplinary networks and teams has become a key capability in the field. Public organisations provide an important framework as well as resources for various forest cluster actors. In their long-term research and development, pulp and paper firms increasingly rely on public research and technology organisations, whereas their internal R&D focus is on projects with
close links to business activities and markets. The role of private expert service firms (KIBS) (e.g., in the fields of engineering, IT, and consulting) is typically to find a technically and economically optimal solution to a certain project.

In mill service and maintenance, new business models are based on outsourcing of maintenance and related service functions to industrial full-service firms, equipment suppliers and joint ventures. Overall such new partnering relations can bring forth improved performance for the mills, new innovative maintenance solutions, disseminate knowledge and competence, and make maintenance a more business oriented, higher profile activity within the mills. Again, the biggest challenges are related to co-ordination of effort between the parties involved.

As paper- and paperboard firms are moving into the provision of integrated solutions to their customers, new concepts are developed jointly with the key customers, KIBS firms, other horizontal partners as well as research and technology organisations. Typically, solutions that add most value to the customer require a network of partners in different industries or branches. The aptitude to introduce value-adding solutions to markets calls for capability to coordinate and make use of existing and emerging knowledge in different technological fields as well as developments on the markets. It is evident that these different bodies of knowledge cannot be entirely mastered by in-house KISA, and external providers of knowledge intensive services are needed.

2. Challenges of coordination and new integrator roles

As indicated above, the increased importance of co-operation between the forest cluster KISA providers leads to new requirements in building and managing such networks. The management of relations with external partners necessitates a high level of co-ordination skills and tools, capacity to manage contract relationships, and potentially, new management roles. Progressive division of labour between the organisations raises the question of who co-ordinates the overall processes? Here, new integrator roles are emerging. Equipment suppliers are taking a more extensive role in mill development (provision of equipment, engineering, maintenance and project management services – and potentially in the future other operational services and financing). Paper and carton board firms are adopting integrator roles in their provision of integrated solutions to their customers. Some KIBS firms are aiming at integrator roles in building and managing of partnering networks as well as in providing integrated, ‘turn-key-innovation’ services.

3. Reliance on internal KISA in core business areas

Despite the general trend towards networking and distributed innovation, the role of internal KISA is strongly emphasised in those areas which businesses consider as their core competence. For instance, in the development of new business models

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1 Integrator KISA extends KIBS role in innovation support to areas like creating links between different actors, building and maintaining networks. New type of innovation process management includes training, documentation, systematization of the process. There are also ‘turn-key-innovation’ services where the service supplier identifies technologies, creates new applications, and builds the network of partners, as well as provides analysis on business strategies and market potential.
and concepts, pulp and paper companies want to keep such core competences as creative input, integrator role, and overall process control within their own organisation. These are considered as important areas for the control of future business potential. Intellectual property rights are a significant issue in contractual relations and a way to secure the development of internal KISA. Business acquisitions are also an important means to get new in-house expertise in the core business areas.

4. Knowledge on markets, end-users and consumers is vital for the paper manufacturers

There are signs that the balance is shifting from supplier driven innovation towards user-driven innovation and technology alone is no longer a source of meaningful competitive advantage, it is a minimum requirement to be in the game. As part of this process different actors are migrating downstream in the value chain closer to the markets and towards consumers. Key drivers influencing the downstream migration include:

- higher margins at the consumer end of the value chain (e.g., packaging for electronic goods, food and medical purposes);
- power based on intimate market related knowledge, now available as a result of rapidly developing ICT;
- need to secure future markets for fiber-based products.

In terms of research, universities are doing increasingly applied research, even to an extent that there are concerns about the erosion of knowledge base due to lack of long-term basic research. Equipment and chemical suppliers are working within the mills focusing their development activities on solutions selling and integrated systems around life-cycle service and maintenance. Finally, paper and carton board producers are developing solutions for their traditional customers in converting- and printing industries but also further down stream to electronics, food and retail industries. As a result, these businesses are entering new markets which they have only a limited knowledge about. All the above industries can be also R&D partners with close linkages and in-depth knowledge on consumer markets. Close following of consumer markets benefits Forenel cluster by providing early signals on the changing markets and demand for fiber-based products. Thus external KISA can be used to provide new non-technological, cross-discipline scientific knowledge on customers’ needs and requirements (behavioural, psychological, socio-economic fields). At the same time these firms are also building up their own internal KISA in cross disciplinary R&D teams focusing on the key customer industries.

5. Credibility of the innovator and his/her ability to build necessary networks are essential in the case of an individual innovation

Many innovations originate from individuals who have special insights in to the production or markets of the Forenel cluster. Even if network-based innovation activity is vital, the role of strong individuals is crucial in initiating and advocating the innovation in the organization. Such innovation champion needs to have credibility as well as persistence in developing and lobbying the invention within one’s own organization. Public sector financing can have a critical role as such but
it can also be helpful in attracting complementary private sector financing at the early stages of innovation process.

The afore-presented findings illustrate how KISA is present in all stages of the value chain from R&D and early stages of innovation to production to customer interface. It plays a significant role at different levels of innovation related activities including individual experts, businesses, networks as well as the framework conditions surrounding Forenel cluster.

Policy related issues

Policies targeting KISA relevant for the Forenel cluster can cover a wide range of issues. Possibilities of innovation policy contribution should be examined in the areas of technology, service activities, delivery channels, customer interface, organisation and in various types of networks. The emerging pattern is markedly close to the dimensions of service innovation discussed in chapter 2. More generally, the role of KISA in innovation can be divided into interaction with customers (front office activities/soft side) and systems which enable the delivery of KISA (back office activities/systems & technologies). In terms of service innovation, effective customer interface is of central importance as businesses develop and commercialise innovative service solutions. It is also a source of invaluable in-depth customer related information for the research and development. While the back office technologies are a familiar area for technology policy, the customer interaction part is far more uncharted area of innovation policy and deserves more attention. In terms of policy mix, the nature of interaction process favours indirect measures as well as improvements in the framework conditions. However, according to international benchmarking innovation policy mix in Finland is heavily leaning on technology specific instruments, and direct firm specific interventions (see Hertog and Segers 2003). Even if the instruments now have been ‘opened up’ to cater also service innovation related projects by adapting the eligibility criteria. The very nature of instruments may make them less effective in promoting service innovation (see Kuusisto and Kotala 2004).

The stock of available knowledge provides the foundation for the provision of knowledge intensive services. Investigated Forenel cluster represents leading edge technological knowledge on a on paper and board production and also on a number of other forest industry related areas. Effective knowledge exploitation requires good transfer capabilities from the knowledge creators and absorptive capacity from those who wish to utilise external KISA. As such these capabilities appear to work fairly well within the Forenel cluster. Yet interviewees indicated a need for better division of labour and specialisation between universities and need to secure sufficient level of long-term basic research. Secondly, concerns were raised about the erosion of the knowledge base as a result of universities shift towards more applied research. Thirdly, the focus of university research is biased towards the early stages of the value chain in the forestry and engineering areas. More emphasis is needed on the customer end of the value chain. There is a need for cross disciplinary research which can build up the knowledge base necessary for building and selling of complete solutions for market needs.
Forenel industry is a large customer to KISA and there appear to be limited need for policy measures which seek to stimulate demand. However, outsourcing can be seen as an activity that can increase the demand for KISA. Increasingly outsourcing can be seen as an opportunity to develop business and its competitiveness, not only as a cost cutting exercise. It can lead into more effective specialisation and re-configuring of value chains according to the evolving market place. It can also facilitate businesses strive to renew their mature manufacturing business to a high value added KISA and solutions supplier.
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Introduction

Jari Kuusisto, SC-Research

Services represent a dominant 70% share of the economic activity in all OECD countries and various types of service activities make significant inputs into the value chains across the industries (OECD 2005). Hence, any policy seeking to facilitate economic growth, employment or innovation should pay attention also to services. Fundamental to understanding services role in the economy is the notion that services and manufacturing are highly intertwined. Many of the services would not exist at all out of the manufacturing context. At the same time a large number of people working in manufacturing are, in fact, service sector jobs (Bryson et al., 2004).

Over the last ten years OECD has been engaged in activities seeking to develop thinking on national innovation systems (NIS) (OECD 2004). Considering services dominant role and continuous growth since the 1960s, they have attracted very limited attention in the innovation system research. There is an evident bias of understanding innovations as artefacts of hard technology. Thus, a clear need for empirical research that can advance thinking on innovation policy does exists. By employing a range of different types of studies and methodologies it is possible to unravel the service phenomena. Such studies ought to cover different technologies, clusters, sectors, firm level processes, institutions, policy coherence and governance issues. OECD has taken up this challenge by initiating a number of international projects. In 2002 the OECD launched a set of case studies in innovation. Two are sector based – energy and pharmaceutical biotechnology – and the third focuses on the role of knowledge intensive service activities (KISA) in innovation.

The OECD KISA project is a multi-national research effort which includes more than twenty projects in eight countries. The investigation of KISA role in innovation takes place in four key areas including health care-, software-, tourism and leisure services and resource based industries. The report at hand will analyse forest and related engineering and electronics cluster in Finland (FORENEL). It belongs to the resource based industries group, other contributions to this area include studies on the mining technology services by Australia, and aquaculture by Norway.

The role of KISA in innovation

Innovation has a critical role in the dynamics and development of modern economy. Also individual firms’ success relies increasingly on their innovativeness along with ability to adapt to and exploit changes in customer needs and technologies. Rapid technological and structural changes in the economy have also altered the dynamics related to the generation of new competences and innovative capabilities. Innovative firms are not operating in isolation. Rather, innovation is best seen as an interactive process were a multitude of actors, private and public, internal and external, are involved in creating and disseminating knowledge that provides the basis for the firms’ and whole clusters’ competitiveness. In the context of this
research the contribution of knowledge intensive service activities will be focused.
The concept of KISA involves expert services that may be produced by:

- private firms (KIBS);
- public or hybrid research organisations (e.g., RTOs);
- other public actors (e.g., financing agents);
- networks (formal & informal);
- internally within innovating businesses.

As a whole, the above described knowledge intensive services represent a wide spectrum of activities that bear significant innovation potential across the sectors. It is their capacity to act as catalysers of renewal for the Forenel cluster that makes their analysis particularly interesting and important.

**Objectives of the Forenel study**

Forenel study follows the research themes agreed by the OECD KISA focus group. More specifically Forenel study investigates the role of KISA in the manufacturing context from three different perspectives, as a *cluster level* phenomena, as a contributor to a *value chain* and on the level of an *individual innovation*. In particular, it seeks to shed light on following areas:

- What constitutes the Forenel cluster?
- What types of KISA contribute the development of the Forenel cluster?
- How organizations use them to build and renew their capabilities and competitive advantage?
- How organizations incorporate them to create a dynamic of continuous innovation?
- How organizations use them to increase their absorptive capacity for further new ideas?

Other issues central to discussion include the questions of what causes a firm to develop knowledge internally versus getting it from outside, and how the firm manages knowledge once it has acquired it?

**Research method, data and analytical procedures**

*Forest-engineering-electronics cluster description.* This study by ETLA presents statistical overview of the forest industry and related cluster in Finland. The data has been mainly drawn form the OECD, ETLA, Statistics Finland and the Index of Revealed Technological Database by CHI. Chapter 1 of the report.

Forenel case studies

*Evolving Forenel Cluster and the role of KISA.* This study was conducted by ETLA and it presents an analysis of the evolving role of ICT and R&D related KISA in the Forenel cluster. This section is mainly based on 21 expert interviews. Section 3.1 in the report.
New business models and the role of knowledge intensive services. This case study by SC-Research analyses KISA role in the evolving business models within the Forenel cluster. This section draws information from 25 expert interviews and a focus group interview with industry practitioners. Section 3.2 in the report.

The role of KISA in innovation process: Case POM-concept. This Case-study by VTT analyses the role of KISA at the level of an individual innovation. Personal interviews were conducted for this study. Section 3.3 in the report.
1 Forest-engineering-electronics cluster description

Clusters, such as Forenel i.e. Forest cluster, are networks of organizations, in which dynamic interaction between various actors enhance the growth of competitive advantage. Cluster relations cross sectoral boundaries, thereby innovations and knowledge transfers typically spill over sectors as well.

The Finnish forest cluster is based on wood and beneficiation of wood in its various forms and it can be defined as a concentration of forest-based expertise. Exhibit 1 illustrates a standard Porterian chart of the Finnish forest cluster. The cluster encompasses primary products surrounded by related industries, customers, associated services, machinery, and special inputs.

Exhibit 1 A Porterian cluster chart of the Finnish forest cluster

The forest industry accounts for ca. 5 % of Finland’s GDP. When forestry is included, the share of the whole forest sector rises up to 7 %. It accounts for one-fifth of industrial production.

In 2002, the forest industry encompassed ca. 25% of Finland's goods exports. Although the forest industry has grown steadily in recent decades, it forms a decreasing proportion of Finnish exports. Export of metal products and electronics has grown more rapidly, which explains the reduced share of forest industry products. Currently forest industry exports its products approximately of 12 billion euros, of which paper and cardboard covers two thirds.
Wood, which is the main raw material for the forest industry, is obtained mostly from Finland. The domestic energy input in the forest industry is also high. On average, only 15% of the input required for production is obtained abroad, which is considerably below the figures for other export sectors. Thus the forest industry is still a primary generator of net export revenue to Finland. Geographically, 80% of the exports is directed to Europe. The share of the EU countries was two thirds of Finnish exports in 2002. The parallel share of the North America was 7% and Asia 10%. The most significant export partners of pulp and paper industry are Germany and the Great Britain while the main markets for the wood-products industry i.e. mechanical wood processing industry are the UK, Japan and Germany.

**Exhibit 2  Key figures of forest industries**

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<td></td>
<td>Value added</td>
<td>Value added</td>
<td>Employees</td>
<td>Employees</td>
<td>Export</td>
<td>Export</td>
<td>R&amp;D</td>
<td>R&amp;D</td>
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<td>Forestry (2)</td>
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<td>%</td>
<td>1000 h.</td>
<td>%</td>
<td>1000 h.</td>
<td>%</td>
<td>mill. e.</td>
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<td></td>
<td>2194</td>
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<td>2.2</td>
<td>246</td>
<td>1.4</td>
<td>248</td>
<td>1.2</td>
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<tr>
<td>Wood and products of wood and cork (20)</td>
<td>1115</td>
<td>1.3</td>
<td>1279</td>
<td>1.0</td>
<td>276</td>
<td>1.6</td>
<td>286</td>
<td>1.4</td>
</tr>
<tr>
<td>Pulp, paper and paper products (21)</td>
<td>4246</td>
<td>5.0</td>
<td>4499</td>
<td>3.6</td>
<td>392</td>
<td>2.2</td>
<td>376</td>
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<tr>
<td>Printing and publishing (22)</td>
<td>1425</td>
<td>1.7</td>
<td>1680</td>
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<td>321</td>
<td>1.8</td>
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Lähteet: OECD STAN ja ANBERD tietokannat

Forest industries employ approximately 70000 people in Finland. Indirectly forest industries employ considerably more, because the most of the raw materials, intermediate products and services required in the production processes of forest industry are obtained from domestic suppliers. Forest Academy Finland estimates that forest cluster employs all together 170000 people in Finland. Of these people 70000 works in forest industry, 24000 in forestry, and 16000 in engineering industry. Furthermore, 12000 employees are involved in wheel transportation and carrying functions. Business services, such as maintenance, consulting, education, research and development employ 25000 people. Some 24000 employees are involved in chemical engineering industry, furniture industry and printing houses. The whole value added the Finnish forest cluster creates with these functions is 12,2 billion euros. Also international comparison shows the relative importance of forest and wood processing industries for Finland as Exhibits 3 and 4 indicate.

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2 The basic products are sawn goods, wood-based panels and a variety of derivatives.
Exhibit 3  Relative Importance of Wood Products and Furniture Industries

Exhibit 4  Relative importance of Paper, Paper Products and Printing Industries
The given figures are, however, estimates as the industries included in the forest cluster are contractual and depend on the specific viewpoint chosen. Also the internal structure of the forest cluster has changed during the years and the boundaries of the cluster vary in time as well. For example, increase of foreign ownership and internationalisation of companies has meant that Finnish forest cluster is less home country oriented than previously. In addition, electronics, machinery and chemical engineering industry have mostly transferred to foreign ownership. In this respect one can argue that the Finnish forest cluster means, more than before, development of forest cluster related knowledge and know-how in companies and research institutes and universities located in Finland rather than the Finnish ownership as such. Furthermore, internationalization of the Finnish forest industry companies’ via investments abroad has increased heavily in the end of 1990s. These investments have included both acquisitions and real investments. Investments abroad peaked 2000-2001 due to large acquisitions made abroad, but have slowed down after that as Exhibit 5 indicates. In the year 2002 the level of investments was 2 billion euros. In 2003 investment of Finnish forest industry groups was still below the top years, 2.3 billion euros as a whole. Still, most of it, 1.5 billion euros, continued to be abroad. Currently about 60% of total capacity of the Finnish paper industry is located outside Finland.

**Exhibit 5  Investments of Finnish Forest Industry Companies**

The investments abroad have improved the operating environment of mills in Finland, as investments made in different parts of the world have complemented each other and evened out the risks faced by the companies. Exhibit 6 shows some of the biggest acquisitions of the Finnish forest industry in 1999-2001. The North-America, China and Europe are all represented widely.
Since the Finnish paper industry has focused on high-quality printing and writing papers, efficient capital expenditure is constantly required to maintain the competitiveness of the industry. Technological competitiveness of the Finnish paper industry is among the highest in the world and the production capacity is modern and the paper machines among the world’s largest.3

The overall competitiveness of the Finnish forest cluster industries in the world markets has reflected to the export shares as well. The share of Finland in the world’s forest industry exports is 10%. In the printing and writing papers the share is as high as 25%. In the exports of machinery production, the share is even higher; in forest tractors 25%, paper machinery 30% and pulp machineries 40%.

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3 The wood products industry is less capital intensive than the paper industry.
The roots of the forest industry are in the raw material and traditionally raw material has been the major determinant of the location of the forest industry companies. However, the liberalization of world trade and the expansion of the production abroad, development of information and communication technology as well as development of the final demand of the products have sifted the core of the competitiveness to such elements as *ability to innovate, ability to use and exploit new technologies, as well as ability to establish to new markets*. What is typical to this stage as well is a significant increase in demand and supply of knowledge intensive services (Hernesniemi et al. 1996; Viitamo 2001).

Several studies have pointed out that knowledge intensive service activities are related to innovation activity (Toivonen 2001; Leiponen 2000, 2001). Knowledge intensive companies are shown to influence on demand of knowledge and the production of new information in a society. On the other hand they seem to influence also their clients’ and customers’ innovation activity by supplying them knowledge, competence and skills. Expert activities and services related to them connect companies at the same time as they create and spread information in the

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4 The index of RTA (Revealed Technological Advantage) for nations is the ratio of relative share of patents in technological field M in country N over the relative share of patents in technology M for the world. A value of a RTA>1 for a given technology implies that the country is specialized in this technology. For long term analysis, the RTA index is calculated for 30 technological fields (provided by the CHI database) in three periods: 1980-1986, 1987-1993, 1994-2001.
economy. Knowledge intensive businesses do not typically innovate alone but act in close relationship with various actors. Therefore their services have been seen broadly as an element of creating networks and bridges in an economy (Flanagan 1999).
2 Theoretical context of the Forenel case studies

Jari Kuusisto, SC-Research

Andersen et al. (2000) argue that the knowledge-based economy is also a service economy characterised by at least four key elements typical for industrialised countries.

1. The bulk of economic activity, employment, and output is taking place in service sectors of the economy. This reflects the growth of marketed services as well as public services.

2. Service-type work is prevalent in all sectors as more knowledge-intensive white collar work characterises most sectors.

3. The notion of service extends across the sectors as an important management principle. This means that firms are oriented to providing services – whether their products are raw materials, goods or intangible products – focus increasingly on what their users are achieving. Their strategies are oriented to achieving markets and customer loyalty by responding to user requirements – which means understanding of these requirements, i.e. knowledge.

4. Specialised expert services are providing critical inputs to organisations in all sectors on a vastly increased scale. One major source of growth of service sectors has been the expansion of business services (see Abramovsky et al. 2004). This has reflected in part the outsourcing of functions from ‘leaner’ organisations, and in part business needs to access and use new knowledge, or at least knowledge that is new to them. Knowledge-Intensive Business Services (KIBS) can play important roles in facilitating technology choice, diffusion and implementation; others support organisational innovation and adaptation to changing market and regulatory circumstances (see Miles 2003). Technology-based KIBS, such as computer and engineering services, technological training and consultancy services, and R&D services, play important roles in generating innovations, and in improving the quality of innovation-relevant knowledge around the economy, as they tackle the problems of their clients (see European Commission 2002).

2.1 Defining Knowledge Intensive Service Activities (KISA)

Knowledge intensive services comprise more than just KIBS, private firms providing market-based services to other firms. Services supporting innovation are also provided by public and private research institutions, other public services and through network connections on a non-market basis. In addition, firms themselves provide internally an important share of crucial services. The definition of KISA adopted in this study covers all these aspects. (OECD 2001) Here the examined activities can be defined as:

Knowledge-intensive service activities (KISA) are service activities provided either internally or externally to a firm, in manufacturing or service sectors, in combination with manufactured outputs or as stand-alone services.

By definition such service activities can be undertaken by businesses, public sector actors, or hybrid organisations that are not operating under public sector but are clearly advancing public policy objectives. Such organisations may produce
services themselves, facilitate supply and demand of services, or act as integrators of different types of product-service combinations. KISA is a new concept, with a rather thin research tradition behind it. Almost all research so far has been from the KIBS perspective, or focused on public private partnership between research and technology organisations (RTOs) on the one hand and private firms on the other. Being a new and emerging concept, or should we say perspective, many fundamental questions need to be clarified through further research. Hence, it is important to find out more on, what services are important for what types of innovation in which type of industries? (OECD 2004).

2.2 The role of KISA in the development of a traditional industry – Forenel cluster in Finland

Originally forest industry developed as resource based manufacturing but today large parts of the sector can be characterised as a global high technology driven industry. Such successful transformation owes a great deal to technology suppliers who have invested heavily on research and development. As a result, numerous technological innovations that are being used in forest industry originate from metal-, chemical- and electronic industries. Even if these suppliers are the direct source of many forest industry innovations, it is the national innovation system (NIS) that lays ground for the innovativeness of the Forenel cluster. Numerous public and private sector actors, external and internal experts are involved in creating and disseminating knowledge that provides the basis for the innovation capacity of the cluster. Technological innovations in particular have had a significant influence on the competitiveness and renewal capacity of the Forenel cluster as a whole.

Exhibit 8 Knowledge production and knowledge diffusion between KISA actors (den Hertog et al. 1995, 9).
Exhibit 8 is a schematic presentation of knowledge flows within the national innovation system, stocks of knowledge, absorptive capacity and firms’ competitiveness. Arrows representing knowledge flows are most interesting, since they are closely related with knowledge intensive activities that are the focus of the KISA study. They indicate that knowledge creation and dissemination is an interactive process where knowledge flows to and from higher educational institutions (HEI), research and technology organisations (RTOs), bridging institutions, and forest cluster firms. Inside the business sector knowledge flows within and between forest firms, and to and from their suppliers. Providers of knowledge intensive business services (KIBS) are located in different parts of the system and such service activities can have multiple roles as carriers, sources and innovators on their own right. Exhibit 8 also identifies policy as an element which can directly and indirectly influence actors and knowledge creation and knowledge flows, and KISA activities within the innovation system.

Exhibit 9 Knowledge flows and knowledge intensive service activities in the Forenel cluster

Exhibit 9 provides a more detailed overview of the key KISA actors, activities and knowledge flows in the Finnish Forenel cluster context. First, it illustrates the importance of the knowledge flows that come from the supplier side networks. In terms of value chain these up-stream actors have traditionally been highly important sources of technological innovations. Much of the R&D and innovations utilised by the forest industry originate from suppliers, that is, from the metal- and electronic firms. Typically such innovations improve production speed and/or quality and product features such as the quality of the output product, namely paper and paper board. More recently also the more downstream activities within the value chain have attracted increasing attention. It has been recognised, that intermediary services such as service and maintenance and ICT are an important area for innovations and productivity improvements for the globalising industry. This has materialised as an increasing outsourcing of activities around the core production and growth of production related expert services / KISA. Further on, the knowledge flows that come from further downstream of the value chain are increasingly important since they provide a link to the customer and consumer end of the process (Davies 2001). In the case of market driven innovation such knowledge flows are crucial. In close co-operation supplier and the client can jointly develop new

Exhibit 9 Knowledge flows and knowledge intensive service activities in the Forenel cluster

Consultants
Engineering firms
Chemical suppliers
RTO’s
Universities
Equipment suppliers

Technology development

Development services
Knowledge-intensive services as carriers and shapers of innovations

Intermediary services
Purchase, operation support, monitoring, maintenance, repair, updating and disposal services

Key customers
- Converters
- Printing firms
- Retail trade
- Electronics mfg.
- Food industry
- Etc.

End-user services
Customers buy product-service packages

Joint problem solving provides invaluable feedback information

Services = joint problem solving with the customer

Joint problem solving

Paper & board production

Paper & board production

Knowledge-intensive services as carriers and shapers of innovations

Intermediary services
Purchase, operation support, monitoring, maintenance, repair, updating and disposal services

End-user services
Customers buy product-service packages
solutions to existing ‘problems’, co-create performance enhancing innovations and hence deliver value to the client. For the supplier such close co-operation offers a chance to develop in-depth understanding of client’s business process. In an ideal case, such supplier relationship can develop into a trusted partnership which is able to generate leading edge innovative solutions (Kuusisto 2000; Kuusisto and Meyer 2003). Forest industry itself is a key actor in terms of research and development which significantly improves its absorptive capacity for new ideas and potential innovations. For instance, the line between the development part of R&D and traditional production erodes when new products continuously require dynamic adaptation of production processes. As a result, production blurs into continuous development of the process (Zysman 2002). Such process is typical in the forest industry where paper and pulp mills are being continuously up-graded in terms of productivity, production output and quite frequently also in terms of product features. These projects are typically joint efforts between equipment supplier and plant staff.

2.3 Evolving innovation concept

The following sections provide a brief overview to the evolving innovation concept itself. In chapter 3 these different aspects of innovation concept can be reflected in the case studies which investigate KISA role within the Forenel cluster from individual innovator, ICT, R&D and business model perspectives. At the earliest innovation concepts individual innovator was very much a central figure and a key champion of the innovation. Since then innovation concept has evolved to a multi-actor concept first in the linear and coupling innovation models. In the multi-actor mode, individual firm was first seen as the key managerial unit of innovation, whereas more recent versions of innovation models cover ever more complex entities such as value chains, different types of networks5. Exhibit 10 presents a typology of different types of innovation models that mainly focus on ‘business level issues’.

Exhibit 10 Five generations of innovation models

<table>
<thead>
<tr>
<th>Generation</th>
<th>Key features</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Individual innovator / entrepreneur</td>
</tr>
<tr>
<td>Second</td>
<td>Simple linear models – need pull, technology push</td>
</tr>
<tr>
<td>Third</td>
<td>Coupling model, recognizing interaction between different elements and feedback loops between them</td>
</tr>
<tr>
<td>Fourth</td>
<td>Parallel model, integration within the firm, upstream with key supplier and downstream with demanding and active customers, emphasis on linkages and alliances</td>
</tr>
<tr>
<td>Fifth</td>
<td>Systems integration and extensive networking, flexible and customized response, continuous innovation.</td>
</tr>
<tr>
<td>Fifth +</td>
<td>Integrative innovation model; incorporates both technology and service innovation elements, is characterized by focus on technological and service related dimensions. The latter includes: intangible elements, continuous/incremental improvements, delivery process, personal aspects etc. (Tidd and Hull 2003, 364-5)</td>
</tr>
</tbody>
</table>

5 Manley (2003) presents a comprehensive overview of the interactive innovation frameworks based on: development blocks, complexes, innovation mileux, complex products and systems, competence blocks, technological regimes, industrial filieres, innovation districts, sectoral-, regional and national innovation systems, innovation networks, business networks, value-chains and clusters.
In the early theories of innovation activity, the role of inventors and entrepreneurs was stressed (see e.g., Schumpeter 1934). Even today individuals continue to have a crucial role as innovators but increasingly their work needs to be seen in context. As such individual innovators have highly different abilities to engage external resources to support their invention. In the modern economy innovators themselves have seldom enough resources of their own to push the new product or service successfully on the markets. Hence, they typically need external financing, expertise and networks to be able to turn their invention into a successful, cash generating innovation. It is not only the limited resources that create a challenge for an individual inventor. Specialisation and complexity of modern technology and markets mean, that cooperation and organised innovation activities have become ever more important. (in Toivonen 2004: Lundvall 1992, 9; Nelson 1988, 219; Schienstock and Hämäläinen 2001, 49). Since the 1980’s the interest towards entrepreneurial activities as a dynamo of economic growth, and innovation has been renewed. However, here entrepreneurship is no longer merely a personality factor, but a role. This role can be taken by employer, employee or even an organisation can be entrepreneurial. For instance, innovation department of a large corporation can be seen as an entrepreneurial activity which systematically discovers unexploited potential and exploits it (Sundbo 1998, 120-5).

Multi-actor innovation activity became first known as “the linear model of innovation” (Kline and Rosenberg 1986, 285-286). According to this conception, basic research produces theories and findings that are redefined in applied research, then tested in the development process, and after that marketed as industrial innovations and taken into use. The inherent assumption is so called technological push of ideas towards markets from basic to applied research to product development, actual production and finally to the markets. Besides technological push linear innovation concept also highlights market pull as a source for innovations. This notion assumes that there is a clear market need for a new product or service which is not readily available. However, often buyers are unable to clearly express their needs and requirements to the suppliers. Further on, consumer goods markets in particular, tend to be flooded with new products and services and supply almost always exceeds demand. Often market driven ideas tend to be incremental improvements rather than radical innovations. This feature is typical of new service development where customers often play a significant role. The pull factor may be less relevant on consumer markets which are flooded with alternative products. However, in reality many innovations are not initiated by the producer but customers or suppliers of production technology (Sundbo 1998, 114-15). Successful innovation is increasingly seen as a team effort between a collective of industry players, rather than an effort of an individual firm (Manley 2003).

As an innovation model it reflects post war era when government spending on basic research (especially in the US was motivated by arms and space race) had grown significantly. Such investments in basic research created a flow of new ideas that originated from the research community. Unlike present days, markets were not flooded with competing products and services. On the contrary, well until 1960s post war period was characterised by reconstruction, and demand for products regularly exceeded the supply. To summarise, in linear innovation mode development was characterized by technology push and on the markets demand tended to exceed supply, meaning that market place was not crowded with fiercely competing products. (Kuusisto and Meyer 2003).
Interactive innovation model (third generation) assumes that innovations can be initiated at any stage of the process, not just by technology push or market pull. Interaction between actors and various feedback loops create a situation where innovation process becomes as ever more complex and multidimensional process. Very much the same applies also to parallel innovation model (fourth generation) where linkages and alliances with key suppliers and demanding key customers are seen in an important role as facilitators of new innovative activities (see e.g., European Commission 2003). All together interactive and parallel models indicate that innovating firms cannot be analysed in isolation since their innovation capability depends also on the amount of information and knowledge that each firm is able to receive from the environment in which it operates (Antonelli 1996, 284). By and large, the interaction between the research community, manufacturer, suppliers, delivery system and customers becomes a platform where innovations take place. Exhibit 11 illustrates how knowledge and competence base are shifting towards the consumer end of the value chain, from supplier driven innovation to consumer driven process. Such interactive competence building implies a reliance on a multiple sources of tacit knowledge in the learning process. A firm that is both effective and efficient at a point of time eventually becomes neither unless it can adapt to changing circumstances (e.g., developing technology). This means that it is important to keep options open by maintaining a broad array of innovation interests through multiple relationships (Manley 2003).

Exhibit 11 Knowledge on customers and consumers as a core business competence

Innovation models emphasising systems integration (fifth generation) have their focus on innovation within highly complex, multi party processes, e.g. large industrial projects. This approach places emphasis on continuous innovation and tailoring enabled by extensive use of ICT’s and networking. Here production of knowledge and application of ICT to the production of knowledge are related to two very different, or even contradicting trends. On one hand, there is trend towards contextual specificity, customization and increasing complexity. Here co-production of complex knowledge takes place in increasingly complex and/or uncertain conditions. Simultaneously, there is a constant thrive to automation of simple knowledge in rather simple or simplified situations. When possible, simplification through standardization and division of tasks allows effective use of ICT. This has gained huge productivity increases in manufacturing sector and to an extent the same development can happen also in the case of services. Whereas ICT is a tool that can yield significant gains in the areas where problems can be ‘simplified’, co-production of knowledge in terms of organisational learning and customer interaction is a key competence area in the case of complex problems. Since the world of production is structurally characterized by increasing complexity
and uncertainty, co-production becomes a central aspect of modern production processes (De Bandt and Dibiaggio 2002, 65-71).

2.3.1 Characterising multi-dimensional innovation concept

The development of modern economy is characterised by the critical role of innovation which can be seen as fundamental, inherent and pervasive phenomenon in this context. More or less innovations are present in all parts of the economic and social activity and they are not limited to specific contexts or to cognitive processes. However, systematic research and development lay the ground for organised innovation activity. New scientific knowledge will not automatically lead to an increase in innovation activities and neither is it necessary for innovation to occur. Arguments for broader view of innovation include the following (Toivonen 2004):

- Innovations are embedded in social activities; they are not exceptions nor belong only to the scientific context.
- There are many kinds of innovations, not only radical inventions or technological innovations.
- Innovation is closely connected with learning.
- Tacit knowledge plays an important role in innovation.
- Innovation is a complex process, not an event.
- The creation and diffusion of innovations are intertwined, not separate stages.
- A large number of different actors are involved in the innovation process.

The inclusion of the above type dimensions and evolving technologies have given impetus for ever more complex innovation models that reflect the multi-dimensional nature of innovation. Exhibit 12 presents a number of dimensions that are frequently present in innovations.

Exhibit 12 The multi-dimensional nature of innovation

Exhibit 12 emphasizes the interlinked nature of multidimensional innovation. In addition to traditional technological innovation, there is innovation through new business models, new ways of organising work, and innovation in design or marketing. Managing and exploiting to best effect all these different kinds of
innovation represents a major challenge to businesses today (European Commission 2004;5). It also implies that the more complex the innovation is the more central role successful integration of various dimensions has. However, even the innovation models emphasizing interaction/systems integration tend to be biased towards technological side of innovations, while service and organisation related innovations tend to be ignored or underestimated. Because of the increasing convergence of service and manufacturing activities, it seems desirable to adopt an integrative approach to innovation, one which underestimates neither the importance of technologies nor the possible role of non-technological innovation (see e.g., Gallouj 2002, 24-7).

Exhibit 13  Integrative innovation model

The integrative approach to innovation seeks to provide a more balanced view of innovation without, underestimating neither technological nor service dimensions. In particular, linear and interactive innovation models represent mainly technological approach which tends to equate or reduce innovation in services into the introduction of technical systems into service firms and organisations. Hence, service businesses are seen as users of innovative solutions not inventing them themselves. At the same time purely service-oriented models try to identify any possible particularities in the nature of organisation and innovation in services. Such models pay limited attention to the technological forms of innovation. Hence, the need for more balanced integrative approach, which covers all types of innovations rather than some specific categories (Kuusisto and Meyer 2003). While technology issues have dominated the earlier innovation concepts, more recent discussion has addressed also services and customer related innovations. They have emerged as catalysers of renewal and sources of innovation that can contribute businesses competitiveness across the sectors. The role of customers in innovation process has been analysed in detail in the recent study by the European Commission (2003). They established a number of drivers and barriers for innovation. Customer related drivers of innovation include:
• changes in customer needs;
• changes in technology;
• opening up of new geographic markets;
• changes in government regulation.

This survey of 1000 businesses and 125 other type of organisations shows that customer needs are three times more important than other factors in creating innovation opportunities for businesses than e.g. changes in technology, or opening up of new geographic markets. More than two thirds of the surveyed businesses reported that they involve customers in:

• the provision of new ideas;
• the evaluation and refinement of ideas;
• the detailed design of new products and services;
• the testing of prototypes.

In addition to the above-mentioned activities, majority of the businesses reported that they seek customers to obtain feedback on ideas developed by the firm and to test market new products. As for the customer-related obstacles for innovation, more than two thirds of the surveyed businesses identified the following barriers, starting with the most important ones:

• uncertainties concerning safety or quality;
• low customer awareness about new products and services;
• high costs related to products and services;
• lack of customer skills to use new products or services;
• lack of technical standardisation;
• negative public attitudes to science and technology;
• concerns about how to resolve contractual disputes;
• opposition to new technologies.

Two of the most important drivers of innovation include changes in customer needs and changes in technology. Significantly, both of these are linked with the ICT. On one hand, ICT opens up vast potential in terms of obtaining and processing of customer related information. This in turn allows effective tailoring of products and services. As for the technological change, ICT is among the most dynamic technologies providing thus a most fertile ground for innovations. Overall, information and communication technologies have become an essential element of the business and innovation process across the industries.

2.4 ICT as a driver of product-service innovations

ICT and R&D related services in particular can have many different roles and they are important inputs into the development of new and improved products and processes. As a whole knowledge intensive services cover wide spectrum of activities that bear significant innovation potential, and they can act as agents of renewal for the Forenel cluster. In an ideal case, new technologies and services can transform mature industries and shift them from stagnation to a new growth phase.
Information and communication technologies provide a set of tools that enable manipulation, organisation, transmitting and storing of information in a digital form. As a result businesses capacity to manage data sets, draw conclusions and exercise control have vastly improved. The emerging digital tool set and networks mean that information in a digital form becomes critical to firm strategies in terms of value creation and market capture. Business strategies, organisation, the business models are all evolving in response to, and as a result of use such data management tools. In the current situation effective market information means a new level of control and ability to give functionality to a products. These issues are increasingly at the core of the creation of value. Information tools create the product value by identifying how to segment the market, by generating functionality, and by creating the product customization through digital versioning (Zysman 2002).

2.4.1 Can digitalisation shift power and control to ICT service providers?

ICT creates a situation where the information flows in production processes and within value chains are getting increasingly formal character as digital information and knowledge. Such formalised knowledge is crucial since it permits control of the production. As a result, the evolution of the product or service can be increasingly held as formal intellectual property rather than individual or organizationally specific know-how. This would seem to imply that ICT firms stand a chance of exercising increasing control of the processes across the industries. It is easy to predict that other industries will fiercely oppose the shift of power to the providers of knowledge intensive ICT services, or to the equipment suppliers. Nevertheless, these parties need each other and they have to resolve these issues in one way or the other. In the evolving situation, competitive advantage is often based on widely accepted standards, characterized by a struggle over setting and evolving de facto product-market standards. The scene is very flux because market power may become lodged anywhere in the value-chain, including product architectures, components, and software. However, de-facto standards tend to dictate how the constituent elements are being specified, and the holder of intellectual property rights can exercise significant market power. In the resulting competitive system, the makers of the critical constituent elements rather than the assemblers or users of product-service solutions dictate the pace of production innovation and market evolution.

2.4.2 Implicit organisational knowledge remains a significant asset

Informal and implicit know-how does not lose its significance even if much of the information will be in formalized digital format. Much of the knowledge of product functionality and its development is embedded in organisations and in groups of people who know how to do tasks that individuals could not do on their own. While entire production systems include both the formal knowledge of a product design, component specification, or tooling characteristics, the subtle know-how of how they are combined is found in teams of people and larger organisations. The power of organisational knowledge is something that bears significance on outsourcing decisions. The question is to what extent outsourcing may fragment the production process and hence erode the base of organisational knowledge? Generally outsourcing of knowledge intensive activities means increasing specialisation which can yield benefits in terms of increased productivity. However, there are also wider
issues that influence the potential benefits of outsourcing such as the impacts on employment, skill content of jobs, regional distribution of jobs and its impacts on innovation in services (Abramovsky et al. 2004). The critical question is whether, or when and under what circumstances, production knowledge is a strategic asset and when a commodity? Advances in ICT and related knowledge intensive services permit the reorganization of the division of labour. Such developments create possibilities for extension and reconfiguration of the value chain. (Zysman 2002) For businesses and policy makers the question is, how to develop production so that it remains and develops as a strategic asset, rather than becomes a commodity that is vulnerable to relocation or closure. Proactive adaptation according to changing logics of production can help us in maintaining production capability as a strategic asset that we control, not one that is used against us (Zysman 2002a).

2.4.3 The impacts of ICT are industry specific

The power of digital information gathering, processing, control and resulting knowledge development has altered value creation and control across the industries. However, it does so differently pending on the nature of the industry. The key dimensions influencing the impacts of digitalization to the industry can be addressed through the three perspectives starting with the case where the digitalisation has the most profound effects.

2.4.3.1 Product/service has digital functionality and/or digital markets

The most profound influence ICT has on the cases where products have both digital functionality and digital markets. This type of products and services can be produced and delivered to any place that has capability connect internet. Products and services that have both digital functionality and –markets include many software products and –services, music in digital format and the content of electronic media as a whole. Such products and services are very information intensive but their physical element is either very small or non-existent. The case where digital functionality and digital markets are combined poses directly the fundamental question; what actually is the nature of manufacturing in a digital context?

2.4.3.2 New processes and new materials

New processes and materials can refer to such instances as biotechnology, nanotechnology\(^7\) and open source software to name some. Potentially all of these are highly significant future sectors on their own right. However, they can also lead into re-structuring of many of the existing traditional industries, among them the forest sector. Biotechnology can have an impact on the entire value chain from the forest (genetically engineered biomass), to the plant (increasing use of bioprocesses) and finally to the consumer products (packaging that keeps products fresh, tiny

\(^7\) Nanotechnology has such broad applications that it may turn out to be as important as electricity or plastic. Nanotechnology will affect every industry through improvements to existing materials and products, as well as allowing the creation of entirely new materials. Moreover, work at the smallest of scales will produce important advances in areas such as electronics, energy and biomedicine (Economist, Survey of Nanotechnology, Dec. 29\(^{th}\), 2004).
processors embedded into the paper etc.)

With new process and materials new kind of production skills become essential and this may be a factor that prevents the further outsourcing of production by the forest firms? Or, is the firm able to develop the required skills if the production has been outsourced?

2.4.3.3 Conventional products with digital functionality and a physical function

Digital controls and sensors are adding value and functionality to a wide range of products from cars to home appliances to complex industrial systems. Here the question is whether the control systems and sensors can be seen as commodities or will they mean more fundamental change to the relationship between forest firms and the suppliers of control systems? In the case of a paper mill and related equipment, the IT instrumentality creates distinct controls and adds value. Yet, the underlying purpose and the source of functionality, transportation or paper production is something physical and not digital. Thus digitalisation has somewhat less dramatic influence on the forest industry. Still, developments in the media sector for instance, have a direct influence on paper industry. It could be argued that it is likely that digital media will increasingly replace printed media, at least on a number of market segments (Moore 2001). The task ahead is to understand the meaning of these dynamic processes. The corporate challenge will be to understand where the new development represents competitive threat. The national challenge is to understand clearly that the process of globalization is powerfully shaped by the resources created at the national level (Zysman 2002).

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8 See e.g., http://search.storaenso.com/mini/food/pages/air.htm
3 Forenel case studies

Forenel research project is one of the four research projects that make up the Finnish contribution to the OECD KISA Focus Group work. As part of the KISA project Forenel report represents resource based industries. Currently many of such industries in the OECD countries are going through cycles of changes as a result of globalization process and technological changes, just to name some prominent drivers. The research has been conducted in collaboration with three research institutes - Etlatieto Ltd, SC-Research and VTT Technology Studies. Each one of these studies focus Forenel cluster but they have applied different perspectives and methodologies that complement each other:

- case-study on ICT-related KISA in the Forenel cluster (ETLA)
- case-study on the role of KISA in emerging new business models (SC-Research)
- case-study on KISA role in the case of individual innovation (VTT)

The specific emphasis in the following studies is on KISA contribution to the renewal of the industries and the policy implications that can be drawn on the basis of the analysis.

3.1 Evolving Forenel Cluster and the role of KISA

Hannu Hernesniemi, Maarit Lindström, ETLA

Among manufacturing industries the pulp and paper industry was the biggest single user of external services up to the end of the 1990s. Second one was the machinery building followed by the publishing and printing industry. Even though in absolute terms the forest based industries incur the highest service expenses, they show intermediate service-intensity in relative terms, somewhat higher than in the manufacturing sector on average. As indicated by Exhibit 14 the service-intensity is found highest in the printing and publishing industry for which the biggest category is the out-contracted labour work. In contrast the lowest intensity in the Forenel is exhibited by the manufacture of the wooden packages.

Naturally, in manufacturing other expenses than service procurement, form the biggest shares in expenses (materials, supplies, energy cost etc.). Still the share of services of all expenses has principally increased in all manufacturing industries in the second half of the 1990s. Several reasons can be found for this. For example, more complicated manufacturing processes and technical development, which have increased demand for expertise services. Also the changes in the operating environment and increased competition have encouraged outsourcing of supporting and related activities (Pajarinen 2001; Viitamo 2000a and 2000b).

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9 The ranking is based on the nominal value of the service procurement.
10 Service intensity is calculated as a ratio between the service expenses and the total expenses.
11 Outsourcing refers to work done for a company by another company or people other than the original company's employees. Outsourcing entails purchasing a product or process from an outside supplier rather than producing this product or process in-house.
Service-intensity has increased in various stages of forest industry upgrading chain. The most important service inputs in the forest industry (excl. forestry) are ground transport and logistics as well as business services. In the case of higher value added paper industry, the share of transportation services decreases and the share of business services increases. The increase in business services correlates positively with the degree of processing included in the products. The closer to final consumer demand the industry is, the greater the increase in service-intensity.

From the overall take up of services we can now move the focus on knowledge-intensive business services role in the forest industry. NACE industrial classification identifies at least the following types of KIBS: computer and related activities, research and development, legal and financial services (74111-74129), advertising and marketing services (774130, 74401-74409, 74843) technical services (74201-74209,74300,74841), consulting and labour recruitment (74140,74501-74509) and education (80220,80300,80421-80429). Previous research has also been able to identify certain forest cluster specific expertise services. These include logistical services, maintenance services, technical design and consulting as well as computer and related services (see e.g. Viitamo 2000a).

It can be argued, that research and development and computer and data processing as well as information and communication technology related services are among the most knowledge intensive services. Exhibit 15 presents R&D expenses, EDP designing and programming expenses as well as expenses due to patents, royalties, and licences as a share of all service procurements in manufacturing. This figure illustrates that the share of most knowledge-intensive services has not increased as much as the share of service procurements all together in 1995-2001. It actually seems that those industries, which are most service-intensive are low knowledge-intensive industries and vice versa. Most of the forest industries belong to the low
knowledge-intensive industries. Paper products belong to the medium level of knowledge-intensity.  


Based on the magnitude of procurement of business services forest industries can be categorized as medium level in service intensity and low level in knowledge-intensity. This implies the restrictions of innovation potential via service procurement. Nevertheless, it has to be noticed that analysis of service procurements do not reveal the whole picture as such, since knowledge-intensive services and innovations come to the capital intensive industries also via investments, especially via machinery and engineering industries.  

3.1.1 Innovation activities in the Forenel cluster

The following will discuss the relative importance of the cluster linkages for the innovation activity. Many innovation studies (OECD 2004, EU (CIS3) have pointed out that large businesses with large resources tend to rely more on internal innovations than do SMEs. Recognizing the average size of the business in pulp and paper industry, the high score in internal innovation activity in Forenel cluster does not come as a surprise (Statistics Finland 2000). However, there are other

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12 It may also be that low knowledge-intensive services are the ones with most potential to be outsourced, especially when high knowledge-intensive services are usually considered to be part of a company’s core functions or at least part of the strategically important assets.

13 For example, in the year 2001 knowledge-intensity of engineering industry was 16% and in chemical industry even higher than that.

14 The third community innovation survey, which was carried out in the Member States of the European Union with uniform information contents and methods, examined the factors related to the creation of new products, services and production methods.

15 In this survey, an innovation is defined as a new or significantly improved product (good or service) introduced to the market by an enterprise or a new or significantly improved production process. Innovations are based on new technology for the enterprise, new combinations of existing
important linkages in the cluster as well. The most significant relations refer to the suppliers of equipment, materials and components or software as well as the clients and customers as sources of innovation (see Exhibit 16). Interestingly, the role of universities and other higher education institutes is considerably lower.

**Exhibit 16** Sources of information for innovation in forest industry\(^{16}\) in 1998-2000

<table>
<thead>
<tr>
<th>Source of information</th>
<th>High</th>
<th>Medium</th>
<th>Low</th>
<th>Not used</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enterprise</td>
<td>40.7</td>
<td>38.9</td>
<td>10.5</td>
<td>9.9</td>
</tr>
<tr>
<td>Other firms within the enterprise group</td>
<td>50.0</td>
<td>50.0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Suppliers of equipment, materials, components or software</td>
<td>21.8</td>
<td>49.5</td>
<td>21.0</td>
<td>7.7</td>
</tr>
<tr>
<td>Clients and customers</td>
<td>21.6</td>
<td>43.8</td>
<td>13.3</td>
<td>21.3</td>
</tr>
<tr>
<td>Competitors or other enterprises from the same industry</td>
<td>2.0</td>
<td>27.6</td>
<td>43.0</td>
<td>27.3</td>
</tr>
<tr>
<td>Universities or other higher education institutes</td>
<td>2.0</td>
<td>12.5</td>
<td>34.8</td>
<td>50.7</td>
</tr>
<tr>
<td>Government or non-profit research institutes</td>
<td>3.3</td>
<td>11.8</td>
<td>32.5</td>
<td>52.5</td>
</tr>
<tr>
<td>Professional conferences, meetings, journals</td>
<td>2.2</td>
<td>22.0</td>
<td>33.4</td>
<td>42.4</td>
</tr>
<tr>
<td>Fairs, exhibitions</td>
<td>3.4</td>
<td>29.7</td>
<td>47.5</td>
<td>19.3</td>
</tr>
</tbody>
</table>

Source: CIS III, Statistics Finland

Innovation study proved also that on average 56% of the forest cluster businesses in the fields of pulp and paper industry and machinery and equipment industries have participated in innovation activities during 1998-2000, which exceeds manufacturing average (49.3%). Instead, wood and wood products sector is lacking behind them (38%). The survey pointed also that machinery and equipment producers made more often products and services new to the market than businesses in the field of pulp and paper. It also indicated that companies in the field of oil, chemicals, rubber and plastics innovated more compared to pulp and paper companies or companies doing business in the area of wood or wood products. Most of this innovation activity of the cluster businesses takes place on the domestic locations. The next important co-operation partner groups can be found in the other EU countries.

**3.1.2 KISA and the changing structure of the Forenel cluster**

In the advanced forest cluster the growing use of ICT has been argued to generate increased use of services in all stages of value chain. On the input side, it has been due to outsourcing of service activities and the gradual substitution of tangible inputs for intangible ones. Especially the role of consulting, data processing services, logistics and maintenance services are important in this respect.

The restructuring activities between industries can be illustrated with the Exhibit 17, which describes the change in the division of labour in the cluster. Pulp and paper industry is outsourcing technical design and production services to engineering companies and machinery manufactures. These companies have online connections technology or utilisation of new knowledge. In addition to innovating enterprises, those enterprises that have had either ongoing or abandoned projects for development of innovations are included in enterprises having produced innovations. The reference period of the survey is 1998-2000.

\(^{16}\) TOL 20 and 21
to the information systems of their customers, enabling the supply of services regardless of geographical location.

Exhibit 17  Forenkel KISA triangle

An inherent feature here is the tendency of production and process innovations to segregate as functions from forest industry companies to other actors. That is to say that process innovations are decoupling as a result of technological development and increase in technological convergence. Progress in the field of ICT has enabled codification and convergence of a growing range of manufacturing operations. Such a decoupling is never complete due to complexity of products, rapid technological change and persistence of non-codified manufacturing knowledge. But it points to the progressive division of labour between firms based on product design and systems integration, and those based on manufacture. All in all, this means that in-house dominance over contract R&D is becoming less rigid than has been the case before. Next, we look at the functions of R&D and ICT more closely.

3.1.3 R&D\(^\text{17}\)

Examination of the costs of research and development by industry uncover that R&D service procurement (KIBS) in pulp and paper industry were 9,2 million euros and that of wood product industry 1,9 million euros in 2000. Nonetheless, the total amount of 73,3 million used in R&D in pulp and paper industry and 13,9 million in wood product industry is used for other expenses than KIBS. Major part of them are salaries and other compensations for in-house R&D (I-KISA), which in pulp and paper industry were 41,6 million euros and similarly in wood product industry 4,7 million euros (Exhibit 18).

\(^\text{17}\) Research and development (R&D) activities refer to systematic activity, the aim of which is to increase knowledge or to use existing expertise to develop new applications.
Exhibit 18  R&D expenses of companies by type of expense in an industry in 2000, million euros.

<table>
<thead>
<tr>
<th>Branch of business</th>
<th>Expenses</th>
<th>Employment expenses</th>
<th>Flat costs and current expenses related to constructs</th>
<th>Materials, supplies</th>
<th>Service procurement</th>
<th>Other current expenses</th>
<th>Other flat cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>3135,9</td>
<td>1453,1</td>
<td>177,5</td>
<td>257,1</td>
<td>365,6</td>
<td>653,2</td>
<td>229,5</td>
</tr>
<tr>
<td>Manufacturing total</td>
<td>2538,9</td>
<td>1155,2</td>
<td>143,0</td>
<td>202,7</td>
<td>271,2</td>
<td>560,6</td>
<td>206,2</td>
</tr>
<tr>
<td>Wood products</td>
<td>13,9</td>
<td>4,7</td>
<td>0.7</td>
<td>1.6</td>
<td>1.9</td>
<td>1.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Pulp, paper and paper products</td>
<td>73,3</td>
<td>41,6</td>
<td>4.4</td>
<td>5.0</td>
<td>9.2</td>
<td>10.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Printing and publishing</td>
<td>6,9</td>
<td>3.6</td>
<td>0.3</td>
<td>1.3</td>
<td>1.2</td>
<td>0.6</td>
<td>0.0</td>
</tr>
<tr>
<td>Machines, equipment</td>
<td>262,3</td>
<td>111,9</td>
<td>12.5</td>
<td>35.5</td>
<td>47.3</td>
<td>47.2</td>
<td>7.9</td>
</tr>
<tr>
<td>Electronics and related products</td>
<td>1593,0</td>
<td>696,1</td>
<td>83,7</td>
<td>111</td>
<td>134,3</td>
<td>412,8</td>
<td>155</td>
</tr>
<tr>
<td>Precision instrument</td>
<td>132</td>
<td>63,3</td>
<td>6.1</td>
<td>15.0</td>
<td>20.2</td>
<td>15.8</td>
<td>11.7</td>
</tr>
<tr>
<td>Post and telecommunications</td>
<td>97,3</td>
<td>50,9</td>
<td>6.4</td>
<td>5.3</td>
<td>11.1</td>
<td>15.3</td>
<td>8.3</td>
</tr>
<tr>
<td>Data processing services</td>
<td>123,2</td>
<td>72,5</td>
<td>7.7</td>
<td>4.4</td>
<td>14.9</td>
<td>20.7</td>
<td>3.0</td>
</tr>
<tr>
<td>Research and development</td>
<td>135,8</td>
<td>65,3</td>
<td>8.5</td>
<td>6.5</td>
<td>24.9</td>
<td>24</td>
<td>6.5</td>
</tr>
<tr>
<td>Other business services</td>
<td>104,8</td>
<td>53,7</td>
<td>4.8</td>
<td>11.2</td>
<td>18.3</td>
<td>14.5</td>
<td>2.4</td>
</tr>
</tbody>
</table>

Source: Statistics Finland, Research and Development in Finland

Analysis of R&D expenses by product groups indicates that in wood products and pulp and paper industry almost 91% of the expenses is concentrated on the core product and final products. In machine building the share of forest industry machines and equipment was 44.8 million euros in 2000. That is the biggest individual product group in the industry. It confirms the result that R&D functions are relatively strongly concentrated on certain products with certain actors i.e. paper firms study and develop mostly final products while machine producers the equipment itself.

Similarly, the R&D done in the chemical industry co-exists in the products run in to paper and paperboard industry via chemical procurement from the industry. Another route is that a pulp and paper business can buy an innovative company all together or that an innovative person is recruited to the company. Due to this type of specialization between forest cluster actors, the role of direct in-house R&D as a source of technology is decreasing in pulp and paper industry. Instead technology, which is very important for the capital intensive pulp and paper businesses, is acquired via investments and intermediate products. By investing heavily on new

Technological content of chemical forest industry’s intermediate inputs have, similar to machine builders, increased during the years as chemicals are domestic and often result of long-span research and development work.
technology forest industry has sought to find its place (and also gained) in the front line of technological know-how. The competitiveness of the forest industry is becoming more dependent on a combination of the R&D contributions done by various forest cluster actors, even if final product characteristics are important to all actors. In case study KIBS firms most typical aim in R&D projects is to find technically and economically optimal solution to a certain plan, intent or project. All of them had several external R&D partners outside their own business.

Exhibit 19  R&D as a contributor to the competitiveness of the Finnish forest industry

In forest cluster’s R&D field there are several organizations that serve various forest cluster actors. Some of these research establishments are owned by the forest industry itself. KCL which is jointly owned by the pulp and paper industry being one of them. KCL develops the industry’s competence by producing for its owners the techno-economic know-how needed to develop products and processes. It also offers the industry laboratory and established facilities. Another actor is Wood Focus Ltd, which is a sales promotion and research organization for the wood products industry, with forest industry companies and trade associations as shareholders. Wood Focus promotes the sale of wood products and conducts R&D work. The third organisation is Metsäteho, which carries out research and development in wood procurement and wood production. Its shareholders include, in addition to the forest industry, the Forest and Park Service and private forest owners. Other institutes carrying out research specifically for the forest sector include e.g.:

- European Forest Institute (EFI), a pan-European organization carrying out research for the forest sector aimed at producing information to aid decision-making in the forest industry and in forest administration.
• Finnish Forest Research Institute (METLA). Under the auspices of the Ministry of Agriculture and Forestry, it carries out research aimed at promoting forestry and forest use, and monitors forest reserves and the state of the forests.

• Universities and Research units of the Technical Research Centre of Finland (VTT).

• Finnish Society of Forest Science and the forestry department of the Work Efficiency Institute.

Close co-operation network between KISA providers and their customers is evident. This is just because forest industry companies, are rather applying technology than developing it themselves. The special advantage with shared R&D and technological-operation is that it supports the development of technology and spread of it. Functionality of this network (N-KISA) is based on close and efficient official as well as unofficial co-operation and close relations between the customers, suppliers and research units in all forms of knowledge intensive-activity.

3.1.4 ICT

Technological changes induce changes in market behaviour, rivalry forms and structure of industries. This is especially true for the development of ICT, which encourages new market entries and differentiated services (OECD 2004b:14-18). Due to internationalization and globalisation of the Finnish pulp and paper manufactures more than 50% of the revenues are currently generated outside Finland. In consequence, companies are streamlining their global logistics and manufacturing processes. Similarly, new order fulfilment systems are being developed.

Exhibit 20  Turnover\textsuperscript{19} of the Finnish forest industry and cost of IT services and equipment

\textsuperscript{19}Turnover in Finland means the turnover of production in Finland. Turnover abroad means the sales value of production abroad.
In practice streamlining of the organizations and outsourcing of non-core functions has meant development in which pulp and paper businesses are currently buying over twice as much IT services than a few years back (Exhibit 20). Furthermore, the data communication needs are expected to grow tenfold in the next ten years, which will generate strict demands on the ICT-solution development and implementation.

**Exhibit 21 ICT Transformation Development**

<table>
<thead>
<tr>
<th>Technology phase</th>
<th>Diffusion phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>N:o of firms</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Graph showing ICT Transformation Development]

Abernathy and Utterback 1978
Christensen 1997, OECD 2003

Our case study analysis revealed following key areas in information and communication services for pulp and paper companies:

1) seamless access to and high quality and cost effectiveness of core networks;
2) comprehensive restructuring of IT services as well as global development and integration of logistics, enterprise resource management (ERM), and customer relationship management (CRM) systems;
3) reliable and secure networking to support the mission critical global processes;
4) open-ended service provision for SME partners in logistics and delivery channels;
5) wireless measurement and control of the production process and global support for maintenance subcontractors.

In creation of ICT services KIBS/KISA producers are confronting various types of buying practices (see Exhibit 22). Important question then is to what extent pulp and paper firms are willing to outsource these services?
It is evident that the most competent pulp and paper producers are not willing to outsource the whole of their production machinery real-time management. Paper recipes and detailed setting of machinery is considered a core competence and an element of competitive advantage. Instead, pulp and paper producers are searching complementary service partners, e.g. businesses who are capable of accessing and maintaining their production resources through the network. Maintenance, IT services and communications are complementary assets that, to certain extent, can be outsourced.

Presently several IT service providers have realised these special prerequisites of knowledge-intensive services in the pulp and paper sector multinationals. Accordingly they have made efforts to exploit future business opportunities. For example, IBM has established the European Forest and Paper Innovation Centre (FPIC) in Finland 2003 together with M-Real to focus on the increasing demands of pulp and paper industry. Similarly, TietoEnator has invested in pulp and paper industrial applications globally. In the USA one of these investments includes the acquisition of Majiq Inc. in 2002, the leading IT solutions provider for pulp and paper industry in the USA.

3.1.5 Knowledge-intensive service providers in the Forenel – What role for them?

Knowledge-intensive services have many roles as producers of information and as distributors of information. Particularly relation between knowledge intensive services and innovations has raised interest as many studies have revealed interplay of knowledge-intensive services and new innovations (e.g. Leiponen 2001). We applied Miles’ (1999) classification based on the roles of service providers in relation to the client companies’ innovations. The three class categorization was facilitator, carrier, and source of innovation. All of the case study businesses are
offering their services to pulp and paper firms, in fact this was a selection criteria of the case businesses.

1. **Facilitator of innovation: supplier of engineering consulting services**
   - A KIBS firm is a facilitator of innovation if it supports a client firm in its innovation process, but the innovation at hand does not originate from this KIBS firm, nor is it transferred (from other firms) by this KIBS firm to the client firm.

2. **Carrier of innovation: high value-added information technology service provider**
   - A KIBS firm is a carrier of innovation if it plays a role in transferring existing innovations from one firm or industry to the client firm or industry, even though the innovation in question does not originate from this particular KIBS firm.

3. **Source of innovation: technology supplier, which provides customer oriented solutions in environmental engineering**
   - A KIBS firm is labeled as a source of innovation if it plays a major role in initiating and developing innovations in client firms, usually in close interaction with the client firm.

According to the analysis it is important to notice that information change related to knowledge intensive activities is not necessarily all in transparent, codified form, but personal interactions seem to be very important as well. In consequence, the interaction of professionals and the teams of client firms and the service providers are crucial in creation of new knowledge and innovations. The exploitation of information base and creativity of both parts require therefore fruitful co-operation. Various forms of tacit and formal knowledge seem to be mixed, reshaped and exchanged during the course of interaction as other studies have revealed (see e.g. Nonaka and Takeuchi, 1995).

### 3.1.6 Conclusions

We found following forms of knowledge intensive service activities in the forest cluster while the focus were on technology oriented R&D and ICT services. These were:

- KIBS i.e. business KISA
- I–KISA i.e. in-house KISA
- N-KISA i.e. network KISA
- P-KISA i.e. public KISA

Research and development activities central to forest industry are spread across various actors within the Forenel cluster. Significant inputs into the value chain are done by input providers (e.g. chemical industry), related industries (e.g. process automation) and service providers (e.g. engineering). It is difficult to identify such inputs by means of statistical analysis, as significant part of them are included in the contents of materials and purchased intermediate products, or investments.
The role of in-house KISA (I-KISA), in innovations and R&D is still very important, but the role of KIBS and network related KISAs (N-KISA) are increasing as carriers, sources and facilitators of innovation. Service providers are also needed as integrators, as innovations in various stages of value chains are not possible without cooperation. The role of P-KISA as a source of direct innovation for forest industry companies is not principal as such, but its role is inherent as network and as innovation partner by creating systemic framework and R&D resources for various forest cluster actors.

ICT services as an integrating KISA and KIBS-element is increasing in the cluster due to strong internationalization tendency of the pulp and paper industry. International ICT requirements create heavy demand for high value added services of international scale. ICT can, however, make it easier to separate the location and timing of service production from its delivery and thus change the presence in foreign markets. New technology can be used, for example, to alter management control systems allowing appraisal and monitoring of local operations.

All in all, intangible elements related to the forest industry products have become more important. Such elements as delivery times, maintenance and support services, brand, and image have become significant elements of competition. This would imply that service activities provided by various actors and the combination of them as well as the competitiveness of this entity become more and more important. The higher the value added production, the more important the role of knowledge intensive services and activities becomes. In higher level interactivity, consulting, customer orientation and problem-solving ability become more significant.
3.2 New business models and the role of knowledge intensive services

This part of the Forenel study provides an analysis of some of the evolving business models within the Finnish forest industry cluster. The objective is to identify knowledge intensive services and analyse their role in innovations, and in emerging new business models. The analysis is mainly based on material collected in 25 personal interviews with industry experts and practitioners (see 4.5.2 Appendix A for the list of interviewees). This interview information has been supplemented by existing research and documentation obtained from the analysed organizations.

The empirical material has been organised in three cases that represent different parts of the Forenel cluster value chain (Exhibit 24). The cases concern: R&D activities as an input into the production process, evolving service and maintenance business models in connection with paper- and paper board mills, and solutions selling approach as market related innovation.

Exhibit 24 Key areas of the value chain and related innovations

Input side represent an area where the boundaries for further competitiveness development are perhaps most imminent in the Finnish case. Overall, it is unlikely that either prices or quality of timber, chemicals, electricity, water, equipments or engineering will make a significant difference to the competitiveness of the Finnish forest industry. Also the mills themselves are modern and the core process technology is highly competitive. However, the role of research and development remains vital, although ‘more of the same’ is not the answer. The future competitive advantage cannot be (solely) based on following the path of technological innovation in the past, since this path is likely to be the one with decreasing returns on investment. Hence, new types of research and development are needed (see Schienstock 2004, 6-11). Indeed, the paper and board businesses in Finland are re-focusing and re-organising their R&D and innovation activities, which at least in part reflects the need to find new growth and value-enhancing innovations. These developments are analysed in Sections 3.2.1 and 3.2.2.

The core manufacturing processes in pulp and paper mills are highly efficient and they have been constantly upgraded with new technological options – recently the major impact has been made by information and communication technologies and
advanced control and monitoring systems. Simultaneously, a new division of labour in mill services and maintenance operations is evolving. Such changes appear to offer potential for business model and value chain innovations largely based on new types of service operations characterised by outsourcing of maintenance and related service functions. Industrial full-service firms, equipment suppliers and joint ventures seem to be taking over the outsourced activities. These new business models and innovative maintenance concepts represent a significant development within the Forenel cluster. Section 3.2.3 discusses in more detail these evolving service and maintenance operations.

On the output side development so far has been very much focused on the product, paper and board, itself. Hence this part of value chain offers perhaps most potential for new business model innovations. Tailored product-service bundles and solution selling to customers appear to be most promising areas. Ultimately the success of the Forenel cluster will depend on its ability to renew itself and its relation to high value adding products targeted to the end user markets. Section 3.2.4 discusses board and paper businesses’ shift towards integrated solutions selling to the customers.

Exhibit 25 Focus of the investigation

Finally, Section 3.2.5 summaries key results of the study. Particularly, the focus is on the role of KISA in the identified recent developments and emerging business models in the Forenel cluster.

3.2.1 Re-organisation of R&D activities

In Finland, the pulp and paper conglomerates have recently sharpened their research and development focus. Perhaps the most prominent feature in re-organising their R&D activities is increasing reliance on network based R&D and external service providers. Other features include shortening time horizon for R&D projects and closer linkages between internal R&D and business activities, and focus on market oriented innovation activities. It is also possible that we will see an increase in the use of specialized KIBS organizations in innovation support in the future, as their potential is not yet fully realized in the sector (especially, in non-technical fields: innovation consultancy, market analysis, etc.) (cf., CEPI Strategy Report 2000).

3.2.1.1 Changes in relations with external providers of R&D

The most important impulses for the re-organization of R&D activities come from the markets. These impacts include downward trend in paper-/board prices, need to secure markets for fibre based products and increasing importance of solutions selling. Hence, there is a sense of urgency in terms of developing new value-adding products and solutions. These typically integrate different technologies and
specialist knowledge that is not found within one organisation (Quinn 2000). Many new business opportunities are expected to be based on technologies, materials and knowledge that are outside the traditional expertise of the forest sector. For example, technologies such as ICT, wireless communication, bio- and nanotechnology are carefully looked into to find new applications to the industry. As a result, research and development focus is increasingly on solutions that integrate different technologies (new or existing). In this situation effective use of external R&D resources and management of cross-disciplinary networks have become key capabilities.

Pulp and paper firms increasingly value the research capacity provided by public research and technology organisations (RTOs). The general expectation of the industry is that basic long-term research is to be funded through public sources – that is work that is beyond the time horizon and resources of the businesses (CEPI Strategy Report 2000). For instance, research programmes commissioned by the National Technology Agency of Finland (Tekes) provide an important R&D network infrastructure for the businesses. Typically, the programmes include various research groups (universities, research institutes), KIBS organisations and paper businesses (as well as supplier and customer firms depending on the programme focus). It is clear that increased funding for programmes jointly implemented by research institutions and businesses – instead of direct institutional funding – has been an important motivating factor for universities to get involved into industry targeted research projects (Nieminen and Kaukonen 2004, 197). However, the interviewees voiced a concern that it is very important to make sure that universities have sufficient funding for the more fundamental, long-term basic research as well. Such funding seems to be creating a bottleneck in the innovation system. The joint research programmes with the industry are not alone adequate for building the knowledge base. Hence the share of basic research at the universities needs to be in better balance with the more applied research (see also CEPI 2000).

Interviews suggest that long-term research programmes should increasingly incorporate forest firms’ customers and their customers down the demand-chain (e.g., media, retail sectors). At best, such joint R&D programmes could identify new opportunities for value creation to the existing and potential new customer industries. More systematic investigation of the potential of market related drivers of innovation in addition to the technological drivers is needed (Hauknes 1999). To some extent this type of shift in research focus is already taking place. KCL, the major pulp and paper industry owned research organisation is conducting R&D related to the end-user industries of paper and board products. The research focus of KCL is increasingly on processes, products and end-user preferences in packaging, printing and media.

3.2.1.2 Division of labour and IPR pose key challenges for the research institutions

In addition to the long-term basic research, other two challenges for the research co-operation between universities and the industry were identified. First, as universities are moving more into the direction of contract research, they are developing their own practices on intellectual property rights. From the industry’s point of view, these complicate R&D co-operation, and may even impede otherwise
deepening relationships. Second, when businesses increasingly rely on external providers of R&D, they need new resources for the management of external expertise. There is a need for managers who are responsible for actively creating and maintaining linkages with external R&D service providers. Of particular importance is systematic development of procedures that facilitate integration of the external R&D outcomes with in-house research and innovation activities.

The key challenge for universities and other research and technology organisations is a more effective division of labour between the actors. This is the only way to make sure that the research institutions will support the industry by providing highly specialized timely knowledge in relevant areas. Research institutions need to make coordinated choices on the research areas that they will focus on, and they need to develop their capacity to adapt to changes taking place in the industry. Universities and other RTOs should provide support throughout the value-chain – from forestry to marketing of end-user brands. Currently the weight of academic knowledge is biased towards the beginning of the value chain, focusing e.g., in various aspects of forestry. However, paper producers are increasingly looking into downstream of their value chain to exploit high value added business opportunities. This is an area where the research institutions and RTOs should develop their offering of KISA for the industry.

3.2.1.3 Customers as driver of innovation

Previous sections have focused on long-term, basic R&D where the pulp and paper firms increasingly rely on external sources, such as public research and technology organisations. When the provision of innovative solutions to customers is focused upon, co-operation with the clients becomes essential part of the process. Paper and board firms have established new internal innovation units to foster interaction between the company and its customers. Overall, innovation activity connected to the provision of new solutions to customers is characterised by close customer interaction, new (horizontal) partnerships, and the need to safeguard intellectual property rights associated with the innovative concepts (these will be shortly discussed in more detail).

Based on the interviews, some new or extending roles in innovation support for KIBS organisations were identified. Especially consultants are actively investing in the development and provision of innovation services: broker/integrator roles (putting different actors in contact, building and maintaining networks), innovation process management (training, documentation, systematization), ‘turn-key-innovation’ services (where the service supplier identifies technologies, creates new applications, and builds the network of partners), and studies on business strategies and market potential. Overall, pulp and paper firms are rather conservative in their use of innovation support from private consultancies. This is true, especially, when the innovation activity focuses upon the development of new business models. Naturally, companies want to keep the development of new core competence tightly

20 Stora Enso Consumer Boards provides an example: As they are moving from being a cartonboard supplier to a supplier of packaging solutions (Exhibit 31), they have found that R&D support in hard to find (for instance, in the field of packaging machinery). Naturally, it is difficult for RTOs to quickly adapt to such new requirements, and it needs to be carefully assessed which technologies and fields of expertise are to be focused upon in Finland.
in their own hands, and the role of a consultant here cannot be that of a carrier of innovation from one client to another (Miles 1999). Hence, to increase demand for more strategic services in the field of innovation, consultants (and other external KISA) need communicate more effectively their working practices with several clients, and the value added they provide to the innovation process. ‘Packaging’ the innovation consultancy services with the services of legal experts specializing in intellectual property rights, could be a way to alleviate potential clients’ concerns.

Finally, it seems that at the same time when forest firms are pushing their R&D and innovation focus closer to their customers, the role of their suppliers in R&D has become ever more important. The key equipment suppliers have a growing role in the mill level R&D and process development. Research and development in components, sub-processes and basic equipment, in turn, is very much carried out in the equipment suppliers’ contractor network. By and large, most projects that support longer-term development of technologies or concern the input side of the value chain are performed in co-operation with RTOs and the suppliers.

3.2.2 Changes in internal organization of R&D

Two ongoing changes in internal organization of R&D are discussed in the following sections. First, pulp and paper firms are concentrating their research efforts and tightening the linkage from research to their business strategies. Second, the businesses have established new innovation units to foster the development of new innovations and business opportunities in close interaction with customers and third parties.

3.2.2.1 Research centres

The investigated businesses continue to invest on in-house development of products, processes and technologies that they perceive to be in their core competence areas that include: board grades and paper surface and fibre processing. However, the emphasis of in-house R&D is shifting towards integration of existing technologies to create new solutions to markets rather than developing new technologies as such. Accordingly, research and development projects carried out in the firms’ internal research centres have increasingly a product focus and new projects are tightly integrated with the development needs of the business units. To encourage this market-oriented focus, changes in the research organisation are taking place. A recent example is provided by UPM-Kymmene which announced in the early 2004 that it will concentrate the research and development of its Finnish paper division in Lappeenranta, Finland. The restructuring means that three other R&D centres in Finland will be either closed or transferred to Lappeenranta by summer 2005. The objective is to bring together experts with different but complementary skills and competences and to establish multi-disciplinary teams to create innovative solutions to the markets (Kauppalehti 28.1.2004).²¹

²¹ The research/technology centres have the responsibility for technological development and longer-term R&D projects that are carried out by the companies. There is variation from one company to another, but in general, the focus is on technologies that are more than 3 years away from commercialization – whereas the new innovation units typically focus on commercialization within 3 years.
3.2.2.2 New innovation units

Paper and board firms have established new innovation units to facilitate their search of new business opportunities. New Business Innovations (NBI), a business unit belonging to Stora Enso Consumer Boards, started operations in the beginning of 2004 and UPM-Kymmene founded its New Ventures unit in 2002. One driving force behind these organizations is the need to ensure demand for fiber-based products in the competition against plastic and electronic media. It is also essential for the industry to create new businesses with high value adding potential. Typically that means new innovative products to existing and new markets, as well as new business models – new ways of adding value to the customer industries. A key competence here is the ability to integrate knowledge about what is technologically feasible to the understanding of what type of solutions best support customers’ business challenges. New solutions offered to customers make use of technological innovations, or combine existing technologies and products in new ways to respond to changes that are taking place in the customers’ business and markets (see Davies 2003a, 325). Also, equipment and services produced in different industries or branches are combined to create new value into firms’ ‘own’ products.

Both the development and the implementation of innovative concepts calls for close co-operation with the customers and the partners with whom the solution is provided. The development work may be best characterised as a highly iterative process – in literature, terms such as learning-by-doing and learning-by-interacting have been used (in Toivonen 2004, 79: Johnson 1992, 32). The interviewees described the implementation of new combinations as gradual, practical problem solving where continuous feedback from all parties involved is needed.\(^2\) New innovative concepts can originate from several sources. Investigated businesses are examining new types of products and technologies and they are talking to their suppliers and customers to be aware of their strategies and future expectations. In particular, end-use of products and early signals of change in the end-user markets are studied. Some attractive market segments, such as food-, electronics- and medical packaging, have been identified for systematic development of new applications. Also new internal processes have been developed to systematize the creation and screening of ideas. Finally, a very important way of getting new innovations is by company acquisitions: small enterprises with a potentially winning new concept but insufficient resources for further development are searched for. One concern is that there are very few Finnish medium-sized firms that can have an essential role in the commercialisation of new innovations.

The ability to carry out the innovation process also calls for new vision and skills. The challenges are many including: coping with uncertainty, management of the projects with (new) networks of partners and customers, strict time horizons for commercialisation, ability to make new ideas attractive within the own organization.

\(^2\) The work carried out in the innovation units has similarities with what is typical of innovation in services: the involvement of the end-user, knowledge creation and development intertwined with practical joint problem solving, innovation efforts occurring outside the traditional R&D organization, and the important role of market related knowledge (e.g., in Toivonen 2004, 79 and 91). Indeed, the re-organization of innovation activities in pulp and paper companies provides them with new possibilities for creating service based innovations (such as integrated solutions) in which non-technological features are highly important.
as well as among the customers and the partners. A major challenge is the need to simultaneously build the innovation process for the new organization, and to actually develop innovations to the markets. Consultants and other training organizations are used as facilitators in the development of the innovation process management, but concerns around intellectual property rights seem to result in some cautiousness in the use of outside expertise.

Overall, new innovation focus organisations are trendy in manufacturing. Most major businesses have a unit working on new innovative business concepts. The importance of new innovation units in the paper companies will be tested in the long run. A genuine commitment to building-up new products and businesses necessitates consistent support from the top management and willingness to invest in and take risks in innovation activity. Exhibit 26 brings together the recent developments in the paper businesses’ R&D and innovation activities. The discussion so far has been rather selective and it does not provide a comprehensive review of the R&D activities within the businesses. Instead, the objective has been to highlight changes taking place in the field of research, development and innovation services. The aforementioned can have a significant impact on the development of new business opportunities within the Forenel cluster.

### Exhibit 26 Drives and emerging patterns of R&D and innovation activity in paper companies.

<table>
<thead>
<tr>
<th>Drivers of R&amp;D</th>
<th>Emerging patterns in R&amp;D and innovation</th>
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</thead>
<tbody>
<tr>
<td>➢ Downstream migration in the value chain</td>
<td>➢ Reliance on RTOs and suppliers in long-term basic research</td>
</tr>
<tr>
<td>• Contractors take responsibility of equipment development</td>
<td>➢ Reliance on public funding in basic research</td>
</tr>
<tr>
<td>• Equipment suppliers put emphasis on mill development</td>
<td>➢ Multi-disciplinary and multi-organisational teams at all levels of R&amp;D</td>
</tr>
<tr>
<td>• Paper/board producers develop solutions for their clients</td>
<td>➢ Research centres focus on strategic key areas and form tight links to business units</td>
</tr>
<tr>
<td>➢ High value added products and new business models needed</td>
<td>➢ New innovation units search for opportunities on the markets</td>
</tr>
<tr>
<td>• Focus on integrating existing technologies</td>
<td>• Innovation activity close to customers and end-users</td>
</tr>
<tr>
<td>• Multi-disciplinary teams and networks</td>
<td>➢ Consultants and other KISA organisations develop innovation support services</td>
</tr>
<tr>
<td>• Partnering with media-, printing-, packaging-, retail businesses</td>
<td></td>
</tr>
</tbody>
</table>

#### 3.2.3 Evolving service and maintenance operations in paper mills

Recent outsourcing trend has been obvious also in the paper and board manufacturing where equipment suppliers and third parties have increasingly taken responsibility of service and maintenance functions. There are several interrelated factors that can explain the increased outsourcing of maintenance and related service functions. One of the key drivers behind outsourcing is the pursuit of enhanced cost efficiency and increased uptime of machinery in the mills.
Economies of scale are likely to be achieved when highly specialized maintenance experts work for several units instead of a one. With the growing complexity of production processes these specialists can also best utilize and develop their skills while working across several production environments (Porter 1996, 63). Also, the share of proactive maintenance – based on new technology enabled remote control and diagnostics – is on steady increase (Viitamo 2003, 25). This makes it possible for the service provider to perform some of the service functions physically independently from the production facilities.

The downstream migration of the businesses in the value chain is also relevant here. As the forest firms are moving the emphasis of their business closer to the end user markets, equipment suppliers and industrial full-service firms are finding new business opportunities within the mills. For example, services related to analyzing the condition of the equipment, process optimization, repair and maintenance, and training of customers’ maintenance personnel (http://www.metsopaper.com). In other words, there is both demand and supply for new maintenance services in the mills. Forest firms are willing to outsource non-core activities in their pursuit of higher cost efficiency and as they are placing more focus on providing new products and solutions to their customers. In the supply side, selling of products and systems alone has become less profitable. It is the life-cycle profits generated by servicing the complex products and systems that have become true sources of profitability and continuous revenue streams. This holds true for a wide range of industries – for example, railways, mobile phone networks and flight simulators (Davies 2003a, 322).

The following sections describe two evolving models of organising the maintenance and related service within pulp and paper mills. In the first one maintenance is outsourced to a firm jointly owned by the forest company and an industrial full-service firm. In the second one maintenance is based on service contracts or outsourcing to the equipment supplier. Exhibit 27 illustrates these business models as well as a future option for organising maintenance in paper mills. Though these new business models are based on outside service providers and new partnering relations, it should be kept in mind that the majority of the Finnish paper and pulp mills continue to rely on their in-house maintenance resources.

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23 However, maintenance services may also be perceived to be in the strategic core of the pulp/paper company’s business, and if this is the case the management remains conservative about outsourcing options. It seems that the outside service providers have more interest and potential than the Finnish pulp and paper mills are ready to welcome at the moment. An important reason is also the trade union policy, which strives to keep maintenance activities in-house.

24 Life-cycle profits are generated by maintenance, renovation, operating of complex systems in addition to training customers personnel.
3.2.3.1 Maintenance firm jointly owned by the forest firm and an industrial full-service firm

BMS (*Botnia Mill Service*) and Fortek represent new types of maintenance businesses currently evolving in Finland. BMS was founded in 1997 by Metsä-Botnia and YIT. Metsä-Botnia is Europe’s second largest pulp producer, its main shareholders being M-real and UPM-Kymmene. The industrial service firm, YIT offers technical infrastructure investment and maintenance services for several industries and sectors, in eight countries. Fortek, in turn, is a subsidiary of Stora Enso, which currently owns 75% of the shares. The remaining ownership belongs to ABB, which has developed a high level of expertise in service and maintenance business in global scale. Overall BMS employs 300 and Fortek 780 staff.

The key objective in these joint ventures is to achieve more effective use of service manpower resources. In both cases service staff can achieve higher level of effective working hours when they serve several plants instead of a single unit. These firms also offer full service contracts to customers in related process industries on chemical- and energy sectors. Hence, experience is accumulating in these organisations. The advantage of full-service partners is that they can bring in to pulp and paper mills their global knowledge of and capacity to further develop innovative maintenance concepts and tools. Also, they have developed a strong business perspective, which helps in the overall development of service and maintenance operations within the mills.

Performance guarantees are a common feature of service and maintenance agreements. In such a case, the service contractor makes a commitment to strictly scheduled yearly down time of the plant, quality of production outcome, and a yearly increase in the production capacity. Such incentives, bonuses and penalties,
naturally motivate the service provider to take full longer-term responsibility of the maintenance activities during the agreement. However, the skills of the main equipment supplier(s) may still be used in the form of annual service agreements on special equipment. But it is the single service contractor who has the managerial responsibility for all maintenance activities taking place within the mill.

Exhibit 28  Service and maintenance related KISA activities

<table>
<thead>
<tr>
<th>Typical examples of KISA provided by service- and maintenance firms include:</th>
<th>Examples of KISA activities within the mills:</th>
</tr>
</thead>
</table>
| • Technical services  
• ICT services  
• Software services  
• Diagnostics services  
• Quality control and management services | • Engineering and project management  
• Preventive maintenance  
• Repair shop services  
• Maintenance data system services  
• Process computer maintenance  
• Automation systems services  
• Maintenance/ preventive maintenance of systems  
• Measuring and controlling paper quality  
• Electrical systems and automation  
• Electricity distribution and electric drives  
• Organisation and implementation of lubrication maintenance  
• Roll maintenance |
| For examples see the right hand column. | |

The strengths of these businesses lie in the utilisation of the economies of scale and in the competence experienced professional employees are sharing in different technologies, data systems, mill and works know-how, and specific tools. In addition, the businesses have developed a wide range of services – not only maintenance but engineering and project management, in particular. These functions have become increasingly inter-related as it is the life-cycle performance of equipment and systems that is focused upon. Also, new software technologies allow maintenance services to be ‘embedded’ in equipment and systems. Hence, it is natural that maintenance solutions are planned already in the design and engineering phases. By being directly responsible for the maintenance activities in several mills will provide the service organisation with important feedback for future engineering and project management challenges. Exhibit 29 summarises the potential gains of re-organising the service and maintenance activities in a separate firm that is jointly owned by the forest firm and an industrial service firm.

Exhibit 29  Potential benefits of a joint venture firm providing maintenance services (pulp/paper company and an industrial service firm)

| Benefits of the joint venture business model |
|---|---|
| ➢ Improved overall performance for the plant  
  • lower service and maintenance costs  
  more effective utilisation of labour force and spare parts logistics  
  • focus on life-cycle performance  
  provision of maintenance, engineering, and project management services | |
| ➢ Business perspective to service and maintenance operations  
  • continuous development of these functions as a profit centre | |
Well motivated partners
- performance guarantees: down time, yearly increase in production
- shared gains: bonus and penalty clauses

Enhanced knowledge base
- global specialist knowledge of the service firm and equipment supplier are available
- local plant specific expertise will remain and further develop

Ideally, the client and the service supplier can agree a transparent and mutually agreeable way to share the gains from the new types of service and maintenance business models. However, there are also challenges that need to be tackled. The biggest challenges are probably related to the co-ordination of maintenance effort. For instance, during the actual one-week long service and maintenance break, there are some 500 highly skilled outside experts working within the plant. Any lack of co-ordination between the separate firms operating within one mill may easily exceed achieved gains. It is essential that all parties perceive that there is a win-win situation in terms of fair sharing of risks and economic outcomes. Trust and transparency between all the parties is essential element for achieving effective high quality mill services.

Overall, the joint ventures between forest businesses and service firms have brought forth new innovative maintenance solutions, disseminated knowledge and competence in the partnering organisations, and made maintenance a more business oriented, higher profile activity in the mills. The combination of a paper/pulp company and an industrial full-service firm also appears to be a good one in a situation in which maintenance know-how is becoming less industry specific (Viitamo 2003, 26).

3.2.3.2 Maintenance is based on service agreements or outsourcing to the equipment supplier

When the mill makes use of the equipment supplier’s maintenance services, the nature and depth of co-operation may vary to a great deal. For instance, the service agreement may cover specific equipment or equipment groups, or entire production lines. Scandinavian Mill Service (SMS) is a maintenance business, owned by Metso Paper and Metso Automation since 2002, and it is focusing on cases where the customer is outsourcing their maintenance operations. For example, two maintenance/service businesses that were recently acquired by SMS are providing complete set of mill services for Ahlström Kauttua and Jujo Thermal specialty paper mills in Finland\(^{25}\). Another example of a full maintenance and service contract provided by the equipment supplier is discussed in Exhibit 30. In Germany, Voith Industrial Services has taken the responsibility of full range of mill services of the Hürth paper plant which is in Finnish ownership.

The objectives of (full) service agreements and outsourcing services to the equipment supplier are very much the same as the ones described earlier (Exhibit 29). The equipment suppliers underline their special know-how on the equipment

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and production processes. Such specialised knowledge and advanced analytical
tools enable development towards proactive mill maintenance operations including
optimized service activities throughout the equipment life-cycle. The equipment
suppliers have also a strong knowledge base in customer support and services. For
instance, consulting and advice for investment decisions is often provided ‘free of
charge’ when working with the client.

Perhaps most valuable of all, is the feedback loop that is created from maintenance
and the operational performance of the equipment to designing the equipment and
industrial systems. Inevitably, there is a strong incentive to work out solutions that
add most value to the whole entity throughout its life-cycle. As Davies (2003a,
336) writes:

’System designers and service providers operate in a closed loop, in
which responsibility for operational performance and costs remain
in the hands of a single organisation. This can initiate a virtuous
cycle of innovative improvements ... leading to the design of more
reliable and efficient systems being build in the future.’

Hence, design, engineering, and maintenance and manufacturing form an
increasingly integrated entity. It is possible to build superior competence around
this type of entity which in turn can materialise as competitive advantage over other
maintenance service providers. Naturally, the fact that maintenance solutions can
be built into the equipment and systems (e.g., automated monitoring and diagnostic
tests) provides the equipment suppliers a strong position in this service market.
Equipment suppliers themselves have contracted out significant amount of
manufacturing in their continuous pursuit of reduced costs. These contract
manufacturers are not only involved in manufacturing but also the delivery of KISA
such as design, project management, and maintenance. Continuous efforts are in
place to enhance the efficiency and openness of communications in these partnering
networks, e.g., in the area of IT based solutions for real-time data sharing.
According to one interviewee, those solutions that add value to the supply-chain as
a whole are the ones that will be adopted in the long run. Equipment suppliers have
a good ‘position’ here. They are investing both in developing the efficiency of their
manufacturing networks as well as creating innovative service concepts for their
clients.

A joint venture between a pulp or paper manufacturer and an equipment supplier is
a business model which holds great potential for further development. For example,
the partners could first establish regionally operating units selling service also to
third parties and further outsourcing some of their operations to a network of local
companies. The model could provide the partners with a number of benefits such as,
very close interaction between service firm and the mill resulting in more efficient
decision making; transparency in operations (in particular, in terms of costs and
revenues); and chance for local service suppliers to remain in the business and
further develop. Equipment suppliers clearly recognise maintenance and related
services as an important future business area (both globally and in Finland), and
they make substantial investments in strengthening their role and competence in the
market – also, by business acquisitions. Though the maintenance service market in
the industry is far from maturation, equipment suppliers are also looking into other
opportunities in providing high-value, knowledge-intensive services. For instance, operational services such as running the production for the customer and providing financing services for their clients.

**Exhibit 30  Hürth paper plant: flexibility through service outsourcing**

<table>
<thead>
<tr>
<th>Background</th>
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<tbody>
<tr>
<td>Voith was chosen as the main equipment supplier when a new paper plant, Rhein-Papier in Hürth was built in 2002. The plant nearby Köln is in the Finnish ownership, and it is an example of a new model of operation in a paper mill where all maintenance and service functions have been outsourced to an outside service provider – Voith Industrial Services.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Flexibility brings forth results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voith Industrial Services takes care of maintenance and service that is not directly linked to the paper making process: that is, all technical maintenance (mechanical, electrical, automation), inventory management, logistics, cleaning, security, etc. Of the 156 employees working in the mill, more than one third is on Voith Industrial Services' payroll. The service provider also uses sub-contractors at times of major service breaks and other repairs.</td>
</tr>
</tbody>
</table>

| Enhanced flexibility is the key concept in the plant: The objective is to minimize the share of overhead costs, that is, to minimize the number of own workers while aiming to maximize the availability of high quality expert service staff. Flexibility is also pursued by innovative organisation of work: every employee masters at least two tasks in the mill. Such multi-skilling of employees means that the workers can quickly take over those tasks and activities that need to be done at any particular point in time. Such an ability to work in several roles within the mill should also enhance employees’ motivation in terms of work meaningfulness and the shared understanding of every function’s and every person’s importance for the whole. |

| The partners of the Hürth project, Rhein Papier and Voith, are pleased and proud of the successful first years of the plant. The reorganisation of work, outsourcing of mill maintenance and service, and the advanced production processes have generated both records in production as well as healthy financial figures. |

| On March 2003, paper machine in Hürth produced newsprint for a period of 30 hours at a speed of 1912m/min, which is a new speed world record for newsprint production. |


3.2.4 Towards integrated solutions to customers

Typically forest firms have been suppliers of materials and physical products to industrial customers. They sell paper to printing houses, carton board to converting business, wood products to the construction business, etc. In order to ensure that fibre-based materials and their know-how on industrial processes remain competitive, forest firms are keen to establish closer links with their customers, and in many cases, with their customer’s customers. As one of the interviewees put it:

‘those who control customer interface will also control paper manufacturing in the future.’

Feedback from the end-user of the product is vital for business development. For example, paper- and carton board manufactures build new contacts with the consumers markets in order to get impulses for innovation activity. This because their first-hand customers such as printing firms and converters do not always appear to have sufficient resources neither interest for major development efforts.
Or, the existing R&D does not sufficiently serve the interests of the paper and carton board producers.

Customer interaction is an integral element in the pursuit of high-value added products. Increasingly, the businesses are moving into the provision of integrated solutions to their customers. That is, innovative combinations of products and services that offer a tailored answer to a customer’s business need (Wise and Baumgartner 1999, 137-9). Developing, managing and selling of solutions are pursued to generate long-term profitability. The idea is that the possibility to earn high profits is tied to the success in providing additional value to the customer by an innovative, integrated product-service package. The following more specific drivers of solutions selling were brought forward in the interviews:

- need to ensure end-user demand for fiber-based materials;
- need to obtain a greater share of the value added in the production chain;
- need to make the value chain more efficient and speed up innovation from the customer’s point of view (as closely connected operations are controlled by one organization);
- need to generate new ways of creating revenue (e.g., licensing fees and royalties).

See Exhibit 31 which presents a case where in Stora Enso Consumer Boards has developed an innovative integrated solution (a turnkey packaging solution for CD/DVD discs).

The new focus in the consumer end of the value chain calls for new resources and competences from the forest firms. First, the provision of integrated solutions usually involves taking over some new activities that previously have been in the responsibility of someone else, for instance, the customers themselves. A key capability is to build and orchestrate the network of partners providing the total offering. Often, solutions that add most value to the customer require a network of partners in different industries or branches (see Davies 2003b, 338-9). Interviewees emphasised the ability to protect intellectual property rights of the new solutions. Both contractual relationship ties as well as trust between the partners were considered to be important in this context. Secondly, the long-term capability to introduce value-adding solutions to markets calls for great absorptive capability from the organisation (Cohen and Levinthal, 1990). This refers to capability to coordinate and make use of existing and emerging knowledge in different technological fields as well as developments on the markets. It is evident that these different bodies of knowledge cannot be entirely mastered in-house, and external KISA providers are needed. However, the management of relations with external sources of knowledge – such as research and technology organisations and KIBS firms – requires highly effective in-house capability (Prencipe 2003, 127).

Naturally, there are many other, or more specific challenges that a businesses face when moving from manufacturing towards integrated solutions provision. For example, the identification of crucial market opportunities, the ability to build trust with new customers, the ability to manage potential conflicts with new competitors or members in the distribution chain, the performance in moving from a unique
solution to repeatable solutions, not to mention internal integration requirements (see also Davies 2003b, 363). However, at the heart of developing innovative solutions to customers seems to be the organisation’s ability to build and manage a network of partners whose complementary assets and capabilities are needed in the innovation activity, in the concrete development of new configurations, and in the introduction and provision of integrated solutions to the markets.26

3.2.4.1 The role of KISA in integrated solutions

Overall, the pulp and paper firms want to have rights to and control of the new solutions. This leads to careful consideration of the use and roles of outside experts in innovation projects. Outside experts are welcome to facilitate the innovation process, but the rights to new concepts will stay within the firm and the expert should not carry the new concept to another business. External KISA providers such as consultancies, other training-, and legal firms had been used in the following innovation support roles:

- innovation process management (documentation, systematization);
- advice on specific issues (IPR);
- support related to organisational changes;
- concept development.

Typically external KISA suppliers contribute to the methods and procedures that are applied in the management of the innovation projects, and to the provision of advice and specialized knowledge on particular issues such as legal, technical and design issues. Thus, there is a clear need to have the creative input and the integrator role within the organisation. This is considered important in developing unique concepts to the markets as well as for later control of the new business potential. In-house innovation expertise is also supported by recruiting experts from customer industries and through business acquisitions. Also customers have a special role in the development of solutions. As one of the interviewees said,

‘The most important outside expertise utilised in our innovation projects is our customers.’ (see also, Exhibit 16, and ‘New innovation units’ in Section 3.2.2.2).

Overall, the importance of the partnering network is recognised both in developing as well as implementing new solutions to markets. Nevertheless, sometimes the required high levels of confidentiality seem to affect negatively the use of external expertise. Perhaps such problems may also be related to the fact that the move into integrated solutions is in still in its early stages among paper and carton board

26 Indeed the term ‘real partnership’ was repeatedly brought up in the interviews. Real partnerships are win-win relationships where the partners work together with a long-term focus – the attitude is that one’s own success is dependent on the partner’s success. The need for open exchange of information and trust was emphasized. There were also problems in this particular issue. Nonetheless – long-term orientation, the perception of mutuality, openness and trust were considered to be prerequisites for a successful partnership (also Ivens 2004, 334-5). The importance of high quality partnerships is not restricted to solutions selling. The vital role of ‘real partnerships’ was stressed by equipment suppliers in developing their sub-contracting network.
businesses. Also, formal contractual documents, such as non disclosure agreements, are considered important. Though they will be needed in the future as well, it is probable that with growing experience and trust, informally instituted practices and close personal links between the partners will also become more important (cf., CRIC Project 2004). Even if network-based and distributed innovation activity is vital, the role of strong individuals is also vital in advocating the innovation in the organisation. Often, solutions selling, as well as other business innovations, face resistance in the organisation. Both employees as well as the management are often sceptical towards a new way of doing business. The interviewees identified two key reasons for this opposition. Fear of ‘cannibalisation’ of current sales, and doubts about adopting new type of operation logic. A good example of the latter one is the resistance towards the use of smaller scale paper machines, even if they would seem to offer more efficient solution on the increasingly fragmented markets. Naturally, new concept development involves high risks. Hence, an innovation champion has an essential role as a person who persistently lobbies within one’s own organisation in favour of the potential innovation.

To sum up, the key expertise in providing integrated solutions is very much related to innovative management of the customer interface and the partnering networks. It is vital to create trust based relationships and procedures for managing such relationships. High level of co-ordination skills, effective tools, and capacity to manage contract relationships are also necessary. New business units represent an attempt to create supportive environment for the development of innovative integrated solutions. On the long-term, the businesses’ capability to make use of several streams of technological and market knowledge and success in making the solutions repeatable to new market segments, are very important.

Exhibit 31  Stora Enso’s innovative CD/DVD packages: a new solution for the customer

| Stora Enso is a global supplier of paper, packaging and forest products, and a market leader in sectors such as fine papers and packaging boards. The group has 44 000 employees in more than 40 countries, and production facilities on three continents. |
| Stora Enso Consumer Boards emphasizes in its R&D strategy the improvement of the end use performance of their products. With the support of the newly established New Business Innovations unit and the InnoCentre concept, the aim is to develop new packaging solutions in close co-operation with the customers: packaging concepts that not only provide the customer with the best of fibre-based materials for their specific needs, but increasingly, all the equipment and machinery for making these packages. DBS (disc box slider) – concept is an example of such an innovative cartonboard packaging solution for CD and DVD discs. |
| History and description of the DBS-concept |
| The origins of the DBS concept are in Sweden. A Swedish company Activation began looking into innovative packaging in the early 1990’s, finding a great potential in the area of CD packaging. The DBS concept – a cartonboard CD-case and a packaging machine for assembling and filling the case with the disc(s) and the booklet – was introduced in 1997. In 2002 Stora Enso acquired Activation and the patent for the DBS concept. |
| Today the DBS concept is an integrated production line for making cartonboard CD/DVD packs and filling them with discs and booklets. The production line integrates digital printing, die cutting, assembling and filling the CD/DVD packs. The latest extension – the digital colour press integrated into the packaging line, was introduced at the Drupa trade fair in Düsseldorf in May |

27 The industry as a whole, at least in Finland, is so accustomed to the benefits of scale thinking, that small units are not seen as a realistic option despite the evidence available.
2004. The concept is now marketed as **Stora Enso DBS Powered by Xeikon** as it combines Stora Enso's DBS packaging system with Xeikon digital printing systems.

From the customer’s point of view the concept is a turnkey solution for all printing, converting and packing phases of CD/DVD packs. The customer acquires a licence to produce a certain number of packs, and pays a royalty on each pack it produces to Stora Enso. A major customer is QC Packaging, a Canadian packaging company, who uses the DBS packaging system to pack owners’ manuals (saved in a disc format) for General Motors. The DBS concept is a business model innovation for Stora Enso: it moves the company from being a cartonboard supplier to a provider of packaging solutions, with new expertise on converting operations and new ways of earning the income.

**Objectives**

The DBS concept suits well Stora Enso Consumer Boards’ strategy for future growth. There is a need to create new business by finding new end users for fibre-based products. As in many other areas, the cartonboard pack competes with the standard plastic alternative. The cartonboard CD-pack can be argued to have many advantages over the plastic case: It is slimmer and weighs less than the plastic one, which means savings in freight costs. Also the material is durable and it does not crack like plastic case. Most importantly, however, the advantages are related to the fact that Stora Enso has taken to offer the customer with an integrated production line: the combination of digital printing, converting and packaging leads to shorter lead-times, faster deliveries as well as increased cost efficiency, even in very small runs. By managing these successive steps – from developing and producing the cartonboard to licensing machinery for the customers to make their own packages – Stora Enso can make the value chain more efficient. Moreover, new value has been added to the end product: Radio Frequency Identification technology based software can be connected to the packages (by inserting RFID-tags), which makes it possible to follow the packages in the supply chain – as well as to authenticate the manufacturer, and thus fight piracy.

**Important partnerships**

In its attempt to add value to cartonboard packaging, Stora Enso is developing new business concepts that offer turnkey solutions for the customers. This calls for new competence from the organisation: the key thing is to find the right partners and to manage successfully relationships within the network of partners. In the case of the DBS concept, Stora Enso has acquired critical competence, in particular, by business acquisition (Activation, to build knowledge in converting), by close supplier and customer relationships (e.g., Stockway – to implement RFID technology in the supply chain; CD-Line – to build the link with the music business market), and most recently, by partnering with Xeikon (to have the competence in digital printing).

A key element in any successful partnership is the perception of mutual benefit. For example, it is the Stockway's RFID software Trackway that provides the DBS packs 'smart' features – making it possible for trading partners to track and trace products on a real time basis in the supply chain. For Stockway, in turn, Stora Enso has been a first major customer with whom they have tested their Trackway software in a real business situation. Thus, it provides them with an important business reference for future sales. Most importantly, for both partners, the co-operation related to the CD/DVD packs is only a very first step in their relationship: in May 2004 Stora Enso and Stockway published in a press release their commitment to jointly develop further smart packaging applications in various fields (e.g., pharmaceuticals, food packaging). Hence, co-operation related to the DBS packs can be seen as a pilot project whereby the partners deepen their knowledge on each others’ business and attitudes, and pave the way for more extensive ‘co-production’ of innovative solutions.

**Critical questions for success**

Success in the following two fields seems particularly important: success in managing a network of partners to develop and implement innovative solutions, and success in market penetration and in building loyalty with the new customers. The management of innovation effort in a network of partners calls for investment, skill and persistence in building mutual trust, co-operative procedures and contracts that effectively protect IPR associated with the new business. The challenges in providing new concepts to often new markets are no lesser: risks need to be taken in terms of speed and investment when the new solutions are launched to the market in order to build credibility for the new business in the market. Moving from manufacturing to delivering high-value integrated solutions is a gradual movement. But once a strong base has been established, the company can extend the activities to provide the customers with solutions, capabilities and support that are increasingly valued in various customer sectors.
3.2.5 Key results of the business model analysis

The Finnish Forest cluster has to meet the challenges of global competition, downward trend in paper- / board prices, rapid technological changes (e.g., ICT, bio- and process technologies), and changes on the end-user markets. Forenel cluster seeks to maintain its competitiveness on the world markets by developing ever more sophisticated product-service offers to the customers. In this process Forenel cluster has transformed itself from resource based industry to a highly knowledge-intensive business and increasingly so in the future. Extensive outsourcing is another outcome of the development characterised by increasing complexity of products, systems and technologies as well continuous search for better productivity. Altogether, the role of knowledge intensive service activities seems to be increasing and they are acting as catalysts of change facilitating the renewal process of the forest industry.

Within the Forenel cluster the utilisation of KISA is increasingly dependent on the ability to combine cross disciplinary knowledge. To work effectively, internal and external KISA need to make a good match. This applies not only the substance of knowledge, but also the level of knowledge, and ability to communicate across disciplinary boundaries. By and large the value chain analysis reveals two simultaneous processes. Fragmentation of the value chain is happening as a result of evolving division of labour (e.g. outsourcing), and integration of the customer offer as a result of solutions selling. In both of these processes KISA has an important role and it will be discussed in the following.

The analysis of value chain indicates that different actors appear to migrate downstream, that is closer to the markets and towards consumers. In the input side universities are doing increasingly applied research, even to an extent that there are concerns about the erosion of knowledge base due to lack of long-term basic research. Similarly, equipment and chemical suppliers are increasingly working at the customers site, focusing their development activities on solutions selling and integrated systems around life-cycle service and maintenance. Finally, paper and paper board producers are developing solutions for their customers e.g., to converting and printing industries. Significantly, there are also efforts to develop and design products that target consumer markets. Key drivers influencing the downstream migration are (see Exhibit 32.):

- higher profit margins at the consumer end of the value chain (e.g., packaging for electronic goods, food and medical purposes);
- power based on intimate market related knowledge, now available as a result of rapidly developing ICT;
- the need to secure future markets for fiber-based products.
All the afore-described processes are highly dependent on various types of KISA, external and internal. The following sections give a closer look into these KISA ‘laden’ processes.

**Exhibit 32  Evolving knowledge base of the Forenel-cluster**

Exhibit 32 highlights the KISA activities contributing the value chain in the forest industry. *On the left are the well established elements of the Forenel cluster* representing KISA contributions from the fields of ICT, manufacturing technology, construction and wood technology, forestry, biotechnology, energy- and environmental technologies. KISA actors that deliver these inputs include: universities and research institutes, supplier firms, KIBS firms and internal R&D.

*Located on the right side of the figure are the evolving, increasingly customer oriented elements of the Forenel cluster.* KISA activities that contribute the creation of integrated solutions for the customers include: market analysis, logistics, behavioural science, psychology and socio-economic research. In addition to the more traditional R&D, marketing and customer intelligence, these ‘new elements’ are important for the renewal and future competitiveness of the Forenel cluster.

These KISA activities are being provided by internal and external experts including: universities and research institutes, KIBS firms, clients, activities at the customer interface, business acquisitions, and innovation units recently set up by the forest firms.

The findings of this study indicate that the following three features in the use of KISA are prominent.

1. *Network based organisation of activities and co-operation between organisations* are highly important. As such integrated solutions involve such a broad scope of expertise, that it can hardly be found from within a single firm. In research and development, multi-disciplinary and multi-organisational teams are formed. In mill service and maintenance, cost efficiency and new expertise is sought through joint
ventures and increasing outsourcing of maintenance operations. When paper- and paper board firms are turning into the provision of integrated solutions to their customers, new concepts are developed jointly with the key customers, KIBS organisations, other horizontal partners as well as research and technology organisations. The key challenge in relying on a large number of outside experts is the management and co-ordination of such multi-actor, multi-disciplinary effort. New co-ordination skills and tools, as well as management roles are needed. This progressive division of labour between the organisations raises the question of who co-ordinates the overall processes, and how it is possible to avoid sub-optimisation within such fragmented process? Here, new integrator roles are emerging. Equipment suppliers are taking a more extensive role in mill development (provision of equipment, engineering, maintenance and project management services – and potentially in the future other operational services and financing). Paper and carton board firms, in turn, are adopting integrator roles in their provision of integrated solutions to their customers. Some KIBS firms (consultancies) are aiming at integrator roles in building and managing of partnering networks as well as in providing integrated innovation services.

2. Despite the general trend towards networking and distributed innovation, the role of internal KISA was strongly emphasised in the development of new business models. Forest firms want to keep such core competences as creative input, integrator role, and overall process control within their own organisation. This is important for later control of new business potential. Hence, intellectual property rights are a significant issue in contractual relations. Also, business acquisitions are an important means to get new in-house expertise required in the development of new business concepts.

3. Knowledge on markets, end-users and consumers is vital for the paper manufacturers. Hence, these businesses should benefit from increasing their cooperating with KIBS firms and RTOs providing non-technological, scientific knowledge on customers (behavioural, psychological, socio-economic fields) and markets. To summarise, competitiveness seems to be increasingly based on effective customer interface, businesses’ absorptive capability (ability to make use of knowledge in separate technological fields and markets), and their ability to build and manage effective partnering relations.
3.3 The role of KISAs in innovation process: Case POM-concept

Jukka Hyvönen, VTT

3.3.1 Introduction

In this case study the role of KISAs is analysed at the level of an individual innovation. The case is POM-concept - a compact wet-end system for paper machines - which was developed by POM Technology Oy during 1990's. Empirical data was collected in the interviews with the inventor and President of POM technology Paul-Olof Meinander. Additional information has been gathered from the documentation provided by the POM Technology Ltd (www.pom.fi). In the analysis the focus will be on the innovation process from the early idea to commercialised product. POM-concept is a radical innovation in the sense that it changed significantly the wet-end in a paper machine compared to conventional systems. The development process of the innovation involved different kind of co-operation with different KISA-providers like universities, companies and public financers. This co-operation played a key role in this case during the development process of the innovation.

POM Technology Oy was founded 1993 by Paul-Olof Meinander. It develops and supplies a compact wet-end system for paper machines (POM-concept) developed and patented by Meinander. All the equipment needed in the POM-system is manufactured by different sub-contractors. POM Technology Oy employs at the moment 12 persons and the annual turnover is approximately 3 million euros. Half of the annual turnover comes from selling hardware, approximately 20 per cent from the development services and the rest from selling different equipment and products involved in the system. The main owners of the company are Meinander and his family (42%). Private investors and members of the board own 40 per cent, venture capitalists 13 per cent and employees 5 per cent share of the company. POM Technology has delivered so far 30 installations to paper mills around the world since 1996. Meinander have received different awards of his innovation like Marcus Wallenberg Prize in year 2004.

From the technological point of view the basic idea in POM-concept is to simplify the wet-end in a paper machine. Large volumes of stock are used in conventional paper making process. One reason for that is the possibility to control the whole process with large volume of stock, especially the behaviour of air. The presence of air in the stock is problematic because it disturbs forming of the paper sheet and destabilizes the whole process. In POM-concept this problem is solved with centrifugal degassers (POMp) which are the key elements of the POM-concept. These degassers remove the air from the stock and the airfree stock flows in a closed system thereafter in the process. This solution makes it possible to make a compact wet-end in a paper machine without huge tanks and water silos.
The benefits of POM-system compared to conventional wet-end systems are diverse. Grade changes and adjustment are remarkably faster with POM-system which is significant improvement in terms of flexibility in production. Compared to traditional systems POM-systems stay also cleaner. This has two consequences, firstly the product quality improves and secondly it decreases runnability problems. POM-system is also more stable because it reduces disturbance in the process. POM enables also a more compact construction solution which means less materials and energy consumption.

The development of the concept started already in early 1980's when Meinander started to rethink the paper making process when he was working at Ahlstrom Paper. The concrete development started in 1991 when Meinander left Ahlstrom and started to fully concentrate on the development of his idea. He applied patent 1992 and started to build pilot version in co-operation with The Helsinki University of Technology (HUT). Test runs with pilot versions of the POM-system were done in STFI in Stockholm and at Lohjan Paperi's mill. First commercial installation was 1996 in Albruck mill in Germany.

In the next two Sections (3.3.2 and 3.3.3) the development process of POM-concept is described from the generation of the early idea to commercialisation phase. The focus is on the co-construction of the innovation and the network of different actors contributing to the development of innovation. In Section 3.3.4 the emphasis will be on discussion about the role and the relevance of different KISAs during this process.

3.3.2 The development process of POM-concept

3.3.2.1 The emergence of an idea of compact wet-end system in 1980's

Early idea generation phase behind the POM concept originate in the early 1980's when Meinander was working at Ahlstrom Paper. He had started to work for Ahlstrom already in 1966 immediately after his graduation from the Helsinki University of Technology in the Department of Paper Technology. During his career at Ahlstrom he worked in different positions with varied tasks at Ahlstrom's paper mills. His first position was in Italy where he worked both in production and in maintenance and technical services. He was also preparing investments in the mill and before moving back to Finland 1970 he made a modernisation plan for the mill. In the early 1970's Meinander worked in Finland in diverse process development projects and later in production and product development. In the late 70's he moved to Germany and was again responsible for a modernisation of a mill in Kämmerer, Osnabrück. At the end of this period he became the operations manager and was also responsible for the production, maintenance and R&D at the mill. In the early 1980's he was appointed as a vice president in Ahlstrom Paper focusing on business development.

At that time Boston Consulting Group made an extensive strategy research to Ahlstrom Paper. One of the outcomes of this analysis was that the most important single factor that affected to paper making process was the product programme. In order to be cost effective and competitive a paper machine should produce one
single product or products which fit technically well together. Calculations showed that the product programme was more important cost driver than e.g. the size of the paper machine or personnel costs. In this scenario large companies were able to be cost effective by focusing on big scale paper machines on single grades. This quantified a generic problem in paper industry in general at that time and led to strong consolidation in industry.

Meinander started to study the reasons behind the problems in paper making process from technological point of view. An internal study was made on a start-up of a paper machine in one of Ahlstrom's mills in Varkaus. According to that it took 2 days until the optimal production level was achieved after the start. The basic problem in the optimisation process was the large volumes of stock in the paper making process. Every grade change in the process affected to everything and it took plenty of time to balance the stock in the process. As a solution to these time consuming grade changes paper companies concentrated on high production volumes which could balance these changes in production process. One of the reasons for the use large volumes of stock was that it enables to control the air during the process. Stock contains plenty of air and it disturbs the forming of paper sheet and destabilizes the whole process. With large volumes it was also possible to remove the air from the process and to control the whole process. Another problem related to large volumes of stock was the inflexibility of production. With highly concentrated production it was difficult to react to customer's demands for specialized products. The grade changes were time-consuming and therefore expensive. In order to shift towards more flexible production the volumes of stock use in the process had to be minimized.

Based on these two studies - the strategy analysis and the study of a start-up of paper machine - Meinander discovered two relevant issues which were the cornerstones to the emergence of the basic idea. Firstly the relevance of a product programme and secondly the technological bottleneck related to the use of large volumes of stock in the process. These findings directed Meinander when he started to formulate a concrete idea of a new compact wet-end system.

3.3.2.2 The development process from the idea to prototype in 1992-95

In the early 1990's Meinander left Ahlstrom and started to work as consultant. The main reason for this was a disagreement with the head of the company about the importance of production technology versus marketing in the company. This arrangement was suitable for Meinander since Ahlstrom promised to buy certain amount of Meinander's services. In practice this left him time to concentrate on the development of the new idea.

From the point of view of technology the basic problem was the use of large volumes of stock and especially the existence of air in the stock. Meinander started to look for a solution to this problem. He discovered that silos and white water tanks could be replaced if a centrifugal degassing would be possible during the process. The basic idea was that with centrifugal degasser the stock could be free of air and thereafter the stock could be handled in a closed system during the process. In this solution the wet-end in a paper machine could be more compact compared to conventional system and the whole production process more flexible. Meinander
applied patent to this idea in 1992 in co-operation with a patent office Borenius & Co. According to Meinander the representatives of Borenius & Co. had a significant role in further development of his ideas. In addition to patent application procedure he was able to define the basic problem, elaborate and spar his ideas in discussions with them.

When the patent application was submitted Meinander was on the watershed with his patented idea. He started to discuss about the idea of compact wet-end solution with different experts in the field of paper making. Feedback from some researchers was encouraging and he even got estimations of the costs of a development work of such a system. In these estimations it cost approximately 2 million Euros. Due to the scarce financial resources Meinander tried to sell his idea to different large companies in Finland but his idea was rejected especially in machinery industry. Finally Beloit Ltd. made an offer but Leo Vatanen - ex-director of Tampella - encouraged Meinander to continue the development of the idea in his company. The possibility to get public and private funding led Meinander to continue the development of his idea by himself.

According to Meinander the financing of the development work was then easier than to sell the idea to another company. The National Technology Agency of Finland (Tekes) granted a subsidy to the first development project of POM-concept. The role of Tekes has been significant in supporting the research and development of POM-system ever since. Startfund of Kera - a public venture capital organisation - was willing to invest to POM Technology Oy after hearing an expert panel about the possibilities of such technology. A Swedish company Alfa Laval Celleco promised to invest to POM Technology Oy when they heard that Tekes would also grant support. It is notable that in addition to the basic role of Tekes as a public financier its participation to the project was a kind of guarantee for Alfa Laval Celleco that Meinander's idea was technologically feasible.

On the basis of this kind of funding the development of POM-concept continued and the next phase was to find a research laboratory where the centrifugal degasser could be developed. Meinander turned to professor Wuori and asked who could help him to develop the degasser at the Helsinki University of Technology (HUT). Wuori was the former rector of Helsinki University of Technology and happened to live close to Meinander. It turned out that Wuori's Department of Mechanical engineering was an appropriate laboratory to do such research and to develop the centrifugal degasser and they even had spare time in the laboratory to concentrate on this issue. One of the students - Kimmo Molander - started to do his master degree thesis on this subject and to develop the centrifugal degasser.

Since one of the basic questions in the new concept was the behaviour of the air in the process Meinander started look for theoretical understanding of that. He discussed with professor Paulapuro from the Department of Paper Technology at HUT and one student - Topi Helle - made his licentiate thesis related to POM. This work was financed by the Academy of Finland. Paulapuro's Department of Paper Technology worked closely with the department of mechanical engineering because they were part of the same university and the hardware was placed there. The first plant scale pilot was build up and tested in the department of Mechanical engineering already during winter 1994-95. When everything was working well
with the first pilot version the second pilot was build up in autumn 1995 and this version was already acid-proof. This pilot version was cast at the VTT Technical Research Centre of Finland and it was later tested in a Swedish research institute STFI in Stockholm for a week. STFI was a proper place to make this kind of test run because they had the suitable pilot paper machine for this kind of testing, namely EuroFex. Tekes promised to pay part of this test run but additional financing was needed since the test run would take a week. Meinander knew Douglas Wahren from a swedish company Stora AB since they had co-operated some years earlier in another project. After negotiations Stora became interested about the POM-concept and promised to pay part of the costs of this test run. The test run was the first time when POM was used in actual paper making and it was a success. The formation and the uniformity of the paper improved, grade changes were faster and stabilization process was even ten times faster compared to conventional system.

3.3.3 The commercialisation of POM-concept 1996

The first industrial scale test run was made at UPM's paper mill in Lohja after the successful test in Stockholm. In this test POM's industrial suitability was tested and it was running 3 months there. At the same time Meinander started discussions about the first commercial installation. Meinander met Thomas Nysten from Myllykoski Oy by coincidence in a school class reunion party. Nysten was interested about POM and Myllykoski seemed to be open-minded and willing company to invest in this new technology. The first POM was then sold to Myllykoski and installed at Albruck mill in Germany on Christmas 1996. The last equipment tests were made at the mill and some problems aroused when the POM-system was installed. Unexpectedly it took 5 months until POM was ready to start-up. After intensive development period the POMps were fixed and in May 1997 POM started to run beside the paper machine. It was a pilot installation in the sense that none of the heavy equipment was removed from the paper machine. The old system could have reinstalled in two days if any problems would arouse. Everything, however, functioned perfectly.

Anyhow after three months some of the pumps in the system broke down. Sarlin Oy who delivered the pumps had agreed upon with POM Technology Oy that Sarlin will also consult in technical issues related to them. There were some difficulties in this co-operation which was due to the lack of quality control with Sarlin's subcontractors. Some of the advice the representatives from Sarlin gave was also misleading and according to Meinander this was due to the lack of knowledge in this new area. Part of the problem was also that Sarlin's had knowledge of pumps but POMp-pumps were actually not functioning like conventional pumps. Co-operation with Sarlin finished when the company was sold to a Danish company Grundfors. Grundfors made a decision that Sarlin should concentrate on production instead of R&D-projects. Nowadays Kotka Power Oy delivers the pumps to POM. The new compact wet-end system in Albruck was a good reference for POM Technology Oy and led many contacts with possible customers. International Paper (IP) from U.S. visited the mill and Meinander introduced the POM-system to them. One of the members of the board in POM technology - Matti Kankaanpää - was also in contact with the Technology Manager of IP and these connections led to a deal where 10 POM-systems would be sold to IP in the U.S. Meinander felt that this deal was a real breakthrough to POM-concept. Unfortunately after two installations in
1999 IP made a decision that they will congeal all the investments due to a merger with another paper company Champion. Due to this decision the installation of the last 8 systems were postponed in the future.

Anyhow the POM-system has gradually gained new customers. At the moment (2004) POM-system has 30 references around the world. Best markets for POM-system have been in Germany (7 installations) and in Japan (4 installations). Other POM-systems are installed in USA, Korea, Spain, and France. So far the only POM-system running in Finland is in Stora-Enso's mill in Varkaus.

3.3.4 The role of KISAs during the innovation process

As a background for the analysis of the role of KISAs in this case study two issues should be underlined, namely the nature of innovation and the size of the innovating company. POM-concept is an example of a radical innovation in traditional sector: it challenged the conventional way of making paper. Since the nature of innovation was radical new knowledge was needed and applied in the development process of the innovation. Therefore the role of KISAs was also important in this case.

Partly due to this radical nature of innovation it was developed by a small company instead of a big company. First of all according to the innovator the development of such system was not in the interest of big companies since they should have rejected the existing idea of papermaking. The complex nature of paper making is a result of the development of the paper industry and the content of this development has been mainly adding new solutions to old process without changing the basic structures. In order to accept radical changes one had to rethink the whole paper making process. Another reason for the innovator to develop the innovation in a small company was the possibility for him to get public and private funding for the further development of the idea and to co-operate with different experts in the field.

Since a small company have to operate with scarce resources compared to a big company it had to co-operate in order to succeed. Two significant drivers for the emergence of the idea were the strategy analysis and the internal study i.e. internal KISAs made at Ahlstrom Paper. The strategy research made with Boston Consulting Group addressed the importance of production programme in order to be cost effective in paper making process. The internal study made at one of Ahlstrom's mills guided the innovator to focus on the technological bottleneck related to the use of large volumes of stock in paper making. These two different findings were relevant to Meinander when he started to generate his idea of compact wet-end system.

In the development process from idea to prototype and further to a commercialised product Meinander co-operated with many different KISA-providers (see Exhibit 33). This phase included at least three types of co-operation: research and development in academic context, enhancement of understanding and further development of the concept in industrial context and financing from different public and private organisations.
Representatives from the patent office Borenius & Co. not just contributed in the patent application procedure but were a relevant discussion company for Meinander in the sense that they posed relevant questions and helped to frame the content of application. Since the patent application was submitted Meinander tried to sell his invention to bigger companies but they were not interested in developing this invention to a product. Meinader was encouraged to develop the innovation by himself. In this context - with limited resources compared to a situation in a large company - Meinander needed different kind of resources like laboratory for the development work, machinery, understanding and knowledge of different phenomena and naturally financing. The role of two departments from Helsinki University of Technology was essential especially when developing the equipment for the system since POM Technology Oy did not have any facilities to do that. First industrial test runs were done in co-operation with STFI in Sweden and in Lohjan Paperi mill involving all the KISA providers.

The role of public and private financiers was extremely relevant during the innovation process. Since other companies were not interested to buy and start to develop Meinander's idea in the early 1990's these financiers enabled the

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<td>internal KISA</td>
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<tr>
<td>Boston Consulting Group</td>
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<td>the development of centrifugal degasser</td>
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<td>business/network KISA</td>
</tr>
<tr>
<td>Lohjan Paperi/UPM</td>
<td>the development of the prototype in 1996</td>
<td>test run in industrial scale</td>
<td>private</td>
<td>business KISA</td>
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<tr>
<td>National Technology Agency of Finland (Tekes)</td>
<td>the funding of the development of the prototype in 1990's</td>
<td>funding of the R&amp;D of the innovation</td>
<td>public</td>
<td>public KISA</td>
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<tr>
<td>Startfund of Kera</td>
<td>the funding of the company in 1990's</td>
<td>the seed funding of the company</td>
<td>public</td>
<td>public KISA</td>
</tr>
<tr>
<td>Alfa Laval Celleco</td>
<td>the funding of the company in 1990's</td>
<td>the seed funding of the company</td>
<td>private</td>
<td>business KISA</td>
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development of POM-system by the innovator himself. The role of Tekes was even more extensive than just pure financing since their participation was crucial in order to get Alfa Laval Celleco to join the co-operation. Also Startfund of Kera based their decision to finance POM Technology Oy to an evaluation made by the group of experts.

The development phase from idea to a commercialisation is a good example of co-construction of knowledge during the innovation process. It was based on network KISAs where the innovation was developed in mutual interaction. The formation of network was strongly based on innovator's former contacts with experts in the field of paper industry and related research. In order to co-operate with relevant organisations and persons innovator's contacts, experience and understanding of the field were significant resource for him. Firstly it was relevant in order to formulate technologically feasible idea of a new wet-end system that challenged the traditional system. His 25 years experience in business and R&D in paper industry had created a network of experts which was an essential resource in the development process of POM-concept from idea to commercialized product. These experts with different backgrounds contributed to the development process of innovation when innovator was looking for solutions and new knowledge related to the innovation.
4 Summary and discussion

This paper presents three research projects which demonstrate how knowledge intensive service activities have an increasing role in the development of the Forenel cluster. The range of different types of KISA is extensive and they exist on cluster-, business- and individual innovation levels. KISA activities do not only include technology development. A wide range of other types of KISA are involved in the development of new types of business models, outsourcing and integrated solutions to the customers, just to name some of the most prominent cases.

4.1 Forenel cluster faces a global challenge

Liberalisation of international trade, global value chains, expansion of the overseas production and downward trend in output prices create pressure towards renewal of the traditional forest industry. Over the last few years time numerous business acquisitions and cross border mergers mean that businesses have grown by size and the industry has become more consolidated. For the Finnish Forenel cluster the global market presence is a necessity based on the needs to: reduce transportation and production costs, improve services to customers, provide faster deliveries, locate production close to the markets where recycled fibre as well as virgin fibre are available. In addition to structural changes, the industry needs to make a number of other strategic choices. These concern approaches to new technologies, business models and the requirements that the businesses need to comply with in the future. For instance, environmental concerns such as emission trade and sustainable production create on their part set the boundary conditions to the industry.

4.2 KISA role in the renewal of the Forenel cluster

The role of KISA as a renewal agent of the Forenel cluster is crucial. Until recently Finnish forest industry has based its competitiveness on superior technology and highly effective production processes. In these areas Forenel cluster is among the most competitive ones in the world. However, the future success cannot be solely based on following the path of technological innovation of the past. The way forward is to become more open, more experimental and to embrace the unknown. Forenel cluster cannot afford to turn inward nor to be too risk averse. It has already transformed itself from resource-based industry to a highly knowledge-intensive business. This trend seems to continue in the future but the focus is widening from the production process and technology development to development of complete solutions for the customers. Strive towards these objectives has resulted into a significant increase in demand and supply of new types of knowledge intensive services within the Forenel cluster. High value added, integrated solutions are expected to promote Forenel cluster growth, knowledge development and employment in Finland.

28 Sustainability in paper supply chain includes: sustainable fibre resources, environmental management systems, low emissions, energy-efficiency, product related information, recycling, common responsibility (Source: Finnish Forest Industries Federation).
4.3 Evolving changes in value chain and business models

Interviews with the Forenel cluster businesses reveal the aspiration to shift business focus towards customer end of the value chain. This process will take time in the industry where production driven by ‘quantity thinking’ has been a dominant thrust forward. Technology driven production development and economics of scale have been the basis of competitive advantage. However, on the global markets customer orientation is becoming an imperative. For supplier industry this means more focus on product differentiation, specialization by market segments and development of integrated product-service solutions for the customers. The future competitiveness will be based more on effective customer interface and understanding of customer segments and key markets.

4.3.1 The strategic role of upstream- and downstream services (KISA)

KISA within the Forenel cluster can be divided into up-stream- and down-stream services in relation to the paper and board producers. Services in the upstream (e.g. service and maintenance) are typically closely connected to the manufacturing firm, and hence, more or less part of the production process. On the contrary, the down-stream services (e.g. logistics and sales) are far less connected to the manufacturing firm, and the production process. As paper and board producers are seeking to extend their value chain down stream, they can gain better control of the business also at this end of the value chain. The value chain analysis indicates that many actors within the Forenel cluster indeed appear to migrate closer to the markets and towards consumers. On the input side, universities are doing increasingly applied research, even to an extent that there are concerns about the erosion of knowledge base due to lack of long-term basic research. Similarly, equipment and chemical suppliers are also moving activities within customers’ site, focusing on integrated systems and services that cover the entire life-cycle of the equipment. Further on, paper and board producers are developing solutions for their customers e.g., to converting and printing industries. Significantly, there are also efforts to develop and design products that target even further to consumer markets (see Exhibit 31). Key drivers influencing the down stream migration are:

- higher profit margins at the consumer end of the value chain (e.g., packaging for electronic goods, food and medical purposes);
- power based on intimate market related knowledge, now available as a result of rapidly developing ICT, and;
- the need to secure future markets for fiber-based products

All the afore-described processes are highly dependent on various types of internal and external KISA which facilitate changes in the value chain. A summary of the main categories of identified KISA is presented in the Exhibit 34.

Exhibit 34 A summary of identified KISA

<table>
<thead>
<tr>
<th>KISA</th>
<th>Description of the activity</th>
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<tbody>
<tr>
<td>R&amp;D</td>
<td>Research and development activities related to: forestry, logging, fiber research, chemicals, process development and logistics. Services are provided by: suppliers, universities, research institutes, RTOs,</td>
</tr>
<tr>
<td>Service, maintenance and facility management</td>
<td>Plant maintenance, servicing &amp; plant level R&amp;D. Key service providers include: equipment suppliers, chemical suppliers, facility management firms, industrial service firms, service and maintenance joint ventures, local and regional service suppliers including educational institutions.</td>
</tr>
<tr>
<td>Techno-economic expert services</td>
<td>A variety of environmental and forestry-related services mainly supplied by: engineering firms and Forest industry consultants, equipment suppliers and their contractors, universities and research institutes.</td>
</tr>
<tr>
<td>ICT-services</td>
<td>Process control and automation, business management systems and global infrastructure mainly sourced from: IT-equipment suppliers, software developers, software service firms, and telecommunication operators.</td>
</tr>
<tr>
<td>Marketing, logistics and customer interface related services</td>
<td>Solutions selling, integrated systems and marketing services mainly supplied by: research institutes, consultants, a wide variety of experts providing specific knowledge for projects requiring cross disciplinary knowledge, experts from customer firms.</td>
</tr>
<tr>
<td>New business venturing</td>
<td>Business incubation and new business venturing type of services provided mainly by: innovation units, inventors, SMEs, business development experts, legal experts (patenting), financing experts and researchers.</td>
</tr>
</tbody>
</table>

4.3.2 Integration of internal and external KISA

Due to extensive scope of KISA within the Forenel cluster there are several ways to integrate internal and external expertise. The overall effectiveness of knowledge exploitation depends on the firms absorptive capacity and other parties transfer capacity. Further on, sufficient knowledge base is the foundation of KISA.

In the case of Finnish Forenel cluster the knowledge base is fairly strong. Finland has leading edge research, technology and education, as well as high level knowledge on the techno-economic management of complex paper and board production. However, the analysis indicates that there is a need to build new knowledge in incorporating new technologies on the paper products (electronics and biotechnology). Another area where knowledge base needs to be strengthened is the value chain orchestration and closer integration to customers. The following list is not a comprehensive one but it gives a good indication of the ways in which Forenel businesses seek to secure effective co-production of knowledge with the external experts:

- by employing experts in multi-disciplinary research teams businesses can build up their knowledge base as well as absorptive capacity
- by making use of personal level connections with industry- and other experts
- by setting up innovation units that scan the business environment and develop new types of expertise and business opportunities
- by business acquisitions which bring in new knowledge and innovative thinking within the firm
• by participating in various types of networks which offer multifaceted opportunities for incorporating internal and external knowledge
• by engaging in close cooperation with suppliers and setting up joint development projects
• in joint ventures which typically (e.g., service firms) represent a further step in institutionalising cooperation and integration of KISA with other firms
• by buying integrated product-service bundles bring external KISA within the firm
• by engaging in close cooperation with customers so that internal and external KISA can be used in new solutions development
• in joint projects with research institutions research based KISA is brought in to practical problem solving situations and development projects
• by using outsourcing as a way to integrate former internal KISA with the external expertise
• by purchasing services from KIBS businesses and working with them

On the business process level the integration of internal and external KISA needs to overcome a number of challenges. As the product-service solutions are becoming ever more complex and involve a wide range of external and internal experts there is a need for integrating services. Hence, some negative effects of knowledge fragmentation can follow from an extensive use of external KISA. Interviewees recognise the mounting challenge of managing increasing numbers of external experts representing numerous different disciplines. This indicates a need for improved management skills among experts as well as R&D management. Such training could facilitate the effective integration of internal and external expertise. Some of the consulting firms have realised this market opportunity and they are taking a role as integrator offering turn-key innovation services. Such integrated packages seek to avoid knowledge fragmentation problems by offering complete R&D service solutions.

4.3.3 Outsourcing and the use of external KISA

Use of external KISA and outsourcing are closely related concepts that have a number of common features. Extensive outsourcing can be seen as a one way to cope with increasing complexity, since it opens up possibilities for specialisation, combination of cross-disciplinary expertise and more effective division of labour. Along with growing internal expertise the need for external KISA is clearly increasing. As such the use of external KISA can be seen as outsourcing that brings some complementary knowledge within the firm. Service and maintenance case provides a practical example of the benefits and problems attached to the use of external KISA. While some paper and board firms are already outsourcing, or moving into joint ventures hundreds of different types of service and maintenance KISA. Other firms consider service and maintenance as their core competence, which they will keep tightly within the firm. Outsourcing of service and maintenance operations can clearly yield benefits in terms of specialisation, knowledge accumulation and enhanced business focus of service operations. A reason why some firms are reluctant to go for this route is the production process
related learning that takes place through service and maintenance functions\(^{29}\). As long as the production process remains rather stable outsourcing would seem to be a safe option. It will allow learning to take place in limited ways in supplier firms servicing the paper and board business. The problem is that nobody knows when a radical change will happen and then it is important to bring the production learning in-house (Zysman 2002). Undoubtedly, the ICT related developments, increasing automation and a number of other technologies represent potential for significant changes. Hence, despite the obvious benefits of outsourcing, production related knowledge remains a highly sensitive issue in paper and board production. Albeit the above type of concerns, the role of internal as well as external KISA seems to be increasing and they can have a strategic role in the renewal process of the forest industry.

### 4.4 Innovations and R&D

*Private sector KISA appears to be more agile to respond to changing needs than KISA offered by the public sector.* More effective allocation of R&D resources is an on-going phenomena in the Forenel cluster. The process is well on the way on part of the R&D that takes place within the business sector. Research is becoming more targeted, better organised, and overall the business R&D is turning more applied and closely related to the business activities. Perhaps most important, government is now more responsible for long-range, strategic research projects that are increasingly beyond the reach of the private sector. Despite these apparent changes in the division of labour in the R&D field, the public sector is yet to show ability to fully respond to the situation. Better division of labour between universities and targeting of long-term basic research are issues to be addressed. There is increasing need for basic research that targets the consumer end of the value chain. Such research can facilitate the key element of future innovation – ability to address the market need with complete solution. Overall strong basic research was raised as an important element defining the future competitiveness of the Forenel cluster.

#### 4.4.1 Supplier driven technological innovations

Technological competence continues to be the cornerstone of the forest industry and *supplier driven technological innovations* have been typical in the forest cluster. Technology influences Forenel cluster in numerous different ways at every stage of the value chain starting from the R&D, to building and upgrading of mills, to more effective logistics, and enhanced interaction with the customers. In all these areas knowledge intensive service activities are highly significant element along with the technology. Suppliers have been the main source of new technologies and

\(^{29}\) Hundreds of different types of service and maintenance related KISA are necessary for effective running of the mill and in the constant upgrading of the production process. In the end constant improvements make the difference between R&D and production vanish (Zysman 2002a). As a result, paper mills are able to gradually increase production output, as much as 50% over ten years time. Moreover, at the same time mills are able to improve the quality of their production through out their entire life-cycle. Such highly significant increases in production output and quality come through process upgrades that increase accuracy of the process control; higher speed paper making technology; high efficiency capacity or improved sensing and control from the wet end up to the final product. Overall, effective use of technology and maintenance services that minimize the down time are highly important elements of success in such capital intensive industry.
related KISA for the forest industry. The question is for how long this will continue, as the suppliers are facing decreasing returns? It also seems that often suppliers are expected to provide expert services free of charge in connection with the equipment delivery. This makes them increasingly frustrated as buyers are willing to pay for similar services if they are provided as stand alone services by the consultants. Such situation can undermine the potential benefits of KISA and both suppliers and buyers need to seek solutions that in the longer run are acceptable for both parties. Win-win type partnerships can be seen as possibility to speed up horizontal as well as vertical innovations within the Forenel cluster. Suppliers need to be more effective in service ‘product’ development and transparent in making buyers to realise the added value of product-service bundles.

4.4.2 Increasing importance of user-based innovation

The influence of user-based innovation is growing and technology alone is no longer a source of meaningful competitive advantage, it is a minimum requirement to be in the game. Going forward successfully will depend on effective customer interface which facilitates customization, flexibility, speed and innovation, not competing in a low-wage, mass-production system. In the industrial context the world used to be divided into ‘producers’ and ‘consumers’, with the former in control. Today the centre of gravity is shifting as innovation increasingly occurs on both sides of the cash register (see e.g. Council of competitiveness, 2004). For manufacturing firms that have operated on the business-to-business markets this new type of R&D situation is a challenging one. Even if the firm is performing very well in the technological ‘back office’ innovation, it takes many new skills before businesses can effectively move in the area of ‘front office’ innovation in close cooperation with the customers (see Exhibit 12). Besides new types of non-technological knowledge also new types of management practices need to be adapted accordingly. As firms are pursuing for customer oriented solutions selling there are increasing need to develop teams that can create solutions for complex situations. This calls for internal- and external expertise that firms need to integrate into competitive customized solutions. Effective co-operation within teams requires well-developed partnerships and transparency of the operations. For instance, there is a need to have clearly specified rules for intellectual property rights, and mutually agreeable sharing of revenues. Such co-operation and open discussion can increase chances for multifaceted user-driven innovations.

4.5 Policy related issues

In the case of Forenel cluster KISA related support policies and instruments can cover a wide range of issues. The development of KISA is related to service innovation concept that encapsulates a number of areas where the possibilities of innovation policy contribution should be examined. These include innovations in technology, service activities, delivery channels, customer interface, organisation and in various types of networks. A thorough analysis of these dimensions is needed to reveal the most relevant areas for policy measures.

The role of KISA in innovation can be divided into interaction with customers (front office activities) and systems which enable the delivery of KISA (back office activities). In terms of service innovation, effective customer interface is of central
importance as businesses develop and commercialise innovative service solutions. It is a source of invaluable in-depth customer related information for the research and development. While the back office technologies are a familiar area for technology policy, the customer interaction part is far more uncharted area of innovation policy and deserves more attention. In terms of policy mix, the nature of interaction process favours indirect measures as well as improvements in the framework conditions. However, according to international benchmarking innovation policy mix in Finland is heavily biased towards direct firm specific interventions (Den Hertog and Segers 2003:26). Apparently, the Finnish innovation policy mix can be developed so that it supports also service innovations more effectively. Future policy development and prioritisation ought to address the front office as well as the back office related dynamics of service innovation. In addition, a number of other areas could benefit from further research in the area include the following:

- The impacts of outsourcing / offshoring of KISA to innovation within the Forenel sector and in more general context.
- The question of, how businesses make a decision on what KISA to outsource and what to offshore?
- Impacts of the use of external KISA on the skills content within Forenel firms

4.5.1 Supply of KISA

The stock of available knowledge provides the foundation for the provision of knowledge intensive services. Investigated Forenel cluster represents leading edge technological knowledge on a on paper and board production and also on a number of other forest industry related areas. Effective knowledge exploitation requires good transfer capabilities from the knowledge creators and absorptive capacity from those who wish to utilise external KISA. As such these capabilities appear to work fairly well within the Forenel cluster. Universities and research institutes are in good cooperation with the industry and consulting firms. Yet there were three key concerns that interviewees voiced in the discussions. These include a need for better division of labour and specialisation between universities. Another problem concerns the need for long-term basic research. Interviewees raised concerns about the erosion of the knowledge base as a result of universities shift towards more applied research. Thirdly, the focus of university research is biased towards the early stages of the value chain in the forestry and engineering areas. More emphasis is needed on the customer end of the value chain. There is a need for cross disciplinary research which can build up the knowledge base necessary for building and selling of complete solutions for market needs. Other policy relevant issues on the supply of KISA include:

- There are a number of new technologies that could be applied in the Forenel cluster but the industry seems to be fairly conservative in its approach. Policy measures could seek to speed up the adoption of new technologies.
- Innovative small firms represent an important element that can contribute the innovativeness of the Forenel cluster. Small firms and early innovations are highly dependent on external KISA. The availability of KISA for this type of small firms ought to be a policy priority.
• Much of the KISA comes with the equipments used by the Forenel cluster. Thus policies should recognise equipment suppliers’ role as KISA providers and support the development of solutions selling and related product-service offers.
• Forenel cluster includes a number of consulting firms some of which are global leaders in their focus areas. From policy point of view it is important to keep these firms in the country and engage them in the policy measures supporting the development of KISA.
• Many firms within the Forenel cluster are laden with knowledge intensive services and they are organising their R&D activities be able to develop and utilise KISA more effectively. Policy measures which support this type of reorganisation could be considered.
• Policy needs to make sure that public sector provision for KISA does not substitute the private sector activities

4.5.2 Demand for KISA

Forenel industry is a large customer to KISA and there appear to be limited need for policy measures which seek to stimulate demand. However, outsourcing can be seen as an activity that can increase the demand for KISA. Increasingly outsourcing can be seen as an opportunity to develop business and its competitiveness, not only as a cost cutting exercise. It can lead into more effective specialisation and re-configuring of value chains according to the evolving market place. It may also enable businesses to renew their mature manufacturing business to a high value added KISA and solutions supplier. There are also other situations which may benefit from policy attention. These include:

• Solution selling typically requires a network of KISA providers. Formation of such networks and good practices of buying network KISA could be supported by a range of policy actions.
• Research which highlights good practices and bottle necks in KISA supplier-buyer relations can create a favourable framework conditions for the increasing demand.
• Extensive use of external KISA is a challenging management task and there seems to be some training needs in this area
• Effective use of external and internal KISA could benefit from some further research and development projects in this area
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### Appendix A

**Interviews / SC-Research**

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<th>Name</th>
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### Appendix B

**Interviews/ ETLA**

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<td>Esa Rousu</td>
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