ETLA ELINKEINOELÄMÄN TUTKIMUSLAITOS
The Research Institute of the Finnish Economy
Lönnrotinkatu 4 B 00120 Helsinki Finland

Sarja B 160 Series

Colin J. Hazley

Forest-Based and Related Industries of the European Union – Industrial Districts, Clusters and Agglomerations

ETLA, The Research Institute of the Finnish Economy

Publisher: Taloustieto Oy

Helsinki 2000

Cover: Mainos MayDay, Vantaa 2000

ISBN 951-628-311-X
ISSN 0356-7443

Printed in: Yliopistopaino,
Helsinki 2000

Foreword

This book reveals the importance of the forest-based and related industries of the European Union, which is a large economic entity, providing widespread benefits to the whole of the EU. Combined, these industries provide direct employment for over 4 million people, have a turnover of 400 million Euro, and generate a value-added of some 160 billion Euro. These industries are widely distributed across the EU and provide employment both in urban and rural areas, whilst contributing 13% of the EU's trade surplus.

Despite the fact that most of the forest-based and related industries are classified as low-technology industries, tight interaction with specialised machinery and chemical suppliers, reveals that most of the R&D is conducted by the suppliers and thus technology is embodied in purchases of these inputs. Nonetheless, the forest-based and related industries have shown to be very competitive over long periods of time. In fact, most of the competitive elements are based on specialisation and localised learning and are especially located in industrial districts, clusters and agglomerations. In many cases, the sources of competitive advantage are derived from localised intangible resources, which are built-up over long periods of time and are not easily transferred or rebuilt.

In revealing some of the forest-based and related industries' strengths and weaknesses, in key products and industries, the book also highlights some threats posed by the expansion of the European Union to include its neighbours in Eastern Europe. Although EU forest-based and related industry exports have grown rapidly to Eastern Europe, the share of imports from the Eastern European countries and Russia has grown even faster, and now stands at 6.5 billion Euro, the second largest importer after North America. Expansion of these industries in some of the least regulated markets in Eastern Europe, also suggests that environmental problems are being encouraged to develop, unabated. Developments in Eastern Europe will clearly have an impact on the forest-based and related industries of the EU, hence a more detailed analysis of the situation using the cluster approach would seem the most appropriate way forward.

February 2000

Pentti Vartia

Acknowledgements

ETLA would like to express its gratitude to all persons and companies who assisted with this research, over the past two years. Although the list of companies, organisations, and persons is very extensive and we can not list all, I personally, would like to especially thank the following staff at the Research Institute of the Finnish Economy:

Mr. Markku Lammi, for his inspirations and perseverance in improving the research material and its presentation; Mr. Mikko Mäkinen, for his meticulous processing of trade statistics; Ms. Pia Järvinen, for her hard work in producing industry maps and employment statistics; Mrs. Kaija Hyvönen-Rajecki who greatly assisted in obtaining much of the reference material; Mrs. Tuula Ratapalo and Mr. Kimmo Aaltonen, for their hard work in compiling the presentation material in this publication and Mr. Pekka Ylä-Anttila for his assistance with material presented on clusters within the book.

Helsinki, February 2000

Colin J. Hazley,
MBA, BEng.

Contents

Introduction

At the beginning of 1995, the accession of Austria, Finland and Sweden into the European Union not only saw the enlargement of the EU but also the doubling of its forest area, overnight. The total forest area in the EU now stands at some 103 million hectares, covering about one-third of EU land area. At the same time the EU became one of the world-wide leaders in forest industry activity. For example, the EU tripled its production of Wood Pulp and become the world's second largest producer, doubled its production of Sawnwood making it the world's second largest producer. Additionally, the EU is now also the world's second largest producer of Paper and Paperboard and also Wood-Based panels.

Notwithstanding the above facts and the obvious contribution of forest-based industries to the EU economy, very little recognition has been accorded to the industry to date, whilst environmental issues tend to dominate media coverage of the industry. Moreover, the forest-based and related industries are not well known in many parts of Europe, yet they are located all over Europe and represent a formidable economic entity within the EU. For example, the Forestry Commission of Great Britain estimates that the 'British wood industry' (which includes many forest cluster activities) employs around 35,000 persons, and that this figure may grow by 1000 per year up until the year 2016.[1] Impressive though the prediction may be, it shows that the true nature of the industry is not understood, since when one examines the UK national statistics we find that the forest-based and related industries employ over 600,000 people.[2] Hence the real issue is one of defining exactly what are the forest-based and related industries and conveying this to the public and policy makers alike.

In addition, the problem of definition is not confined to national authorities alone. According to a report published by the European Parliament, (Memo – 'Europe and the Forest 1998') the for-

---

[1] The Forestry Industry Handbook 1998 – The Forestry Industry Council of Great Britain.

[2] Total employment is 643,600 and is comprised of: Wood & wood products, 79,100; furniture manufacturing, 129,100; pulp, paper & paper products, 125,800; publishing & printing, 309,600. Source: UK Office for National Statistics-Sector Reviews, 1997.

est industry in Europe which includes wood and wooden furniture and paper industries (but excludes forestry activities) employs some 3 million people and has a turnover of about 230 billion ECUs. However, as our research will show this is only part of the picture and certainly does not reflect the true size or nature of the industry. For one to understand how important and to what extent the forest industry in Europe contributes to the EU economy in whatever respect, one must look at the combined effect of all forest-based and related industries and examine the 'Forest Cluster'. The exact characteristics and the importance of the EU forest cluster are the scope of this particular research.

The forest-based and related industries of the EU encompass a broad spectrum of manufacturers connected through the forest-wood chain. Industries include, forestry, pulp and paper, mechanical wood processing, wood furniture manufacturing, printing and publishing as well as other related and supporting industries and speciality input providers who supply key products to various branches of the industry, each of which we hope to demonstrate in the following chapters.

Related and supporting industries include manufacturing industries such as paper machinery manufacturers, wood processing and woodworking machinery manufacturers, and speciality input providers include bleaching chemicals for pulp and paper, adhesives for wood-based panels and wooden products etc.

These industries are inter-connected through numerous user-producer relationships, where tight bonds between different industries and competing firms help to produce innovations, and further improve competitiveness across the whole production chain.

In fact, the forest-based and related industries of the EU are widely distributed across Europe, and are not concentrated in any one region or country. Combined, the forest-based and related industries provide employment for over 4 million people, have a turnover of some 400 billion Euro and produce some 160 billion Euro in value-added. The evidence to support these facts is detailed within this publication.

In this report we attempt to answer the following questions in relation to the EU forest-based and related industry cluster:

- What is the significance of the forest cluster in EU countries;
- What is the role and importance of SMEs;
- What are the levels of employment, production and trade;
- What is the share of the forest industry's technology inputs;
- What is the regional significance within EU countries;
- Who are the most important firms in the EU;
- What is the extent of Interplay between firms and industries across Europe;
- What links do firms have within the EU;
- What are the strong and weak areas of the EU forest cluster.

Hence the report is laid out to cover these areas amongst others. In chapter 1, we discuss the cluster approach, the role of governments and the advantages of cluster-based policy making. In Chapter 2, we attempt to convey the cluster concept as applied to the forest-based and related industries. From chapter 3 through to chapter 7, we describe the main industrial sectors of the forest cluster, which include forestry, mechanical wood sector, wood furniture industries, pulp and paper industries, and the printing and publishing industries. In chapter 8, we attempt to describe what the related and supporting industries are and how they constitute an essential part of the industry. In Chapter 9, we discuss R&D, whilst in chapter 10 and 11 we show the regional significance of the industry and importance of SMEs within it. Chapters 12 and 13, attempt to summarise the whole forest cluster, be describing trade and industrial statistics.

This report does not cover environmental issues affecting the industry or the services sector, saving where relevant, and only briefly covers statistics within the forestry sector. At the end of every chapter we provide summary conclusions, and hence the following executive summary covers the main findings, only.

Executive Summary

The cluster concept

The main advantages of the cluster concept and cluster-based industrial policies relate to the concept's focus on linkages and interdependencies among various actors in the value chain. The cluster approach offers a framework within which the determinants of national competitiveness may be identified, and the way in which they interrelate to each other. In that sense the cluster concept offers an alternative to the traditional sectoral approach which looks at different industries in isolation. Clusters provide a coherent framework for policy design, enhance dialogue between various partners in the economy, clarify the roles of different agents in policy formulation, and provide an insight into how the sustainable and productivity-based competitiveness emerges.

There is not one correct definition of the cluster concept, but different dimensions are of interest. Moreover, this is not a drawback of the cluster concept, on the contrary, it underscores the usefulness of the cluster approach for the practice of government and business. The dimensions of clustering provide a basis upon which tailor-made policies can be developed, in order to enhance the effectiveness of policies and strategies for governments and firms alike. The main message of the cluster concept is that traditional economic sectoral analysis fails to capture competitiveness. Statistical approaches utilised in the cluster approach overcome this hurdle by helping to identify potential areas were further research is warranted. However, it is only after detailed cluster analysis is carried out that can competitiveness be effectively assessed.

Forestry

There are over 7.3 million forest holdings within the EU, and up to 12 million forest owners. It is also estimated that forestry directly employs some 300, 000 people in the EU, but since current statistics do not cover employment, adequately, it is likely that forestry sector employment is much higher than estimated. At the same time, it is believed that a significant amount of forestry based activities goes unrecorded, and hence the economic value of forestry is also likely to be seriously underestimated.

Mechanical wood sector

The mechanical wood sector is comprised of 90% SMEs with less than 20 employees. Products manufactured within the mechanical wood sector are wide and varied and range from semi-finished to final products both low and high value-added. The production of wood-based panels is widely distributed across Europe, with some non-traditional forest industry countries being amongst the largest producers (e.g. Belgium and Italy) although Germany is by far the largest producer. The production of sawnwood is mainly located in countries where the largest forest resources are found, namely, Sweden, Germany, France, Finland, Austria and Spain. Nonetheless, a significant amount of tropical wood is still imported by countries engaged in the manufacture of furniture and/or other related industries.

The wooden furniture industry

The EU furniture industry is also dominated by SMEs - enterprises with less than 20 employees account for 90% of the total employment. EU countries are the top furniture exporters in the world (over one-third of EU production is exported), Italy and Germany are the top two exporters in the world - Italy alone, accounts for 37% of all furniture exports. The EU furniture industry also provides a trade surplus to the EU.

Furniture manufacturers are distributed across the EU. Agglomerations of wood furniture manufacturing tend to be concentrated in industrial districts throughout regions of the EU (numerous examples have been identified in many areas). The wooden furniture industry does not derive its competitiveness from tangible assets (such as high-tech machinery etc) it is the intangible assets (specialisation, trust, local business culture, localised learning) that provide the basis for success.

Competitiveness based on localised learning has proven to be more successful and sustainable. It is achieved through co-operative production arrangements based on specialisation, quality, flexibility, and customisation and within an institutional environment characterised by trust and reciprocity. Specialisation contracting, which takes advantage of localised learning and skills, facilitates incremental product and process innovations through user-producer relationships.

The furniture industry is low-tech and supplier dominated - i.e. innovations are mainly process innovations, embodied in capital equipment and intermediate inputs originated by firms whose principal activity is outside the industry. Related and supporting industries such as woodworking machinery are strong in two of the largest furniture producing countries, Italy and Germany. Strong wood furniture clusters have been found in Italy and Denmark.

The pulp and paper industry

Of the world's 150 largest pulp and paper companies, 60 are from the EU. The EU is the second largest producer and consumer of paper & board, accounting for one-quarter of the world's total paper and board. The EU also produces one-fifth of the world's supply of woodpulp (mostly bleached sulphate pulp). The largest pulp producers are Finland, Sweden, Portugal and Spain, whilst the largest consumers of market pulp are Germany, France, the UK and Italy.

The EU is a net exporter of paper and board. The main producers of paper and board are Germany, Finland, Sweden, France, Italy and the UK. The largest consumers of paper and board are the five most populated countries in the EU. There are over 1000 paper and board mills distributed across the EU, with about two-thirds of these located in Italy, Germany, France, and Spain. Paper and board capacity is also widely distributed across the EU, and is not confined to any particular region or country.

The increased use of recycled fibre has caused a shift in the industry closer to the larger consumer centres - nearer highly populated areas - this is particularly the case in newsprint production. Rapid changes in printing technology continue to pose many new challenges for graphic paper producers, resulting in increasing co-operation between paper manufacturers and the printing industry. Whilst continued printing technology developments may lead to higher product customisation this may also result in a shift of production towards the main centres in Europe.

The pulp and paper industry has been affected by the growing environmental awareness of the consumer and by stricter environmental controls, but this has been a major source of innovation within the industry. Nowadays European producers have become leaders in many areas of associated environmental technology, which has provided a competitive edge to the industry.

Most of the major multinational companies have subsidiaries in many parts of Europe and further afield, and employ many people across Europe. At the same time, this enables paper manufacturers to maintain tight co-operation with the printing and publishing industry to develop new products and processes. A number of pulp and paper clusters have been found in Sweden, Finland, and Austria.

The printing and publishing industry

Printing and publishing industries are mainly comprised of SMEs, with about 85% having less than 20 employees. Printing and Publishing industries are found at local, regional, and national levels. Although some firms are international and multinational the printing industry itself is not a global industry. A printing cluster has been found in Germany.

The vast majority of value-added information products are paper-based (books, periodicals and newspapers earn bout 95% of their revenues from paper products). Despite the apparent threat, Internet is not likely to replace books or newspapers but is more likely to find niche markets which may be complementary to paper products. In fact, new technology has increased the use of paper, not reduced it - a trend that is forecast to continue for the foreseeable future.

Printing technology is changing fast. Offset printing will remain the main type of printing, however, flexographic and digital printing will erode its share. Gravure printing will continue to decline as run lengths are reduced. Digital printing will become the second largest type of printing in the near future. However, the rapid changes in printing technology combined with new working patterns and work-flow arrangements will necessitate even tighter cooperation throughout the value chain (from raw material and equipment suppliers to publishers).

Related and supporting industries

Some 8 billion Euro was invested in machinery and equipment into the forest based and related industries of the EU in 1995 - with about 60% into the pulp & paper industry, alone. European companies are the world leaders in pulp and paper machinery and equipment with Finland, Germany and Austria, accounting for much of the market. European companies are also the world leaders in woodworking machinery and equipment with Italy and Germany accounting for over half of world trade.

Investment in machinery and equipment is a more appropriate measure of R&D in so-called low-tech industries such as the forest-based and related industries, since most R&D is carried out by suppliers of machinery & equipment and other speciality inputs. A review of machine building industry companies provides ample evidence of close co-operation and sources of innovation to the forest-based industries and confirms their role as 'related and supporting industries'. 'Embodied' R&D and technology within machinery, are transferred within the industry – e.g. machinery and equipment developed around world class paper and wood product manufacturers is often transferred to other centres of production.

'Speciality inputs' are wide and varied and include, pulp and paper chemicals (bleaches, starches), pigments and fillers, wood product adhesives, chemical treatments, and printing inks, to list but a few. Speciality inputs are developed especially for the forest-based industries by companies who have long established connections with the industry. Development of speciality inputs usually occur within competitive regions of industry, and are then transferred to other regions via the input supplier, Hence R&D and technology embodied within the product are transferred throughout the industry, internationally.

Suppliers of speciality inputs tend to be large multinational chemical companies with subsidiaries in many parts of Europe and the world. Speciality input suppliers typically supply to several branches of the forest-based industries, and since they conduct most of the R&D they are therefore central to the innovation process within the industry. In some cases, the speciality input industry is more oriented towards the forest-based and related industries than any other - more than 50% of printing inks are used on paper and board products; more than 50% of adhesives are supplied to wood and paper manufacturers.

R&D within the forest cluster

R&D in the European forest industry has provided a competitive advantage in global competition and created a broad range of new products. In new technology transfer and as an end-user, the pulp and paper industry is a relatively innovative sector, being a strong user of new technology. While chemistry, machinery, electronics and information technology represent some of the main related and supporting industries in forest cluster technology, industries such as the life sciences have become increasingly important.

While Asia is expected to be the focus of the highest growth rate in the pulp and paper markets in the future, the technology of logistics and transportation of forest goods as well as information technology, environmental and energy R&D will also gain increasing importance in future decades. As the EU enlarges, the Central and Eastern European countries are also expected to become important markets. This means that technology transfer and foreign direct investment will likewise grow, and thus increase the importance of R&D in the European forest cluster.

Within the forest cluster, pulp and paper technology is based on a comparatively large number of sciences, which are harnessed to find new R&D solutions. Thus, the pulp and paper industry can be classified as a broad-technology industry. Eg. finding efficient solutions in energy R&D is a matter of great importance for the cluster. As mechanical paper grades in particular are energy-intensive, the new innovations in energy R&D are crucial.

The share of R&D expenditures of turnover in the forest cluster industries is estimated at 0.7 per cent for wood and furniture, and around 1 per cent in pulp and paper in Europe. In terms of turnover, R&D expenditures for pulp and paper machinery is approximately 4 per cent, forest related electrical machinery 4-5 per cent and for forest chemicals 5 per cent.

The forest cluster, as a whole, includes various specialised sources of advanced knowledge in universities, private and public research institutes and corporate R&D departments. Degrees relating to the forest cluster can be studied in at least 97 universities in 151 departments around Europe.

Regional Importance

Forest-based and related industries and companies are widely dispersed across the EU, and are not concentrated in one region or country. Employment within the forest-based and related industries is widely distributed throughout the EU, and accounts for about 9% of total employment in EU manufacturing. The forest-based and related industries provide between 8-24% of total manufacturing employment within various *regions* of the EU.

Companies and employment within the forest-based and related industries are located mainly in areas of high population density. However, forest-based and related industries are also very important to the peripheral areas (rural) of the EU. The wide dispersed nature of the forest-based and related industries suggest that the successful implementation of well thought out policies within this field could potentially benefit regions in many parts of Europe.

Importance of SMEs

The forest cluster is comprised primarily of SMEs - employing 250 persons or less - which account for about 99% of the total enterprises. Moreover, SME size classes of 20 employees or less make up the vast majority of the industry – accounting for about 85% of all companies within the forest cluster. SMEs account for about two-thirds of employment and VA within the forest cluster. However, within the mechanical wood sector (including wood furniture), SMEs account for about 90% of the employment, whereas within pulp, paper, printing and publishing, SMEs account for about half.

Trade Analysis

EU forest cluster exports account for about 7% of the EU's total exports to the world. The EU forest cluster accounts for about 60% of OECD forest cluster exports. About 70% of forest cluster exports remain within the EU as intra-EU trade. Much of the forest cluster trade takes place between neighbouring countries. Nonetheless, in 1995, the EU forest cluster had a positive trade balance with the world of around 8.5 billion Euro, representing 13% of the EU's trade surplus with the world.

The origin of forest cluster exports is widely dispersed around the EU and not concentrated in Sweden and Finland. The reliance on forest cluster exports has declined in terms of total exports in the traditional forest cluster countries whilst it has increased in non-traditional forest cluster countries.

EU strengths within forest cluster have been identified as mostly higher value-added products across all areas of the cluster, and are especially strong in machine building. Nonetheless, a considerable amount of speciality inputs and other forest cluster products are imported from outside the EU. North America and Eastern Europe are the main origins of forest cluster imports to the EU, with Eastern Europe's share growing the quickest.

Industrial statistics

The EU forest cluster has been estimated to comprise of about 4.2 million employees; has a turnover of about 399 billion Euro and yields approximately 161 billion Euro in value-added. In terms of value-added, turnover and employment, the most significant forest cluster countries in the EU are Germany, the UK, France and Italy.

The total value-added of the forest cluster is estimated at about 2.8% of the EU15's GDP (161 billion Euro), and could be higher at around 3%. The forest cluster provides 2.9% of total employment in the EU. Within the OECD, the EU forest cluster's share of value-added is greater than 25%, whilst its share of production in total manufacturing is about 35%.

Conclusions

The forest-based and related industries of the EU are widely distributed across Europe, and are not concentrated in any one region or country. Combined, the forest-based and related industries provide employment for over 4 million people, have a turnover of some 400 billion Euro, produce some 160 billion Euro in value-added, and also provide a trade surplus to the EU.

EU countries comprise a formidable amount of technological know-how and expertise in all areas of the forest cluster. The high levels of expertise contained within the related and supporting industries are demonstrated by the fact that a considerable proportion of machinery and equipment is exported by the EU forest cluster. This is significant, since it shows that many innovations continue to occur within the EU, and suggest that other elements of the forest cluster continue to be competitive. However, in the area of speciality inputs - such as pulp and paper chemicals, which is dominated by large multinationals – a considerable amount of inputs are imported from outside the EU. In this instance, the forest cluster may be losing its edge in some key inputs.

The EU forest cluster exists as a series of 'industrial districts', 'clusters' and 'agglomerations' found in many regions of Europe. These are found both localised in certain districts or regions and sometimes dispersed at the national level but the vast majority are comprised of SMEs. In many cases, they are linked to one another via multinational firms and networks of related and supporting industries. As such, key innovations developed in one competitive region may be transferred to another. However, there are many intangible assets, which may not be easily transferred. History also plays a key role in the development of these competitive regions, or districts, with companies and regions accumulating knowledge over centuries.

Due to the shear scope of research, it has only been possible to provide an overview of the EU forest cluster, its characteristics and some of its strengths and weaknesses. Nonetheless, it is evident that there are numerous examples of competitive industrial districts, clusters and agglomerations located in many regions of the EU. Therefore, to assist policy-makers, it would be highly desirable to conduct a series of cluster studies at the national level to obtain even more accurate information on the EU forest cluster.

Apart from strengths and weaknesses, we have also highlighted several opportunities and threats. Opportunities exist in the shape of new markets e.g. in Eastern Europe, which are anticipated to grow as living standards increase. Between 1989 and 1995, forest cluster exports to the Central and Eastern European countries have grown from 0.6 billion Euro to 3.5 billion Euro, faster than the forest cluster exports to Asia. Moreover, given the high levels of expertise contained within the EU, opportunities also exist to enhance collaboration in research and development, and co-operation throughout the value chain, and indeed, the cluster concept offers a good starting point in this respect.

Eastern European countries also provide potential threats. During the period 1989-1995, the share of forest cluster imports from the Eastern European countries and Russia has grown from 5 to 7 per cent and now stands at 6.5 billion Euro, the second largest importer after North America. Although not the focus of this research we have highlighted numerous examples demonstrating the expansion of Western companies into Eastern Europe. In many cases, subcontracting arrangements are being utilised to take advantage of lower wage production and even new production facilities are being established. In the short term, there may not appear to be any concerns arising from this phenomenon. However, even though it is claimed that most of the production being outsourced or transferred may be termed lower value-added, the trend still points to major structural change within the forest cluster. At the same time, the shift of lower stages of production process to some of the least regulated industries in Eastern Europe, also suggests that environmental problems are being encouraged to develop, unabated. It is therefore necessary, that these forest-based and related industries be the subject of detailed cluster studies at the country level to determine their status before entering into the EU.

Chapter 1. Clusters

1.1 Clusters – a long-term view on competitiveness

In the globalised world economy the comparative advantage based on endowments of basic factors of production – like natural resources – has become less important. An abundance of traditional factors of production – raw material, energy, unskilled labour – is not enough to guarantee long term success; it is continuous innovation and improvement in productivity that are crucial. National competitive advantage is not inherited – it has to be created. Most of the innovative activity takes place in private enterprises who compete in the market place.

A competitive business enterprise is capable of selling its products and services at a profit in the competitive global market. A country's international competitiveness is a question of how competitive its firms are, how its industries and industrial clusters perform in world markets, how institutions are organised, and how successfully industrial policies affect the performance of firms and industries. The public and private sectors have different, but interrelated roles in creating national competitive advantages and a competitive economy.

It has been shown by many recent studies that a particular national competitive advantage is often born within industrial clusters – entities encompassing, for example, inter-linked industries, suppliers of specialised inputs, and providers of infrastructure services. A specific analysis is needed to uncover and identify the clusters within which the interaction of producers, suppliers, customers and competitors, promotes efficiency and increases specialisation.

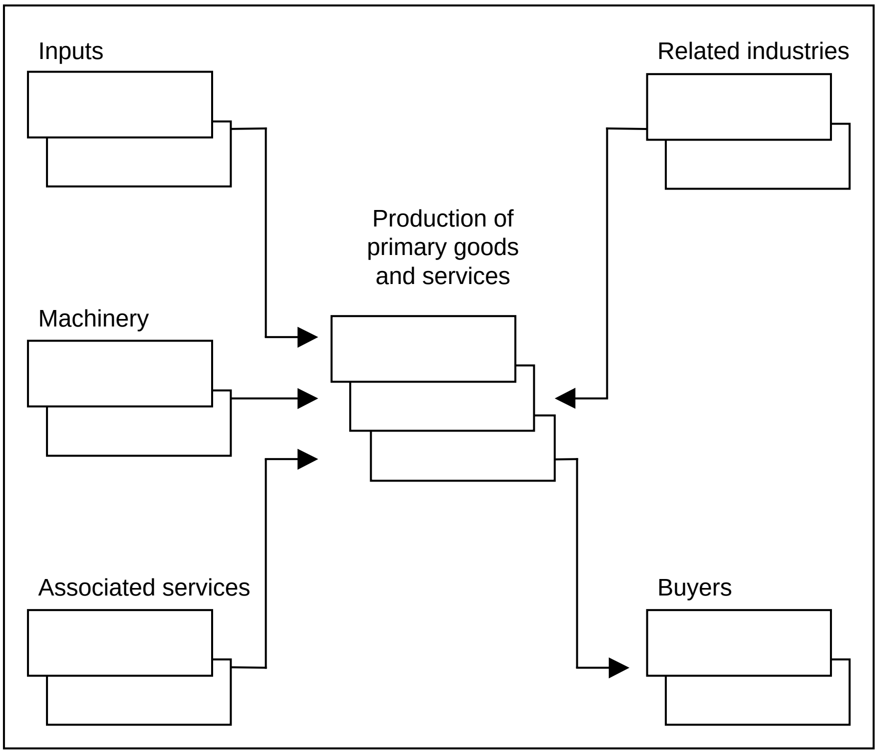
1.2 The framework for forest sector analysis – the diamond model and cluster analysis

What is a cluster?

The concept of a cluster helps to understand the evolution and current structure of an industry without establishing artificial sectoral boundaries. Sharp distinctions between branches are not made; the focus is on uncovering mutual connections and interaction among firms, industries and other important players in the sector. Clusters are defined based on these product and information flows between firms and industries. This industrial agglomeration of producers, customers, and competitors promotes efficiency throughout and increases specialisation.

Geographical proximity is typical of clusters - although it is not absolutely necessary. The agglomeration of many participants creates positive externalities: specialised factors of production are more readily available, recent innovations are easier to come by due to active interaction, and desirable technological spillovers are virtually unavoidable. The main idea is that a cluster is considered to be better equipped to succeed in the market place than the individual company. The cluster analysis incorporates the forces that influence the firm's ability to sustain and upgrade its competitive advantage. Continuous innovation and improvement in productivity are crucial for this process.

Figure 1.1 The cluster chart

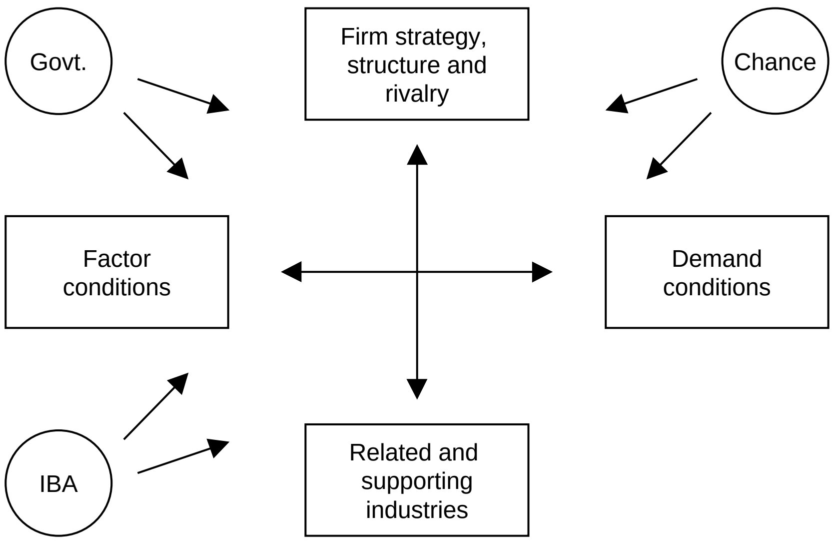


The practical tool in cluster analysis is the so-called cluster chart, which contains the relevant cluster components: primary goods and services, speciality inputs, machinery production, associated services, related industries, and customers.

1.3 The industrial diamond – model of competitive advantage

In the forest cluster analysis the so-called diamond model (see, M. E. Porter, The Competitive Advantage of Nations, 1990) is used to structure the determinants of competitiveness and to identify differences across the countries. Success in a Porterian sense can be defined as a company's long-run profitability and a high market share. The means to achieve these goals are continuous innovation and upgrading. Porter's research takes place on the industry and firm level. A link is drawn from the industry level studies to national level by noting that *"Nations succeed in industries if their national circumstances provide an environment that supports this sort of behavior."*

Figure 1.2 The diamond model



Source: The original diamond model as in Porter 1990a, p. 127. International business activities added due to discussion inspired by Dunning 1991 among others (see Dunning 1993).

(Porter 1990, p. 67). Institutional structure, domestic factor pools, and macroeconomic conditions constitute major factors defining the setting where national industries operate.

The diamond model incorporates the forces that influence a firm's ability to sustain and upgrade its competitive advantage. The four main determinants of the diamond are: (1) factor conditions, (2) demand conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. Besides these there are three outside forces that shape the operating environment, namely (5) government, (6) chance, and (7) international business activities (IBA). The diamond model is illustrated in Figure 1.2

At its best the components of a diamond form a cluster where each part strengthens each other. Unfavourable conditions in some parts of the diamond can be compensated by more advantageous conditions in other parts, and shortcomings can often be circumvented through innovative activity. The most vigorous diamonds tend to be fairly well balanced.

Factor conditions

Porter splits factor conditions into two categories: basic factors, which are inherited, and advanced factors, which have to be created by the country in question. The former includes natural resources, climate, location, and demographics. The latter includes communications infrastructure, sophisticated skills acquired through higher education, and advanced research facilities. To sustain the advanced factors, firms, individuals, and the government have to invest continuously. It is through these often highly specialised and industry specific factors of production that the most significant competitive advantages are being gained.

Demand conditions

Porter argues that globalisation has not diminished the important role of domestic demand. Porter sees the demanding customer in the 'home base' as the genuine force behind innovation and technological development. This is due to the fact that firms are most sensitive to the needs of their closest customers. Demanding domestic customers are especially valuable if changes in their demand help to predict future global trends.

Related and supporting industries

Porter concludes that successful industries tend to form clusters. A competitive cluster upholds a number of related and supporting industries that may in turn also be internationally competitive due to the sophisticated demand they are facing. While a cluster's companies compete fiercely in the market place, they might co-operate, for example, in research and development. Due to the accelerated diffusion of technology and knowledge spillovers a successful cluster has internal synergies that further feed the innovation and upgrading process. By having internationally competitive related industries, a firm in a cluster can gain competitive advantages: it can concentrate on its core competencies and rely on its suppliers for other activities.

Firm strategy, structure and rivalry

Porter acknowledges that national characteristics partly determine how companies in a country are founded, organised and managed. He argues that different management systems suit different industries. In addition to domestic demand, intense domestic rivalry is, in Porter's opinion, another major source of competitive advantage. He justifies this emphasis on national competition by stating that the competition among domestic companies tends to be more intense and direct, since each enterprise has to operate under the same conditions.

The role of government – cluster-based industrial policies

Innovation and technology policies pursued by governmental bodies have changed markedly over the past few decades. The emphasis has, roughly, moved from 'backing the losers' (in the 1970s), to 'picking the winners' (in the 1980s), and to 'let the market pick the winners' policies in the 1990s. This is in accordance with globalisation of business and changing mechanisms of creating competitive advantages. It is the firms that create their own firm-specific advantages, the role of policies is to ensure framework conditions conducive to economic success instead of direct interventions. Industrial policies have become 'competitiveness policies' or 'conditions providing policies'.

In many OECD countries – like Finland, Denmark, The Netherlands – where extensive cluster studies have been carried out, cluster-based industrial policies have been adopted (see, “Cluster Analysis and Cluster-based policy. New perspectives and rationale in innovation policy-making”, OECD, Paris, 1999). Generally, on the basis of such policy-oriented cluster studies the appropriate roles of government are seen as follows: 1) Establish a stable and predictable macroeconomic and political environment, 2) Improve the availability, quality, and efficiency of general purpose inputs and institutions, 3) Establish rules and incentives governing competition, 4) Facilitate cluster development and create forces for upgrading and innovation, 5) Promote development of human capital. Thus, the appropriate role is usually not in providing direct subsidies, but rather in indirect measures to promote competitiveness.

The role of chance

Chance has a role in many of the industrial success stories according to Porter. Chance events include 'pure' innovations, technological jumps (rapid changes in specific technologies), price shocks, changes in political systems, wars, etc.

International business activities

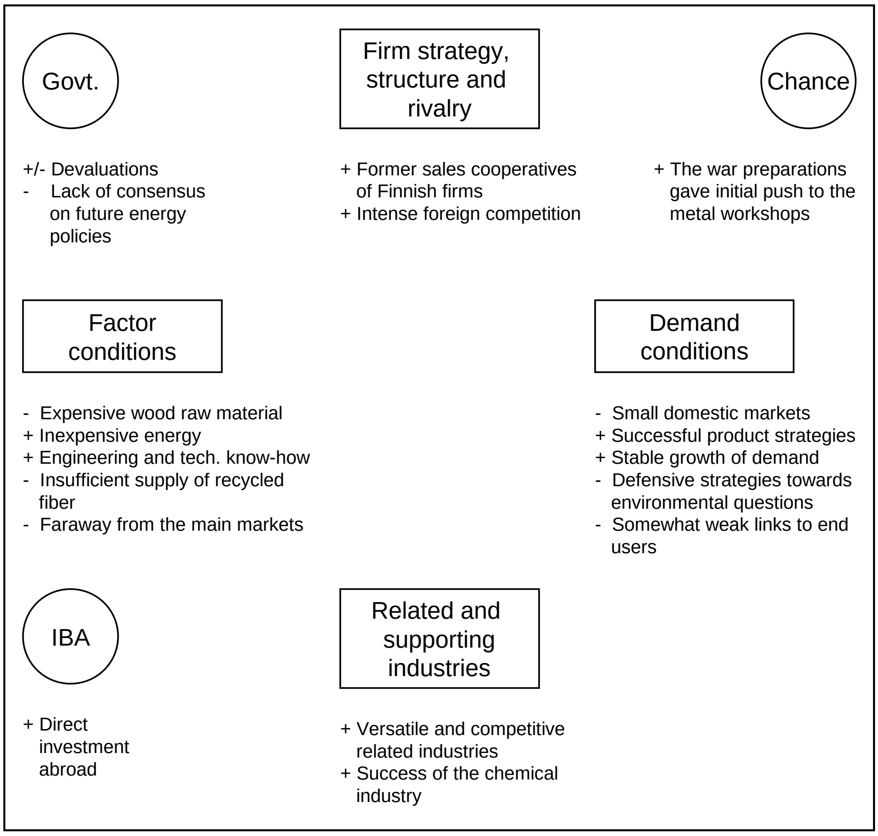
International business activities were not part of the original diamond model. They have been added later thanks to discussion initiated by scholars in international business. Multinational corporations can be seen as extensions of national diamonds. However, while most firms indeed have a 'home base,' there are truly global corporations with a corporate culture that is not much influenced by any single nationality.

In the comparative analysis of the forest clusters international business activities (IBA) and globalisation of the forest sector are looked at as a part of the analysis of global market and business trends, and also briefly in connection of the country studies.

Defining the forest cluster and methodology for comparative analysis:

The practical tool in comparative analyses among the EU countries is the cluster chart as presented in Figure 1.1. It contains the relevant cluster components: primary goods and services, speciality inputs, machinery production, associated services, related industries, and customers. The Finnish forest cluster has been determined as a well-functioning example, since it represents one of the most developed forest clusters in the world. Therefore our starting point has been to utilise the Finnish forest cluster model, which was then adapted to include other industrial branches which are also connected to the forest cluster in other parts of Europe. Nonetheless, it is recognised that further refinements would be necessary upon more detailed analysis in various regions of the EU.

Figure 1.3 The Diamond of the Finnish Forest Cluster



The Finnish forest cluster, the evolution of the cluster, determinants of its competitive edge, and future prospects have been thoroughly studied in several ETLA studies (e.g. Ojainmaa, *International competitive Advantage of the Finnish Chemical Forest Industry,* 1994, and Lammi, *The Success Story of Paper, Machines and Know-how – The Competitive Advantage of the Forest Cluster*, in Finnish 1994). The diamond of the Finnish forest cluster is presented in the figure 1.3 and is discussed in more detail in chapter 6.

1.4 Pros and cons of cluster analysis and cluster-based policies – traditional sectoral approach vs. cluster approach

The idea of industrial clusters has moved rapidly during the 1990s from research to practical policy making. The main advantages of the cluster concept and cluster-based industrial policies relate to the concept's focus on linkages and interdependencies among various actors in the value chain. The cluster approach offers a framework within which the determinants of national competitiveness may be identified, and the way in which they interrelate to each other. In that sense the cluster concept offers an alternative to the traditional sectoral approach which looks at different industries in isolation from each other or linked together through flows of intermediate goods and raw materials. The cluster approach emphasises the role of technological spillovers and other external economies as well as cross-sectoral linkages of dissimilar and complementary firms as major sources of long run growth. In doing so, it goes beyond the horizontal networks in which firms, operating on the same end-product market and belonging to the same industry group, may co-operate on aspects like collective marketing and purchasing policy.

Table 1.1 Differences in traditional sectoral approach and cluster-based approach

Sectoral Approach	*Cluster Approach*
Groups with similar network positions	Strategic groups with mostly complementary and dissimilar network positions
Focus on end-product industries	Includes customers, suppliers, providers and specialised institutions
Focus on competitors	Incorporates the array of interrelated industries sharing common technology, skills, information, inputs, customers.
Hesitancy to co-operate with rivals	Most participants are not direct competitors but share common needs & constraints
Dialogue with government often focuses on subsidies & protection	Wider scope for a constructive and efficient business-government dialogue
Looks for diversity in existing trajectories	Looks for synergy and new trajectories

Source: OECD, Boosting Innovations – The Cluster Approach. Originally adapted from Porter (1997).

The interaction between different actors is emphasised particularly by innovation studies. Firms do not innovate in isolation. Rather, innovation activity always involves various agents from both the private and public sector. Innovative firms rely on sources of knowledge and competencies complementary to their own capabilities. This is due to the increasing need for specialisation in the increasing global competition. The modern economic system is characterised by co-existence of co-operation (networking and clustering) and competition. Innovation is stimulated by the increasing competition in the global market, but the knowledge production and innovation process is based on interaction and co-operation.

From the policy point of view the cluster approach is useful for a number of reasons. *First*, and maybe most importantly, it provides a *shared understanding* of competitiveness and the role of industrial clusters in creating competitive advantage. This has proved to be of crucial importance in countries pursuing and implementing cluster-based industrial policies. Cluster members and actors identify common opportunities, not just common problems.

Second, the systemic character of the cluster approach helps to identify the imperfections in the cluster structure and, hence, to promote focusing policy design. *Third*, the cluster concept embraces all size of firms. *Fourth*, the cluster approach provides tools to define appropriate roles for government, the private sector, research institutions, trade and industrial associations, and other agents. The basic notion here is that the role of government has changed from providing subsidies and protection, and limiting rivalry, to enhancing the framework conditions for business enterprises. This does not mean, however, that the role of government would have significantly reduced. Instead, in many respects the government role may have become even more important. The traditional public sector tasks in organising education and constructing technological infrastructure, i.e. in providing advanced and sophisticated factors of production are more important in a knowledge-driven economy than before. The new role of government is that of a facilitator of networking and a catalyst for innovative activities.

Although there is a growing amount of positive experiences of the usefulness of the cluster concept in industrial analysis and policy making, there are also some weaknesses and drawbacks related to the concept and the whole framework. There is much critique concerning the lack of rigour in the diamond model and the analysis based on it. In empirical analysis clusters are sometimes ill-defined due to the deficiencies in the conceptual framework. Hence, there is a lot of abuse of the cluster concept. Sometimes the concept is used to justify collusive behaviour or a planning instrument to create a cluster via political decisions. Competitive clusters are, however, always based on tough rivalry and competition in open markets. The two types of clusters described by Table 1.2 can be identified in almost every economy. Only the offensive ones can have sustainable competitive advantages.

Table 1.2 Defensive and offensive clusters

Defensive	**Offensive**
Protected Markets	Global Orientation
Cartels	Rivalry & Co-operation
Uniformity of Firm Strategies	Differentiation Strategies
Corruptive Behaviour	Innovative Behaviour

Another critical point in the cluster analysis is that it is static and backward looking. It explains the existence of clusters, but tells very little about how new clusters are born or created. That is a weakness that can, to some extent, be modified by putting more emphasis on the historical development of the existing clusters and by making cross-country analysis on clusters in different stages of industrial development. In fact within this study we have relied to a certain degree on historical monographs of companies, to show how these companies have developed over time, and where competitive industries are located.

1.5 Clusters and Industrial Policy[1]

Subsequent to Porter's Competitive Advantage of Nations, there have been many attempts to set a definition that accurately captures everything about the cluster concept. Indeed, this has lead to a broad spectrum of opinions being expressed by users of the theory, who highlight different facets of clustering to suit their own

---

1 This section draws heavily from: Clusters, Industrial Policy and Firm Strategy: A Menu Approach. Danny Jacobs & Ard-Pieter De Man, in Technology Analysis & Strategic Management. Vol. 8. No. 4, 1996, pp 425-437.

requirements or views. According to Jacobs and Man, "there is not one correct definition of the cluster concept, but that different dimensions are of interest." Moreover, they advocate that "this is not a drawback of the cluster concept, on the contrary, it underscores the usefulness of the cluster approach for the practice of government and business." Jacobs and Man then set out the dimensions of clustering to "provide a basis upon which tailor-made policies can be developed", in order to enhance the effectiveness of policies and strategies for governments and firms alike. This section draws heavily on their work.

There are three broad definitions of clusters, which focus on different dimensions:

1. *"Regionally concentrated* forms of economic activity within related sectors (usually connected to knowledge infrastructure such as research institutes, universities..),"
2. *"Vertical production chains,* which are narrowly defined sectors were adjacent stages in the production process form the core of the cluster (supplier-assembler-distributor-customer)," networks surrounding core firms are included here, and
3. *"Sectors defined at a high level of aggregation,* for example 'the chemical cluster' or a collection of sectors at an even higher level of aggregation".

Regional Clusters – are popular among regional policy makers, and are referred to by Porter as geographical dimensions of clusters, although, Marshall's industrial districts and Krugman's subsequent refinement of this theory, are also examples of this approach. Depending on the cluster, the core can be knowledge infrastructure, or a central firm around which a cluster develops. At the same time, the geographical scale of clusters may differ considerably.

According to Jacobs and Man, "for some clusters it is not feasible to direct policies exclusively at the regional or national level." For example, suppliers of a core firm may be located in different countries, and therefore implementation of national policies aimed at helping the core firm may not be effective. Hence, this international dimension must be considered in the formulation of policies. In addition, it is also advocated that policies should not be targeted at the core firms within the international network but rather at the main suppliers of the core firms. In practice, these main suppliers and their specialised jobbers are more regionally concentrated and thus provide a more suitable basis for regional policies. Moreover, by strengthening the supply network, international core firms within the region can be 'anchored' to the region.

Vertical Production Chains – are "the focus of Porter's value system and the filière approach developed in France." This method necessitates an important subjective component. The method utilises quantitative input-output analysis to assess the flow levels of goods between firms to define the cluster. However, the size of the flow of goods is not always representative, as a minor flow may contain key information embodied in it, and hence, more monographical information is also required. As a consequence, qualitative approaches are essential. Vertical relationships are very popular amongst practitioners focusing on sustainable development, since environmental problems are better tackled via co-operation along a value system than individual producers in isolation.

Collection of Sectors – approach "focuses on large aggregations of connected sectors in an economy." Porter developed a standardised quantitative method to define 16 possible clusters, four upstream industries (one of which was forest products), six industrial and supporting functions, and six final consumption goods and service industries. In addition, four levels are distinguished such as primary goods, machinery for production, speciality inputs and associated services. The latter is considered one of the most significant contributions of Porter's cluster approach, since it ignores the traditional distinctions of primary, secondary, and tertiary sectors. In practice each of these sectors play a role and depend upon one another, hence focusing on individual elements is less meaningful.

One of the shortcomings of Porter's method is that "his quantitative approach does not show whether inter-relationships between firms in a cluster really exist." And, whilst his statistical techniques may provide clues about the relative specialisation pattern of a country based on the number of competitive industries present, statistics alone do not always identify existing networks of co-operating firms within or between clusters. Jacobs and Man distinguish clusters from networks, that is, "clusters are broad sets of industries in which not all firms are co-operating with each other. However, those firms in clusters, which do interact, form networks within the cluster, or between clusters. The overlap between clusters is important since synergies can emerge when two or more strong clusters reinforce one another.

New Dimensions

Jacobs and Man show how there are different dimensions used to define clusters, which help to explain why different approaches are adopted. Notwithstanding the subjectivity in defining clusters, this is not a disadvantage, rather it demonstrates the ability of the cluster method to capture the economic reality. Hence, it also enhances the possibilities to formulate policies more effectively. Jacobs and Man propose that the following list of dimensions may be used to define clusters:

- *Geographical* - "spatial clustering of economic activity"
- *Horizontal* - "classical division of sectors at a certain level of aggregation"
- *Vertical* - "adjacent phases in the production process can be present in the cluster (value systems, filières, networks of suppliers)." Which actor is 'pulling' the innovative activities is key within the vertical dimension
- *Lateral* - "capabilities can be shared between different sectors and economies of scope can be achieved"
- *Technological* - "basic technologies are shared between a collection of industries"
- *Focal* - "a cluster of firms around a central actor"
- *Quality of network* – the question here is "not only whether firms really co-operate but also the way in which they do so as well." Networks can also block innovation and encourage defensive behaviour. Whilst "relationships with suppliers can stimulate innovation" they "can also be used to pass expenses on to partners (but in the latter case networks may be neither sustainable nor stimulating)."

Each of the above dimensions offer convenient starting points for governmental policy and firm strategy, and thus policies and strategies can be designed to suit specific situations. Therefore, Jacobs and Man describe possible policies related to each dimension of clustering identified above, to form menus from which policymakers or firm managers can choose based on which dimension they see most fitting.

Industrial Policy in Clusters

According to Jacobs and Man, there are three approaches to industrial policy, which may be observed through past phases of government in many countries. These approaches were known as 'backing losers', 'picking winners' and more recently, the 'cluster approach'.

In the first phase 'backing losers', government attempted to manage the decline of sectors and industries which were threatened under the pressure of international competition. This defensive approach was supported on the basis of the importance of employment in these sectors. Subsequently, this policy proved to be a failure. In the second approach, offensive technology policies were characterised by 'picking winners', were governments attempted to target future growth sectors. However, it was found that it is difficult, if not impossible, to predict which technologies and which sectors are the future winners. Furthermore, even in those technologies, which did prove to be important, successes were limited because many other countries targeted the same technologies, and so the bandwagon effect reduced potential profits.

In the third phase, the 'cluster approach' attempts to combine the best of the previous two phases. "Cluster-based policies draw on the existing strengths in an economy ('backing winners'), and focus on those concentrations of business activity which have already proven their competitiveness on the world markets. The emphasis of the cluster approach is on intensifying the use of knowledge in these strong clusters and on enhancing constructive interaction between different parties in the cluster. Hence, cluster policies strengthen competition based on differentiation and specialisation, rather than competition based on imitation and cost."

Subsequent to Porter's Competitive Advantage of Nations, and the spread of the cluster concept, some governments have tried to introduce previous policies under the veil of cluster policy. "Defensive policies have attempted to maintain clusters which have confronted problems, whilst offensive policies have been used to try to create new innovative clusters." However, the chances of building a new cluster from scratch is, very limited, and it is much less costly to build on the present structure of the economy. Nevertheless, cluster policy redirects attention away from the macro level to the meso level of economic activity, and hence governments become more appreciative of the actual structure, thus steering them away from implementing unrealistic policies.

According to Jacobs and Man, "effective cluster policy should be aimed at intensifying the use of knowledge in traditionally strong clusters." Although this is criticised for leading to lock-in into certain industries, and restricting potential growth in new sectors, existing clusters do present opportunities for growth whilst new areas of growth are rarely completely new – they typically emerge from combinations of existing economic activities.

Jacobs and Man adopt two alternatives for the discussion of policy:

1. "Policies aimed at intensifying the use of knowledge in existing clusters;" and
2. "Policies aimed at creating networks of constructive co-operation in clusters."

Knowledge Intensification of Existing Clusters – "Local and regional governments are part of existing clusters, and hence, they are able to maintain the dynamics of these by means of relatively limited interventions (e.g. concessions and initiatives within vocational training etc)." In regards to international production networks, "it may also be possible for regional governments to anchor parts of the production network in their region, for instance, by sponsoring a centre of excellence to attract firms." To this end, the existing division of labour in research between countries/regions is the best guide for funding research. Hence, "government policy is best conducted at the geographical scale of the networks to be supported, whether regional, national or international". Therefore, government's knowledge of the clusters within its borders is vital to ensure optimal use and benefits.

At the same time, although research institutes are important for knowledge intensification, most of the knowledge used by firms comes from suppliers, clients, competitors and sector specific organisations, trade fairs and journals. Notwithstanding, "a specialised knowledge infrastructure of high quality can contribute to a country's or a region's competitiveness." Clusters at the national level are best served via one central location for research, whilst a decentralised approach should be adopted for the diffusion of knowledge to SMEs. Furthermore, international clusters would be better serviced by international technology programmes and institutes.

There are three different aspects of knowledge intensification and innovation in clusters, which should be considered:

1. "The technological dimension – maintaining and developing high-level technological competencies"
2. "The vertical, horizontal and lateral dimensions – the interaction between the different firms in clusters and the interaction with the demand side;"
3. "The geographical and vertical dimension – and the quality of the network are important for the diffusion of knowledge and innovation towards SMEs." Equally important, is the organisational side of innovation, and thus it is necessary to stimulate firms to think about their strategic position within networks.

Creating New Co-operative Structures – Well documented examples of strong regional clusters, such as Silicon Valley in the US, have inspired governments to attempt to create similar clusters. However, as previously stated, it is doubtful whether it is possible to create lasting co-operative network structures, since the strong self-interest of individual companies will prevail due to the growing pressure of specialisation and co-operation. In addition, whilst there remains considerable doubt as to the possibility to create completely new clusters, it is more plausible to entice firms to co-operate more closely and hence new networks can be stimulated.

To this end, quasi-public organisations have attempted to take the role of broker between firms in attempts to enhance networking. The role taken by these organisations depends largely on the approach adopted. Jacobs and Man propose the following pointers to help decide the shape of policy:

- *The dimensions around which the network is to be organised:* geographical, horizontal, vertical, lateral, technological, and focal.

- *A direct or indirect approach:* does one play an active or passive role in forming and strengthening networks. In the direct approach, public actors are brokers who try to bring companies together, whereas in the indirect approach, the initiative is left to the firms themselves, with public actors offering support in forming the network.
- *The time span for which the links are created:* can vary from a 'one-of' event to a long-term partnership. The quality of the links between firms can also differ, and some governments initially aim at establishing informal links, followed by a structural relationship later.

Table 1.3 Cluster dimensions and industrial policy: the menu

Cluster Dimension	*Relevant Policy*
Geographic scope	Starting point for deciding on which geographical level a cluster is to be supported. Regional scale ideal for diffusion to SMEs and networks of main suppliers and specialised jobbers.
Horizontal	Sector initiatives (environmental policies).
Vertical	Stimulating development of relationships between suppliers and contractors in the direction of co-development, co-makership. Take into account which actors in the network pull innovation. Strengthen networks of main suppliers and specialised jobbers. Direct quality and environmental policies at the whole value system.
Lateral	Technological synergies between sectors direct choices in technology policy.
Focal (eg relation with knowledge infrastructure; technological)	Enhance interaction between organisation via 'cluster projects'. Stimulate mobility of staff between knowledge infrastructure and companies. Starting point for choices in technology policy, e.g. regarding the location of top research institutes.
Quality of the Network	Strengthen knowledge on learning to learn in networks; network management; diffusion of that knowledge. Stimulate the international orientation of networks.

Source: Jacobs and Man.

1.6 Changing Patterns of Industrial and Technology Policies

In industrial and technology policy making, it is increasingly recognised that, innovation and economic growth it drives, are of systemic nature. This is reflected in several, and related, system approaches of competitiveness and policy analysis. Smith (1995) distinguishes three main approaches: (1.) technological systems, (2.) national systems of innovation, and (3.) industrial clusters (see also Vuori (1997), and Vartia and Ylä-Anttila (1996)). All three aim at modelling interaction among the system's participants and recognise the importance of various externalities. More recently, the cluster approach has become widely applied as a practical policy tool.

Besides the systemic nature of technological change, globalisation has been one of the focal points in policy thinking. In a world of free movement of productive assets the basic policy issue is: *How to make a country or a region an attractive location for internationally competitive firms?* This issue is in accordance with, and can be inferred from, the cluster analysis.

Subsidies and compensatory policies are not, however, appropriate tools of increasing locational attractiveness. Instead, the major goals of the new policy are: (1.) to guarantee the functioning of markets, and (2.) to create advanced and specialised factors of production and to sustain high-level technological and social infrastructures. It is recognised that, along with increased specialisation and product differentiation, it is the firm-specific capabilities and created factors of production which determine the competitiveness of a country or region. It is the task of the government to develop attractive industrial milieus with advanced, specialised, and internationally competitive factors of production.

One of the main messages of cluster analysis is that traditional comparative advantage is loosing its explanatory power at the expense of firm-specific competitive advantage and absolute advantage. As factors become increasingly mobile, a country or a region must be the best location worldwide for the multinational enterprises' business activities it desires. This fact has to be taken into account upon shaping modern industrial policy.

There are huge differences across various clusters in their capacity to send and receive knowledge flows and technological spillovers.

Some clusters are not only capable of creating knowledge, but – more importantly – also emit knowledge spillovers outside the cluster. According to Vuori (1997) the materials cluster (a combination of the forest and base metal clusters), the ICT cluster, and the fabrication cluster (comprising of metal products and machinery) have been the most important sources of embodied technology and spillovers in Finland.

1.7 Broadening the Policy Scope

The discussion above has two major policy implications:

– *The scope of industrial policy must be broad.* It should involve not only industries and business firms, and the re-allocation of existing resources, but also focus on the creation of future factor conditions.

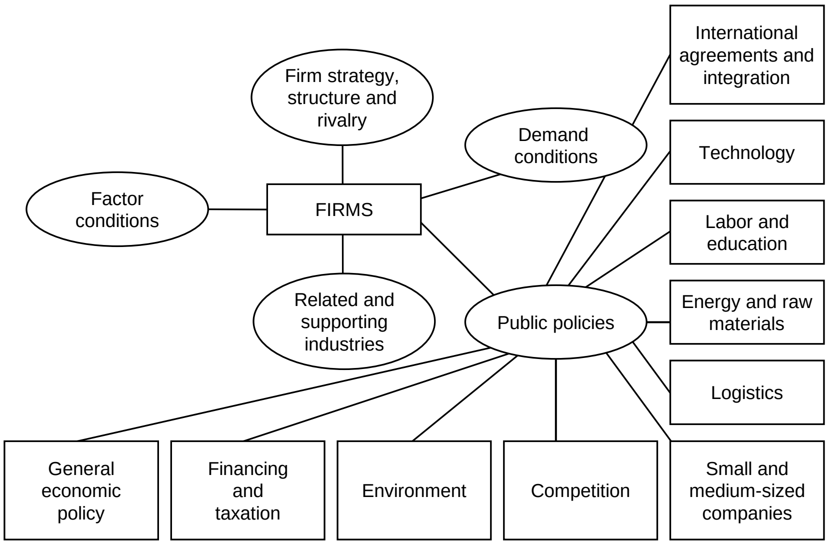
– *Public expenditure on R&D and education are perhaps the most important channels for the public sector to influence national competitiveness.* Taken into account the abilities of different clusters to generate and distribute knowledge within the economy, it is not insignificant how public expenditure on R&D and education is allocated.

Figure 1.4 below clarifies the role of public policy and its broad scope. It also emphasises the indirect role policy has. The main economic, industrial and technology policy blocks have been added to the diamond model. Each policy block influences competitiveness via one or more facets of the diamond.

Education and technological policies create a pool of advanced and specialised factors, which are the main sources of sustainable long-term growth. Competition policy is used to establish a competitive environment, in which companies formulate their own strategies and which affects the firm and industry structure. Financial institutions, along with tax policy, affect the forms of commercial activity, co-operative networks, etc.

The idea of Figure 1.4 is simply to show that virtually *all* government decisions matter and have implications on competitiveness. The diamond model helps to understand the mechanisms through which the decisions affect – directly or indirectly – the competitive advantages of firms.

Figure 1.4 Determinants of Competitive Advantage and the Components of Economic and Industrial Policies



Source: Hernesniemi et. al. (1996), ETLA

Clusters and networks can be seen as collective assets reducing transaction costs by internalising transactions involving positive externalities. Policy measures should attempt to strengthen the common knowledge base within the cluster, and thus correct market failures implied by the existence of external economies. Actually, industrial clusters – including both private and public agents – could be seen as entities with built-in mechanisms for correcting market failures.

In addition to technical advances and innovative activities, research on economic growth emphasises the importance of another fundamental source of growth: specialisation associated with a deeper domestic and international division of labour. Deepening division of labour, expansion of world trade, and the consequent economic growth are possible only if there are well functioning economic institutions at the national and international level. These institutions – broadly taken to mean the trust in agreements between different parties – reduce the inherent risks involved in specialisation and thus encourage firms to invest. Industrial networks are in practice often the organisational forms of these collective risk-sharing mechanisms. Hence, public policies should encourage the networking of businesses.

1.8 Concluding Remarks

Economic integration has been thought to strengthen those industries, which enjoy comparative advantage based on (relatively abundant) factors of production, such as labour, raw materials, and energy. However, the significance of comparative advantage in the traditional sense, as a determinant of the location of production, has changed as a consequence of the increased mobility of production factors. Furthermore, along with increased specialisation and product differentiation, it is the firm-specific capabilities and created – rather than inherited – factors of production that determine the competitiveness of a country or a region. The competitive advantage of the economy and firms in it has changed significantly. The industrial structure has shifted from slow growth industries towards knowledge-driven industries and clusters.

The main goals of the policies are, on the one hand, to ensure the efficient functioning of the market and, on the other hand, to create advanced and specialised factors of production. Industrial policies are taking a broad scope in modern policy thinking: educational, trade, energy, environmental, and competition policies overlap, to a large extent, the areas of industrial policies.

To summarise, industrial policies are becoming competitiveness policies. Governments are aiming at creating attractive locations for internationally competitive firms by developing high level technological infrastructures and advanced factors of production.

Clusters provide a coherent framework for policy design, enhance dialogue between various partners in the economy, clarify the roles of different agents in policy formulation, and provide an insight how the sustainable and productivity-based competitiveness emerges. Productivity growth and competitive advantage require inevitably specialisation. Specialisation, in turn, leads often to higher risks. Industrial networking and co-operation of different agents within clusters is a means to cope with the risks. Clustering and networking are, to some extent, collective goods with various external economies. This calls for, and justifies, active public policies.

Globalisation and volatile fluctuations of the world economy have come to stay, the only way to cope with these is proper co-ordination of macro and competitive enhancing micro policies. Industrial clusters and cluster based policies provide a consistent micro-oriented framework to respond to this co-ordination need.

Chapter 2. Forest-based and related industrial Clusters – Some examples

At the outset we would like to express that in our opinion we consider the forest-based and related industrial cluster to comprise mechanical wood industries, wood furniture manufacturing, pulp and paper industries, printing and publishing industries, and related machine building, speciality input providers and associated services. Hence in this chapter we only wish to convey some typical examples of the forest cluster industries, and by no means do the examples shown here cover all the forest-based and related industries.

In this chapter, we also attempt to show how the forest-based and related industries are inter-linked from supplier to buyer, and how related and supporting industries contribute to the competitiveness of the industrial cluster. In practice we have decided to demonstrate some of the characteristics of a forest cluster by examining several input-output tables and by looking more closely at one of the earliest examples defined, and which was utilised in Porter's Competitive Advantage of Nations (1990). Hence, in section 2.2 we draw heavily on the detailed study on Industrial Clusters in Sweden (Sölvell, Zander and Porter, 1991).[1]

2.1 Input-Output Analysis

In this section we attempt to demonstrate some of the relationships between the forest-based and related industries and their suppliers. Tables 2.1 through to 2.4 are based on UK 'product to industry' input-out tables for domestic supply only. Nonetheless, they are fairly representative of the product flows from industry to industry and help to demonstrate whom the main suppliers and customers are.

---

1 Extracts from: Advantage Sweden – Sölvell, Zander and Porter – pp 56-63, Norstedts, 1991.

Table 2.1 shows the product purchases by the main industrial branches within the forest-based and related industries. Product flows between the main industry branches such as furniture, timber & wood products, pulp, paper and board, paper and paper products, printing & publishing are fairly self evident, based on the large percentage of purchases. However, the importance of some product flows is not so evident. In many cases industry purchases of machinery- and chemical-type products are quite small in proportion to others but they are often the most critical relationship, since these products may contain embodied R&D which greatly enhances the value-added content of the final product. Chapters 8 and 9 discuss the relationships of some of these machinery- and chemical-type products in more detail.

Table 2.2 shows some of the typical services purchased by the forest-based and related industries, and demonstrates the importance of these purchases to the services sector in general. In fact, we have also examined the growth in industry purchases of these services over the period 1992 to 1996, shown in table 2.3. What we find is that the purchases by the forest-based and related industries have grown in most areas, whereas industry purchases of other suppliers have remained the same. Therefore, it is likely that the forest-based and related industries contribute to the overall growth in business services.

In table 2.4, we attempt to demonstrate whom the main customers for the forest-based and related industries are. Apart from the main purchases by the forest-based and related industries themselves, the main customers are the food and drinks industry, pharmaceuticals, construction, wholesale and retail trade, banking, finance and retail services, advertising, public administration, education and health services, with a large share of purchases coming from household consumers, themselves. Moreover, it should be clear that most of the purchases are heavily connected to the growth in GDP.

Table 2.5 is part of the German environmental accounting system detailing the production oriented material flows and the use of natural capital stocks in Germany. It is based on domestic and imported

Table 2.1 Who are the Suppliers ?

Demand for Products - The 'Combined Use' matrix in 1996	Industry purchases **as a percentage of total purchases (or total output)**					
Product	Furniture	Timber & Wood	Pulp & Paper	Paper Products	Printing & Publishing	Forest Cluster
Forestry	0.4	12.1	0.0	0.0	0.0	1.3
Other mining and quarrying	0.1	0.3	1.6	0.1	0.0	0.2
Grain milling and starch	0.0	0.1	1.9	0.2	0.0	0.2
other textiles	1.6	0.1	3.6	1.0	0.1	0.8
Furniture	7.7	0.2	0.1	0.5	0.1	1.3
Timber & Wood products	19.8	39.2	3.5	0.9	0.3	7.6
Pulp, Paper and board	0.6	1.9	24.5	27.5	24.7	19.2
Paper and paper products	0.4	0.3	13.3	21.0	2.7	6.4
Printing & Publishing	1.1	0.5	0.7	12.5	31.0	17.3
Coke, oil proc, nuclear fuel	1.1	1.6	0.8	0.7	0.5	0.8
Inorganic chemicals	0.0	0.1	1.5	0.1	0.0	0.2
Organic chemicals	0.1	0.6	2.2	0.7	0.5	0.6
Synthetic resins etc	1.0	1.4	2.6	1.5	0.1	0.8
Paints, dyes, printing ink etc	1.0	1.0	1.1	2.6	2.7	2.1
Chemical products nes	0.3	0.6	0.4	1.1	2.7	1.6
Plastic products	7.6	4.1	0.5	1.3	1.3	2.5
Iron and steel	6.7	0.2	0.1	0.1	0.1	1.1
Metal goods nes	2.9	1.4	0.4	0.4	0.2	0.8
General purpose machinery	0.6	0.8	0.9	0.5	0.3	0.5
Special purpose machinery	0.2	0.1	0.4	0.5	0.2	0.2
Electricity prod & distribution	1.6	2.3	6.4	2.4	1.3	2.1
Gas distribution	0.4	0.4	3.1	0.7	0.3	0.7
Water supply	0.0	0.1	0.3	0.1	0.1	0.1
Total Intermediate purchases	**58.1**	**62.7**	**67.5**	**62.7**	**52.7**	**57.2**
Taxes less subsidies on prod	0.9	1.1	0.7	0.7	0.7	0.8
Compensation on employees	29.9	24.6	18.7	25.3	34.7	30.3
Gross operating surplus	11.1	11.9	13.2	11.3	12.0	11.8
Gross value added at basic prices	41.9	37.3	32.5	37.3	47.3	42.8
Output at basic prices (£ millions)	**7704**	**4930**	**3999**	**8585**	**27061**	**52279**

Source: Input-Output Supply & Use Balances, 1992-1996. UK Office for National Statistics, 1998.

Table 2.2 What are the Services being Supplied ?

Demand for Products - The 'Combined Use' matrix in 1996	Industry purchases **as a percentage of total purchases (or total output)**					
Product	Furniture	Timber & Wood	Pulp & Paper	Paper Products	Printing & Publishing	Forest Cluster
Other land transport	3.8	6.7	5.4	4.8	0.1	2.7
Telecommunications	0.5	0.4	0.2	0.4	1.0	0.7
Banking and finance	2.0	1.8	1.7	2.9	0.4	1.4
Insurance & pension funds	1.2	1.3	0.7	0.8	0.9	1.0
Own- & dealing in real estate	1.8	2.0	0.6	1.2	1.6	1.5
Renting of machinery	1.6	1.5	1.1	1.0	1.5	1.4
Computing services	0.4	0.4	0.4	0.4	0.7	0.6
Research & Development	0.4	0.1	0.2	0.4	0.2	0.3
Market research	0.5	0.3	0.2	0.5	1.6	1.0
Architecture etc activities	2.3	1.8	1.9	2.3	2.5	2.3
Advertising	1.4	0.6	0.4	1.0	3.1	2.0
Other business services	1.4	1.0	1.1	1.4	1.3	1.3
Public administration	0.1	0.1	2.2	0.0	0.0	0.2
Recreational services	0.3	0.1	0.1	0.2	7.0	3.4
Total Intermediate purchases	58.1	62.7	67.5	62.7	52.7	57.2
Output at basic prices (£ millions)	7704	4930	3999	8585	27061	52279

Source: Input-Output Supply & Use Balances, 1992-1996. UK Office for National Statistics, 1998.

Table 2.3 Growth in usage of Business Services

Demand for Products – Growth 1992-1996	Percentage point changes in Industry purchases **(as a percentage of total output)**					
Product/Service	Furniture	Timber & Wood	Pulp & Paper	Paper Products	Printing & Publishing	Forest Cluster
Telecommunications	-0.1	-0.1	0.0	0.0	0.8	0.3
Banking and finance	-0.5	-0.2	0.5	0.5	-0.1	0.0
Renting of machinery	-0.1	-0.1	0.1	-0.2	0.1	0.0
Computing services	0.2	0.2	0.2	0.2	0.3	0.2
Research & Development	0.1	0.0	0.1	0.2	0.1	0.1
Market research	0.1	0.1	0.1	0.1	1.5	0.8
Advertising	0.6	0.3	0.2	0.2	2.8	1.5
Other business services	0.3	0.2	0.3	0.2	0.4	0.3

Source: Input-Output Supply & Use Balances, 1992-1996. UK Office for National Statistics, 1998.

Table 2.4 Who are the Customers ?

Demand for Products - The 'Combined Use' matrix in 1996	Product					
Purchaser (as % of Total Purchases)	Furniture	Timber & Wood	Pulp & Paper	Paper Products	Printing & Publishing	Forest Cluster
Furniture	2.4	**11.7**	0.3	0.2	0.1	1.8
Timber & Wood products	0.0	**16.0**	0.6	0.1	0.0	1.7
Pulp, Paper and board	0.0	1.2	6.9	3.0	0.1	1.5
Paper and paper products	0.2	0.6	**15.4**	**9.6**	1.8	4.4
Printing & Publishing	0.1	0.5	**36.6**	3.3	**14.3**	**11.3**
Food, drink & tabacco	0.2	2.3	**4.7**	**10.2**	0.8	2.8
Pharm, Soaps, Chems etc	0.4	1.1	**7.2**	2.6	1.2	2.0
Construction	1.1	**28.4**	1.0	0.6	0.8	3.6
Motor vehicle distrib & repair	0.1	0.2	0.1	0.6	1.0	0.6
Wholesale distribution	0.2	0.5	0.8	2.8	**2.4**	1.6
Retail distribution	0.4	0.6	0.7	1.2	0.9	0.8
Hotels, catering, etc	0.4	0.7	0.2	1.1	0.5	0.5
Transport services	0.1	0.2	0.0	0.4	1.1	0.6
Banking and finance	0.1	0.1	0.1	**1.7**	**6.0**	2.8
Insurance & pension funds	0.2	0.2	0.1	**2.8**	**5.8**	2.9
Legal activities	0.3	0.2	0.0	0.2	1.3	0.6
Architecture etc activities	0.2	0.1	0.1	1.0	1.0	0.6
Advertising	0.1	0.3	**1.1**	**1.2**	**1.3**	0.9
Other business services	0.4	0.4	0.1	0.9	0.9	0.7
Public administration	**3.0**	0.2	1.0	**5.7**	**1.4**	2.2
Education	**1.6**	**1.6**	0.2	**3.0**	**2.3**	1.9
Health services	0.4	0.0	1.0	1.9	1.0	0.9
Recreational services	0.5	1.0	0.2	0.9	1.4	1.0
Total Intermediate demand	16.3	**83.0**	**86.6**	66.4	59.3	58.1
Final consumption expenditure - Households	**54.2**	10.7	0.0	23.9	**31.1**	28.3
Total Demand	100	100	100	100	100	100

Source: Input-Output Supply & Use Balances, 1992-1996. UK Office for National Statistics, 1998.

products so it is fairly representative of the material usage of the forest based and related industries. A key point to note from this table is the large amount of water, which is utilised in the production of many of the forest-based and related industry products. Indeed, in chapter 8 the large amount of hydraulic equipment and machinery used by the pulp and paper industry is also very evident. The high proportion of recycling is also a feature of the industry in Germany.

Table 2.5 Material flows to industry – Suppliers to Forest-based and related industries in Germany

% of total Material flows to branch of industry				*Destination:*			
Origin:	Wood processing	Man of wood products	Man of Pulp & Paper	Man of paper products	Printing (printing and copying)	Services of sci, cult and publishing	Forest Cluster
Production of forestry, fishery etc.	**54.8**	**14.9**	**13.5**	0.0	0.0	0.0	**18.4**
Production & Distribution of gas	0.3	0.2	2.7	1.4	1.1	0.8	1.3
Extraction & Supply of water	**14.0**	**30.8**	**46.5**	**44.5**	**55.5**	33.1	**37.3**
Mining of coal & Prod of coal products	0.1	0.1	2.0	0.1	0.0	0.0	0.7
Man of chemical products, nuclear fuels	0.8	1.4	1.1	**1.7**	**3.7**	0.2	1.5
Man of refined petroleum products	0.8	2.0	1.7	0.7	0.7	7.5	1.5
Man of Plastics Products	0.0	0.5	0.0	0.2	0.2	0.1	0.1
Quarrying of clays, stone, Man of construction materials, ceramic articles etc.	0.0	0.1	**5.3**	0.2	0.0	0.0	1.7
Man of glass and glassware	0.1	1.2	0.0	0.0	0.0	0.0	0.2
Man of iron and steel	0.3	0.4	0.0	0.3	0.0	0.0	0.2
Cold rolling, Cold drawing of metals etc.	0.0	1.0	0.0	0.0	0.0	0.0	0.2
Man. of machinery and equipment n.e.c.	0.1	0.1	0.1	0.1	0.2	0.0	0.1
Man. of other metal products	0.0	1.4	0.0	0.2	0.1	0.0	0.3
Wood processing	**9.4**	**37.0**	0.0	0.1	0.0	0.0	**7.7**
Man. of wood products	0.4	**6.8**	0.1	0.0	0.1	0.0	1.2
Man. of Pulp & Paper	0.4	0.6	**9.7**	**35.8**	**32.5**	**5.5**	**13.2**
Man. of paper products (paper processing)	0.0	0.5	0.3	**12.1**	1.5	**6.4**	2.5
Printing (printing and copying) & reprod of rec media	0.0	0.2	0.0	0.2	**4.4**	**43.3**	2.0
Wholesale trade, recycling	**18.5**	0.0	**17.0**	1.7	0.0	0.0	**9.6**
All production sectors (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0
All production sectors (Mill of tonnes)	**27.9**	**19.5**	**39.5**	**20.4**	**15.9**	**4.2**	**127.5**

Source: Statistisches Bundesamt Physische Input-Output-Tabellen 1990 Beiträge zu den Umweltökonomischen Gesamtrechnungen, Band 1 Stuttgart, 1997.

2.2 Industrial Clusters in Sweden

'A nation's competitive industries tend to be linked to each other via larger industry clusters, including suppliers, buyers and industries in related technologies. Clusters evolve over time, with changes in demand conditions, changes in specialised factors of production etc. The clusters grow with the entry of new firms and when existing firms add new products and processes. Success attracts new firms and rivalry is enhanced, which in turn affects factor upgrading and demand conditions. This is not a smooth process, but rather a process of continuous tensions where firms are forced to innovate and upgrade competitive advantage in order to survive and prosper'.

Table 2.6 Selection of Top Swedish Industries in terms of World Export Share in 1985

Industry	Rank In 1985	Share of World Exps	Export Value ($ mill)	Industry's share of total Exps
Kraft paper, paperboard	1	41.7	545	1.79
Kraft liner	2	31.7	379	1.24
Sawn Conifer lumber	3	26.4	888	2.92
Unbleached soda, sulphate woodpulp	8	18.7	54	0.18
Bleached sulphite woodpulp	9	17.6	102	0.34
Unbleached chemical sulphite woodpulp	11	16.4	14	0.05
Bleached soda, sulphate woodpulp	12	15.5	818	2.69
Plastic coated paper	13	15.0	159	0.52
Prefabricated builders woodwork	17	14.0	156	0.51
Other coated paper in bulk	21	12.6	329	1.08
Other pulp and waste paper	28	9.8	124	0.41
Newsprint	32	8.9	515	1.69
Other furniture, parts	33	8.8	73	0.24
Other paper and paperboard	34	8.7	319	1.05
Rough or split pulpwood	40	7.6	17	0.06
Paper mill machinery	41	7.6	125	0.41
Uncoated writing paper	44	7.1	230	0.76

Source: Advantage Sweden – Sölvell, Zander and Porter, 1991.

'Swedish firms occupy internationally competitive positions in a few niches, which are linked to Sweden's strong clusters such as pulp and paper and mining'. Successful chemical industries are thus linked to these as speciality inputs within these clusters.

Table 2.6 lists a selection of the top 50 Swedish industries in terms of world export shares in 1985. The complete table demonstrates a heavy bias towards raw material related industries. Sweden's position was found to be particularly strong in paper products like kraftpaper, kraftliner, and liquid board. Iron and steel industries were also important.

The forest products and related industries cluster is one of Sweden's most important clusters, accounting for about 18% of total Swedish exports in 1985. The forest products cluster includes timber and wood products, and pulp and paper of different qualities and trading. Although not among the world's top producers, Sweden has also achieved international positions in machinery and other paper related equipment.

A nation's economy develops in stages, each of which involves different industries and industry segments. Porter distinguishes between four stages of development: factor driven, investment driven, innovation driven and wealth driven nations. Sweden has moved through these stages, and has become an innovation driven economy, on the verge of moving into the wealth driven stage.

'The Swedish economy grew initially out of Sweden's endowments of natural resources. In the factor driven stage Sweden developed the materials/metal cluster, based on iron ore mining. Also, forest-related industries were originally built on favourable factor conditions (timber, hydro-power and rivers used for transportation). National capital was built from exporting steel and timber. Trading houses made large profits which were invested in new industries such as more advanced steelmaking and pulp and paper production. Trading companies, located in Gothenburg, constituted the linchpin between European demand (especially England) and Swedish industry. They often initiated entry of new firms, and trade of timber was often the first base for new entrants to build up international networks. Swedish sawmills and later pulp and paper manufacturers developed into major suppliers to the European market. Capital from the trading companies was instrumental in developing these new industries'.

'Sweden was able to move beyond factor dependence in the late 19th century. The establishment of the two technical institutes, the Royal Institute of Technology in Stockholm (1827) and Chalmers Institute of Technology (1829) were instrumental in facilitating this process. The advent of universal public education in 1842 was also an important step in upgrading reading and writing skills among the general public. Large investments in infrastructure projects and perhaps more importantly, imports of technology and capital in the mid-1800s, formed the basis from which new industries and clusters developed. As is characteristic of the investment driven stage, Swedish companies developed the capability to move beyond passive importation of foreign technologies to modify and improve these technologies in the Swedish context'.

'Foreign expertise and equipment was also used in the Swedish pulp and paper industry. When chemical pulp techniques emerged in Sweden in the late 19th century, most of the technological influences came from England. The first Soda-process mills were nearly all based on English techniques. The Swede C.D. Ekman developed the sulphite process, but in close co-operation with British producers and financiers. Similarly, the very first paper machines were imported from Britain'.

'Moving into the investment driven stage, Swedish domestic demand conditions came into play. The build-up of an infrastructure in Sweden created demand for machinery and transportation equipment. The first wave of mechanical workshops came in the 1830s and 1840s, forming the backbone of Swedish Industry. The most important industries demanded advanced machinery and mechanical equipment, and indeed these industries took off in the late 19th century. These import substituting industries had to withstand the test of international competition since the Swedish market was little protected by trade barriers'.

'Factor upgrading included development of infrastructure such as public telecommunication systems, and the development of technical training institutes, universities, and specialised research institutes. Evolving private banks established more efficient capital markets'.

'A critical mass of sophisticated demand, specialised factors, and supporting industries allowed Sweden to move into the innovation driven stage. Larger clusters of industries emerged, with related and supporting industries in place. In the stronger clusters, all parts of the diamond came into play. The newly developed industries attracted entry by new entrepreneurs, and led to related diversification among established firms. Domestic rivalry was enhanced by aggressive entrants.'

'Domestic innovations came to play a more prominent role in the innovation driven stage. However, Sweden continued to import technologies in the late 19th and 20th centuries with licenses being acquired for various products. After the war period, the competitive advantage was sustained by continuous innovation, not only in products, but also in developing complete systems and related services. New products were spawned from old ones, and competitive Swedish firms moved into more differentiated industry segments. Swedish firm upgraded into more sophisticated sources of competitive advantage, and toward positions in higher-productivity industries. Loss of positions in price-sensitive segments drove Swedish firms to find new sources of competitive advantage, or international positions were lost'.

2.3 Forest Products[2]

'The forest products cluster is one of the most important clusters in the Swedish economy. It includes a number of linked smaller clusters, formed around wood as an important input. Swedish firms have developed international competitive advantage in pulp and paper, sawmills, house construction and furniture (both of which are considered part of the housing/household cluster), and matches'.

'The Swedish forest product's industries emerged as purely factor driven. Sweden had a supply of wood, investment capital mobilised by banks and trading houses, and a pool of people with forest and wood know-how. Demand conditions became important with the increasingly sophisticated uses of products (such as newsprint and graphic paper, and later board used in liquid containers). The pulp and paper industries and the sawmill industry have been characterised by a large number of rivals, although the number has been drastically reduced over time. Competitive supporting and related industries have evolved with the development of primary goods, including pulp and paper manufacturing machinery, speciality inputs used in the production process (chemical etc) and specialised services for industry'.

Pulp and Paper

---

[2] Advantage Sweden – Sölvell, Zander and Porter – pp 76-85, Norstedts, 1991.

'The pulp and paper industries have developed into Sweden's largest net exporter, well ahead of transportation equipment, engineering products and metals. In pulp and paper the full diamond is at work, involving domestic rivalry, competitive Swedish supplier and related industries (logging equipment, machinery, chemicals etc), specialised and continuously upgraded factors of production (including specialised training institutes and research institutes), and sophisticated domestic buyers'.

'Selective disadvantages in raw materials have pressured Swedish pulp and paper firms to develop sophisticated machinery in close relation with suppliers, and to move to more upgraded product segments. Factor upgrading to support this development has included specialised research centres and higher education institutions. The striving for cost reductions has driven mechanisation (including mechanised logging), efficient logistics (trucks and fork trucks), and the introduction of highly automated plants (process control and instruments)'.

'The leading Swedish pulp manufacturers include Stora, Modo, SCA, ASSI, Södra Skogsägarna, NCB, and Rottneros. The largest suppliers of pulp to external customers include Södra Skogsägarna, Modo and Stora. Swedish pulp manufacturers have been on the forefront in developing new pulp qualities. For example, the first chemical method to be developed – the sulphate method – was originally developed in Germany in the late 1800s but did not become widely used until it was refined in Sweden by Munksjö, a paper manufacturer established in Jönköping in 1862. More recent examples include TMP (thermo-mechanical pulp) and CTMP (chemical-thermo-mechanical pulp) processes. Relatively high raw material costs and relatively low energy prices favoured the development of these new processes which are energy intensive but utilise the wood input much more fully'.

'Swedish pulp and paper companies have been leading pulp exporters. Paper exports as a share of total pulp and paper exports rose rapidly during the 1970s and 1980s (from 50 to 75%). Swedish paper manufacturers have developed particularly strong positions in newsprint, kraft paper (kraft liner, sack kraft paper) and paperboard. Fine paper (woodfree printing and writing paper), and tissue paper (toilet paper and other cleaning tissue) have been important'.

'The industry, like others in Sweden, has been characterised by major consolidation over the post war period. Out of 82 manufacturers with 136 manufacturing units in 1957, only 26 firms with 76 units were left in 1982. Today, the industry is dominated by three large groups: Stora (including Papyrus and Billerud), Modo (including Holmen and Iggesund, both acquired in 1988), and SCA. Other paper manufacturers include ASSI, Södra Skogsägarna, Korsnäs, NCB, Munksjö and Munkedal'.

'Stora offers a wide range of paper, and is the leader in Europe in printing paper, especially newsprint, paperboard and wrapping paper. Modo concentrates on fine paper, printing paper such as newsprint (Holmen paper), and paperboard (Iggesund Paperboard). SCA is the third largest pulp and paper manufacturer, and has strong positions in printing paper and corrugated board'.

'Stora took a major step to establish itself as the leader in Europe by acquiring Feldmühle Nobel (at the time Europe's largest manufacturer of printing paper) of Germany in 1990. This acquisition was the largest ever foreign acquisition ever made by a Swedish firm. SCA acquired a number of paper mills throughout Europe in the late 1980s, including Italcarta (Italy), Peaudouce (France) and Laakirhen (Austria), and Reedpack in the UK in 1990. At he same time SCA also announced that they would also acquire control of Modo'.

Machinery

'On the supply side, efficient logging has been a key to lower input costs to the Swedish pulp manufacturers. Sweden has produced a number of leading international machinery manufacturers, which evolved with the mechanisation of logging. The light, oneman chainsaw was developed in the late 1950s. Major Swedish producers of chainsaws were Husqvarna, Jonsered, and Partner. Electrolux acquired Husqvarna in 1987 and has since become a world leader in chainsaws for professional use. Sandvik Saws and Tools also produces handsaws and chains for chainsaws'.

'Mechanisation of logging led to international positions in specially designed tractors, forwarders, processing machines (limbing and ducking), log harvesters (felling and processing), and machines for thinning, and machines for planting. A number of Swedish firms evolved, including ÖSA, Bruun System, Umeå Mekaniska Verkstad, Laxo Mekan, and Kockums. A merger wave resulted in two Finnish firms coming to dominate the Swedish industry (which had built up important international positions). For example, Rauma Repola acquired ÖSA and Bruun, which were merged into Forest Machine

Group, FMG, whilst Valmet acquired Umeå Mekaniska, which was merged into Valmet logging. Other Swedish industries linked to logging and forestry include cranes and other machinery, technical consultants, and firms specialising in forest fertilisers'.

'The development of the Swedish pulp industry spawned a number of international manufacturers of pulp machinery. Leading firms included Götaverken (recovery boilers), Sunds (a range of pulp machinery), Defibrator (a range of pulp machinery), and Kamyr (continuous digesters, bleaching plants). Sunds, a subsidiary of SCA, acquired Defibrator in 1979, forming Sunds Difibrator. The structure of the industry changed significantly in the 1980s. Kamyr was sold to the Kvaerner Group of Norway. Sunds, which had developed strong international positions, joined forces with two Finnish firms – United Paper Mills and Rauma Repola (who merged in 1990 to form Repola). Other machinery industries linked to pulp production include wood handling machinery (KMW, Söderhamns Verkstäder) and conveyors (Consilium Bulk, Kone Wood)'.

'Sweden had one competitive manufacturer of paper machines, KMW, known for its purpose-built machines. However, as the company faced increasing difficulties, its owner Nordstjernan decided to sell out to a Finnish world leader in paper machines, Valmet. Furthermore, Nordstjernan sold out KMW's fiberboard machinery to Sunds Defibrator (1986), and conveyor systems to the Finnish firm Kone. Sweden still has strong positions in drying machinery (ABB Fläkt), and fabrics and felts used in paper machinery (Nordviror, Nordiska Filt and Bruzaholms Viror)'.

'Pulp and paper plants utilise distribution, control and drive systems, and have been important customers to ASEA throughout history (today: ABB Drives, ABB Process Automation, ABB Motors, ABB Distribution). Furthermore, various instruments are used to control and monitor the production process. In this field, four Swedish firms have developed international positions: Scanpro, EKA Nobel, Lorentzen & Wettre, and Boliden Kemi. Scanpump is a leading supplier of pumps to the pulp and paper industries, and has built up an international position (it consolidated its European position by acquiring its leading rival, ABS in Germany in the late 1980s)'.

'The forest products cluster is linked to the transportation equipment cluster in several important ways. Heavy trucks are used to transport timber and paper. Volvo and Scania heavy trucks are known for their reliability and sturdiness for tough log transports (about 85% of timber transported from the roadside to industrial plants is transported via road). Heavy-duty forklift trucks (Kalmar Heavy Lift Trucks) are used within pulp and paper plants'. However, we do not include transportation equipment as part of the forest cluster within the EU.

Speciality Inputs

'On the speciality inputs side, the pulp and paper industries are major users of chemicals. While weak overall in the chemical sector, Sweden historically hosted a number of leading suppliers of chemicals (such as chlorate) for the pulp and paper industry. However, during the last few years the industry has consolidated rapidly. Stora Kemi (including Alby after Stora's acquisition of Swedish Match) and EKA Nobel (part of Nobel Industries, including KemaNord) became the two leading firms. In 1990, EKA Nobel acquired Stora Kemi and established a dominating position in Sweden. Thus, domestic rivalry has been eliminated'.

Associated Services

'Historically, the forest cluster was tightly linked to Swedish trading houses, which developed in the mid-and late 19th century, some of which specialised in forest products. The owners of the trading houses were leading capitalists at the time, and supported the establishment of new pulp and paper manufacturers. The major shipping port was Gothenburg on the Swedish west coast. Leading Swedish trading companies, with a history in trading forest and paper products, include Elof Hansson and Ekman Liebig, both located in Gothenburg. CellMark is a new entrant, founded in Gothenburg in 1984. Pulp and paper for exports is transported on ships in which Sweden has a strong position (Gorthon Lines and others). Already in the 1960s, SCA and other pulp and paper manufacturers developed special cargo ships for paper shipments'.

Sawmills

'The Swedish sawmill industry has a long history. Exports took off in the mid-19th century, sold through independent trading houses. Abundance of wood, a labour cost advantage at the time vis-á-vis competing nations, a rapid increase in English demand for sawn timber, and the introduction of the steam engine, laid the foundation for the expansion of timber yards along the Swedish Baltic coast. In the late 1950s, Sweden had over 6000 mills throughout the country'.

'The Swedish sawmill industry today is the largest in Western Europe, accounting for 3% of world production and 9% of world exports. Sawmills carryout a number of production steps: sawing, planning, fingerjointing, and pressure impregnation. Panel products are another line, including fibreboard, particleboard and plywood/ blockboard, however, the fibreboard industry is of most importance in Sweden. Leading producers include: SCA, Södra Skogsägarna, Iggesund Timber (Modo), Stora Timber, ASSI, Graningeverken and a number of smaller sawmills. There are about 2000 sawmills, with the 300 largest accounting for 90% of the output. Exports account for some 70% of total production'.

Machinery

'The Swedish sawmill industry has only spawned a few competitive supplying industries, such as saw steel and plane machinery. In the 19th century, the sawmill industry played a key role in stimulating an emerging domestic machinery industry. Most importantly, the sawmills were among the early customers of steam engines. The steam engine was the first complex product to be manufactured by Swedish mechanical workshops established in the mid-1800s. These workshops diversified into a wide range of products used throughout the economy'.

Table 2.7 Internationally competitive industries and firms in the Swedish pulp and paper cluster

	Industry	Firm
Primary	Pulp	Stora. Modo, SCA, Södra Skogsägarna, ASSI and several others
	Printing paper/ Newsprint	Stora. Modo and SCA
	Wrapping paper	Stora. Modo, ASSI and several others
	Corrugated board	SCA, ASSI, Stora, Modo,
	Sack paper	Korsnäs, NCB
	Paperboard	Stora, SCA, Iggesund Paperboard (Modo), ASSI and several others

	Liquid board	ASSI, Stora, SCA and several others
	Fine paper	Modo, Stora, SCA and several others
	Tissue	Mölnlycke (SCA), Metsä-Serla, Munksjö
Machinery	Wood handling equipment	Consilium Bulk, Kone Wood, Söderhamns Verkstäder
	Debarking components	Skega (Incentive)
	Continuous digesters	Sunds defibrator, Kamyr (Kvaerner)
	Bleaching plants	Kamyr (Kvaerner)
	Soda-recovery boilers	Götaverken Energy (Celsius)
	Drying machinery	ABB Fläkt
	Paper machinery	Valmet KMV
	Fiberboard machinery	Sunds Difibrator
	Instruments	EKA Nobel (Nobel Industries), Boliden, Scanpro, Lorentzen & Wettre (Incentive)
	Image processing systems	Innovativ vision
	Pumps	Scanpump (Cardo)
	Motors, drives	ABB Motor, ABB Drives
	Electricity distribution	ABB Distribution
	Forklift trucks	Kalmar Heavy Lift Trucks (Componenta)
	Wire-cloth	Bruzaholms viror, Nordiska Filt, Nordviror
Speciality Inputs	Chemicals	EKA Nobel (Nobel Ind.), Stora Kemi (Nobel Ind.)
Services	Consulting	NLK-Celpap, ÅF-IPK, Hevac, J&W
	Trading	Liebig, CellMark

Source: Advantage Sweden – Sölvell, Zander and Porter, 1991.

‘Machinery used in the sawmills include: conveyors, drying kilns, and saw tools. The more sophisticated manufacturers offer whole saw lines. Machinery for sawmills is a home market orientated industry, with exports amounting to 20% (1985). A number of small and medium sized firms keep a tight grip on the Swedish market, with imports around 5%’.

Other related industries[3]

'House construction and furniture developed out of the forest products cluster. Sweden's international success was the result of innovation and upgrading driven by factor disadvantages such as high domestic labour costs and stringent domestic demand that anticipated foreign demand'.

'There is a large construction industry in Sweden as in all nations, which is domestically-orientated. Swedish construction firms like Skanska, NCC, BPA and SIAB have been active in foreign markets for some time, however successful projects have largely been limited to less developed economies, such as the Middle East'.

'In the area of wooden, prefabricated houses[4], however, Swedish suppliers have sought more aggressively to build international positions and have had some success. Swedish production of prefabricated houses of wood started already in the 1920s. Early entrants were mostly sawmills diversifying into house construction to find growth markets. Short building seasons and high labour costs pushed Swedish industry towards prefabricated designs, and laid a basis for internationalisation. Harsh climatic conditions pressurised manufacturers to develop house constructions and products with tight fit and high quality'.

'The 1950s and 1960s were characterised by a rapid increase in Swedish demand for new houses. In combination with a lack of skilled carpenters, the market for prefabricated houses and other products took off (In the 1960s, there were more than 100 manufacturers of prefabricated houses in Sweden and, during the 1970s, at least 60% of the 40,000 single-family houses constructed were prefabricated. The house construction cluster includes industries like prefabricated housing (Myresjöhus, LB-hus, and Gullringenhus), wooden floors (parquet and laminated constructions, manufactured by Tarkett-Pegulan and Kährs), windows (wood and metal, by Elitfönster, Överums Fönsterfabrik and Modulfönster), and doors (Swedoor in the Stora Group)'.

---

3 Housing Construction/Furniture (Advantage Sweden – Sölvell, Zander and Porter – pp 125-128, Norstedts, 1991).

4 Although the manufacture of wooden prefabricated houses has also been identified as part of the Finnish forest cluster, we do not adopt this in our model used within the European Union forest cluster, since this is fairly unique to Scandinavia and statistics do not enable their inclusion in other EU countries.

'Other products related to house construction include kitchen and bathroom cabinets (Ballingslöv and Zig-Zag, Marbodahl – part of Stora, HTH, Tibro Kök, and Kvänum). Electolux has become a major player in foreign markets, with a strong position in the US cabinet market through WCI and Tappan'.

Furniture[5]

'The Swedish furniture production is concentrated to two counties, Jönköping and Skaraborg, in southern Sweden. Major products include office furniture (FACIT, Kinnarp, Polarator, and others) and home furniture (Dux, Ulferts, and others). The industry has been modestly internationally successful, with the notable exception of Ikea. From a level of 10-15% in the 1960s, exports now reach almost 40%, including re-exports mainly carried out by Ikea'.

'Ikea was founded as a mail order firm in 1943 by I. Kamprad. In the 1950s, the company focused on furniture, and in 1953 the first furniture showroom was set up in Kamprad's hometown, Älmhult, in southern Sweden. This was the first Ikea retail outlet in a long series to come. A key concept in Ikea's strategy was to design and market knocked-down self-assembled kits, which were picked up by the customer at the retail outlet. The concept proved particularly successful in Sweden, were high labour costs to assemble furniture could be circumvented. In addition, mobility among young people in Sweden created demand for inexpensive and functional furniture for new home owners. Over time, product design, handled by a few design engineers in Sweden, and tight links with Swedish and foreign suppliers became important parts of the Ikea success formula'.

'Expansion outside the Scandinavian market started in the 1970s, taking advantage of the fact that foreign demand was developing in the same direction as in Sweden. A segment of the furniture market worldwide has similar needs. Including franchises, some 90 Ikea stores are now found throughout Europe, North America and in Asia. In spite of its global presence, Ikea purchases a major share of its furniture from Swedish suppliers, and has therefore been an important driver of the Swedish furniture industry'.

---

5 Advantage Sweden – Sölvell, Zander and Porter – pp 129-130, Norstedts, 1991.

Chapter 3. Forestry Statistics

3.1 Forestry in the EU forest-based and related industries

The total 'wooded area' of the EU is approximately 133 million hectares (ha), which represents about 42% of the total land area of the European Union. Of this total, Sweden has the largest area of wooded land at about 28 million ha, followed closely by Spain who have around 26 million ha, and then by Finland with 23 million ha. However, in terms of 'forest land', the EU has a total area of some 102 million ha, which accounts for almost a third of EU land. Sweden again have the largest share of this figure at 24 million ha, and Finland the second biggest with about 20 million ha. France also has a significant amount of forest land of some 15 million ha, whilst both Germany and Spain have just under 11 million ha each. Table 3.1 provides a selection of forestry statistics within the EU.

According to forestry data extracted from Eurostat, the EU's forest area has been increasing in recent years. Between 1990 and 1995, the change in growing stock has increased by some 880 million m³. The majority (about 75%) of the growing stock consists of coniferous species, which are mainly located in Germany, Sweden and Finland. Moreover, the net annual increment (NAI) of stock amounted to 463 billion m³, in 1995. The majority of this increment is distributed mainly throughout Sweden, Germany, France and Finland, but over the 1989-95 period the change in NAI has been restricted mostly to France (70%), Finland (20%) and Sweden (countries with substantial forest industries). Fellings have also been reduced within the EU over the same period by some 33 billion m³, however, the vast majority of the reductions have been in Germany and France (countries where environmental pressures have led to the increased use of recycled fibres, especially within the pulp and paper industry), whilst both Sweden and Portugal had substantial increases in fellings. Removals increased by some 8.6 billion m³, and again major increases were made in Sweden and Portugal, with decreases occurring in Germany and France.

The biggest producers of roundwood are Sweden, Finland, France and Germany, whilst Spain and Austria are also significant

Table 3.1 Selection of EU Forestry Statistics – 1995

	EU 15	Bel	Den	Ger	Gre	Spa	Fra	Ire	Ita	Lux	Neth	Aus	Port	Fin	Swe	UK
Wooded area (1000 ha)	**132679**	620	417	10741	6513	25984	16874	606	9857	89	384	3877	3238	23003	28007	2469
Wooded area (%)	42	20	10	31	51	52	31	9	34	35	10	47	35	76	68	10
Total land area (1000 ha)	312341	3025	4239	34917	12884	50019	53758	6889	29412	256	3811	8275	9146	30460	41161	24088
Population (1000)	372654	10143	5251	81818	10465	39242	58256	3616	57333	413	15494	8055	9921	5117	8838	58694
Forest land (1000 ha)	**102325**	620	417	10741	3359	10662	15034	570	6821	89	334	3877	2875	20032	24425	2469
Other wooded land (1000 ha)	30354	0	0	0	3154	15322	1840	36	3036	0	50	0	363	2971	3582	0
Total forest and other wooded land (FOWL) (1000 ha)	132679	620	417	10741	6513	25984	16874	606	9857	89	384	3877	3238	23003	28007	2469
Change in FOWL, 1990-95 (1000 ha)	2124	0	0	0	481	362	632	70	752	0	0	0	136	-370	-8	69
Exploitable forest land area (1000 ha)	:	620	417	10225	:	8006	13919	464	:	86	280	3330	2444	18842	21843	2469
Exploitable forest land as proportion of forest land (%)	:	100	100	95	:	75	93	81	:	96	84	86	85	94	89	100
Inhabitants per ha of forest land (inhabitants/ha)	4	16	13	8	3	4	4	6	8	5	46	2	3	0	0	24
Vol of the growing stock, conif species (mio m³ o/b)	**9029**	19	34	2001	85	363	757	40	482	7	31	849	101	1601	2491	167
Vol of the growing stock, non-conif spec (mio m³ o/b)	**4299**	77	27	910	67	229	1202	5	589	13	20	181	100	353	454	73
Change in growing stock, 1990-95 (mio m³ overbark)	879	6	6	96	3	52	68	6	169	0	4	58	-2	181	224	8
Growing stock per ha of FOWL (m³/ha)	100	155	146	271	23	23	116	74	109	226	182	266	62	85	105	97
Net annual increment (NAI) (mio m³ overbark)	**462630**	4457	3200	79000	3813	28891	76753	3330	33942	132	2258	31416	11818	74858	97600	11162
Change in NAI, 1990-95 (mio m³ o/b)	11206	0	0	0	496	0	7890	80	-395	-1	-45	0	-109	2401	889	0
Fellings (mio m³ overbark)	**277330**	3326	2000	37190	3376	15014	36045	2250	6997	345	1568	19846	13738	58410	68200	9025
Change in fellings, 1990-95 (mio m³ overbark)	-33484	0	0	-45330	0	0	-1129	710	-239	18	116	0	2493	950	7982	945
Removals (3 years average) (mio m³ overbark)	**253383**	3029	2000	27070	2250	14886	34462	2160	9340	357	937	16438	13282	53147	65900	8125
Variation in removals, 1990-95 (mio m³ overbark)	8598	0	0	-1590	0	0	-4104	570	1010	36	-348	-768	2410	1570	8962	850

Source: Eurostat.

Table 3.2 Production of Roundwood within the EU in 1996 (1000 m^3)

	Roundwood total	Industrial roundwood total	Ind roundwood, coniferous	Ind round-wood, non-coniferous	Fuel-wood
EU15	246246	211388	168140	43249	34860
Belg/Lux	4185	3635	2680	955	550
Denmark	1876	1249	879	370	627
Germany	**37013**	34537	**26906**	7632	2476
Greece	2012	674	362	312	1338
Spain	15630	12434	7591	4843	3198
France	**40784**	30984	**18364**	**12620**	**9800**
Ireland	2291	2225	2192	33	66
Italy	9018	4070	1112	2958	4948
Netherlands	951	828	583	245	123
Austria	13805	10746	9916	830	3059
Portugal	8978	8428	4575	3853	550
Finland	**46272**	42178	**37329**	4849	4094
Sweden	**56400**	52600	**49400**	3200	3800
UK	7031	6800	6251	549	231

Source: Eurostat.

producers. Sweden, Finland and Germany mainly produce coniferous industrial roundwood, whereas France is the main producer of non-coniferous industrial roundwood. The largest exports of roundwood are Germany, France and Sweden. Germany and Sweden are the largest exporters of coniferous industrial roundwood, whereas France is the largest exporter of non-coniferous industrial roundwood. Germany is also the largest exporter of wood chips and particles. Tables 3.2 and 3.3 provide an overview of roundwood production and export for the European Union.

Table 3.3 EU Exports of Roundwood in 1996 (1000 m³)

	Roundwood total	Industrial roundwood total	Ind roundwood, coniferous	Ind roundwood, non-coniferous	Fuelwood	Chips & particles	Wood residues	Charcoal
EU15	10659	10094	6619	3475	565	3113	2770	42
Belg/Lux	780	748	482	266	32	175	289	1
Denmark	222	221	149	72	1	90	1	0
Germany	**2745**	2693	**2118**	575	52	**1097**	329	2
Greece	1	1	0	1	0	0	0	1
Spain	263	179	94	85	84	0	5	12
France	**2591**	2244	447	**1797**	347	410	843	18
Ireland	250	250	250	0	0	140	125	0
Italy	6	3	0	3	3	0	5	0
Netherlands	394	380	320	60	14	64	204	6
Austria	651	650	490	160	1	675	911	0
Portugal	471	452	78	374	19	22	6	0
Finland	602	599	588	11	3	147	5	0
Sweden	**1629**	1620	**1583**	37	9	271	40	0
UK	54	53	20	33	1	22	6	2

Source: Eurostat.

Table 3.4 Forest Structures within the EU – 1995

	EU15	Bel	Den	Ger	Gre	Spa	Fra	Ire	Ita	Lux	Net	Aus	Porl	Fin	Swe	UK
Wooded area: Total (1000)	1993	2	16	292	13	210	259	18	570	2	7	169	216	96	64	61
Wooded area: > 0 - < 1 ha (%)	**34**	52	15	**30**	57	**36**	**26**	39	**48**	27	56	**18**	46	2	1	23
Wooded area: > 1 - < 2 ha (%)	**17**	22	22	**18**	18	**19**	**21**	14	**18**	18	21	**16**	21	1	3	19
Wooded area: > 2 - < 5 ha (%)	**22**	16	33	**26**	12	**22**	**28**	25	**19**	29	15	**27**	21	4	8	28
Wooded area: > 5 - < 10 ha (%)	11	5	17	14	5	10	13	11	7	14	4	18	7	9	9	14
Wooded area: > 10 - < 20 ha (%)	7	4	9	7	5	5	8	7	4	8	2	11	3	19	16	8
Wooded area: > 20 - < 30 ha (%)	3	1	2	2	1	2	2	2	2	2	1	4	1	16	12	3
Wooded area: > 30 - < 50 ha (%)	3	1	1	1	1	2	2	1	1	2	1	3	1	20	17	2
Wooded area: > 50 ha (%)	4	1	2	1	1	5	1	1	2	1	1	3	1	**29**	**35**	2
Wooded area on agricult holdings:	EU15	Bel	Den	Ger	Gre	Spa	Fra	Ire	Ita	Lux	Net	Aus	Porl	Fin	Swe	UK
> 0 - < 1 - (1000 ha)	277	0	1	40	3	30	29	3	103	0	2	15	41	1	0	7
> 1 - < 2 - (1000 ha)	453	0	4	75	3	49	66	4	130	0	2	39	60	2	2	15
> 2 - < 5 - (1000 ha)	1322	1	16	243	4	137	210	14	**329**	2	3	150	**133**	14	15	52
> 5 - < 10 - (1000 ha)	1432	1	18	**293**	4	**137**	**218**	14	**266**	2	2	**213**	**102**	64	37	60
> 10 - < 20 - (1000 ha)	1862	1	18	**292**	7	**140**	**266**	16	**283**	2	2	**269**	86	270	143	68
> 20 - < 30 - (1000 ha)	1373	0	9	136	3	84	121	9	214	1	1	155	47	367	188	39
> 30 - < 50 - (1000 ha)	2080	0	9	119	4	138	145	8	220	1	2	170	49	761	405	49
> 50 - (1000 ha)	14654	2	60	275	14	3504	376	25	2412	1	65	1669	297	2671	3119	162
Total - (1000 ha)	23454	6	136	1474	41	4219	1432	93	3958	9	78	2681	816	4150	3910	451
Total wooded area - (1000 ha)	132679	620	417	10741	6513	25984	16874	606	9857	89	384	3877	3238	23003	28007	2469

Source: Eurostat.

The structure of forest holdings[1] varies substantially between mainland Europe and Scandinavia. For example, in both Sweden and Finland, wooded areas of greater than 30 ha account for about 50% of the total wooded areas. Whereas, in countries such as Germany, Spain, France and Italy, wooded areas of 5 ha or less make up more than 75% of the total wooded areas. These fundamental differences in the structure of forest holdings do not lend themselves easily to any one common system for forest certification, and this factor must surely complicate matters. Table 3.4.

As far as ownership is concerned, private forests account for about 65% (84 million ha) of the EU15's total wooded area. Private ownership in France is 75%, Sweden, 70%, Finland 68%, Spain and Italy about 66% each, and Portugal with 85% have the highest share of private ownership in the EU. Germany's forests are in the majority publicly owned (53%), with the state owning as much as 34% of its forests. Finland also has a high percentage of state ownership of its forests at around 29%, as does Sweden with 19%.[2]

3.2 Value-added and Employment in forestry

Statistics for forestry in the EU are very limited and as such are currently the subject of an ongoing improvement programme within the European Commission's statistical arm Eurostat. Notwithstanding the limitations, some statistics have been extracted from Eurostat's New-Cronos database, and supplemented with OECD National Accounts. The results are shown in Table 3.5 below. Based on this data for only 12 of the present fifteen member states, the gross value-added generated by the forestry element of the forest-based and related industries has been estimated at around 13.1 billion ECUs for 1994.

Whilst the forestry sector does not appear to provide a substantial amount of value-added to some EU countries, in countries such as France, Sweden, Finland, Germany, Austria, Portugal, and Italy it provides between 1-3 billion Ecu in value-added to each country's economy. At the same time, data for Spain, Netherlands, Luxembourg and Greece is incomplete or not available. The net

---

1 'Forest Holding' means a management unit. A management unit covers all wooded areas, regardless of their location, forming a whole for management and administration purposes. Source Eurostat.

2 Source: Eurostat forestry statistics 1992-96, page 42.

result is that figures for 1994 indicate that the forestry sector contributes about 8% of the total value-added within the forest-based industries.

Table 3.5 Forestry and logging within the EU, 1994

Country	Number of employees – exc home workers (1000s)	Total Employment (1000s)	Gross value-added (mill ecus)
Austria	10	63	892
Belgium	1	1	173
Denmark	3	4	183
Finland	16	25	2628
France	29	39	3548
Germany*	107	134	1106
Greece	NA	NA	109
Ireland	*3*	*3*	NA
Italy	*20*	20	712
Luxembourg	NA	NA	7
Netherlands	*3*	*3*	NA
Portugal	3	10	762
Spain	NA	NA	NA
Sweden	15	36	2710
UK	18	36	255
Total EU 12	**227**	**372**	**13086**

Source: Eurostat; OECD National Accounts, detailed tables Volume II, 1998.
*West Germany Only.

Although there is no data available on employment for the forestry sector within Eurostat, we have estimated levels of full-time employment, using the OECD National Accounts, and have found that the forestry sector employs at least 230,000 people within the EU. We have also estimated the total employment (which includes part-time and casual workers etc), and found this to be around 370,000 persons. However, according to Eurostat data on the number of forest holdings, there are some 7.3 million forest holdings in the EU15.[3] Moreover, according to the Confederation of European Forest Owners (CEPF), "due to the nature of forestry in the EU,

3 Source: Eurostat forestry statistics 1992-96, page 52.

statistical data does not accurately depict the true scale of the industry. For example, there are about 10-12 million forest owners and about 65% of these are SMEs whose size are of such little significance, less than one or two ha, that statistics generally do not cover them[4], thereby ignoring a great deal of activity."

"To add to this, many owners are farmers who earn additional income from forestry activities whilst many others are self employed, retired or their families also help out with forestry activities. In any event, the net result is that much of this economic activity is unrecorded. Moreover, the environmental and social benefits go largely unreported (how does one account for these benefits in economic statistics anyway), extra income from hunting, berry-picking, recreational usage etc may not always be declared." However, although these industries may be important in their own right there is no suggestion that these industries should be included as part of the forest-based industrial cluster.

In sum, the above suggests that a great deal of economic activity is not being expressed at all, resulting in a huge underestimate of the true value and significance of forestry, economically, socially and environmentally. Indeed, further investigation is probably warranted in this area in an attempt to estimate the true levels of employment and value-added within the forestry sector, but this is beyond our remit.

---

[4] Forestry statistics on enterprises start with 1 ha or more and also adopt threshold limits for production.

Summary Conclusions

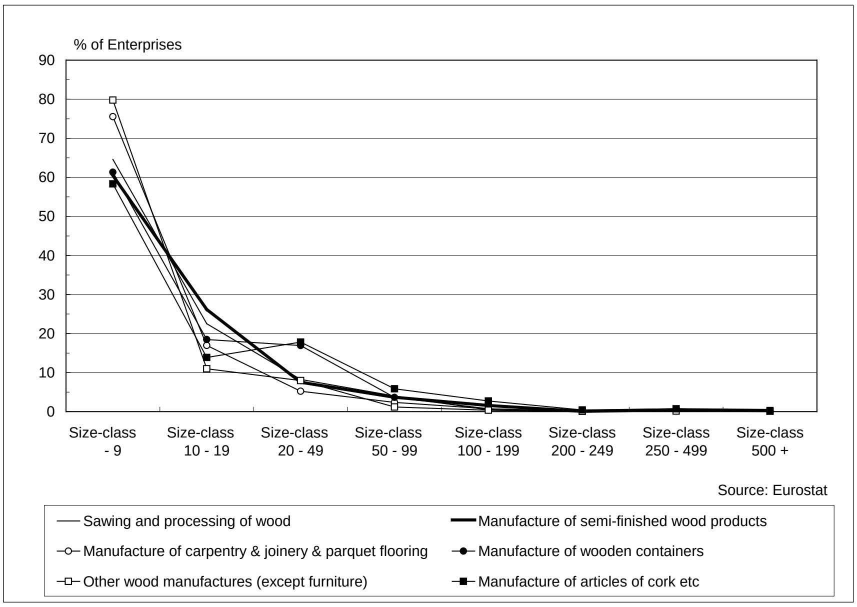
- There are some 133 million hectares of wooded area within the EU, which accounts for about 42% of the total land area. Of this figure about 102 million ha is forest land or about one-third of the EU land area.
- The largest shares of forest land are located in Sweden, Finland, France, Germany and Spain.
- In recent years the growing stock of forests have increased within the EU. The growing stocks are mainly located in Sweden, Finland and Germany (even though the two former utilise domestic raw materials as leading pulp and paper countries).
- Fellings have decreased within the EU since 1989, particularly in Germany and France (countries where environmental pressures have resulted in the increased use of recycled fibres, especially within the pulp and paper industry).
- Roundwood is mainly produced in Sweden, Finland, France, Germany, Spain and Austria, with exports similarly coming from the Germany, France and Sweden.
- The structure of forest holdings varies greatly across Europe, both in size and ownership, giving rise to fundamental differences between regions, and thus complicating the situation within the area of forest certification.
- The Value-added of the forestry sector is estimated at over 13 billion Ecus, accounting for as much as 8% of the forest-based and related industries of the EU.
- The forestry sector provides direct employment for some 230,000 people within the EU.
- There are also over 7.3 million forest holdings within the EU, and up to 12 million forest owners, but since statistics do not cover the forestry sector employment as yet, then it is likely that employment in the forestry sector is much higher than the above figure indicates.
- It is also believed that a significant amount of forestry based activities (extra income from berry-picking, hunting etc) goes unrecorded, and hence the economic benefits of forestry are likely to be seriously underestimated.

Chapter 4. Mechanical Wood Processing Industries

4.1 Mechanical Wood Sector

Within the EU, there is a wide assortment of wood processing and wood product industries, which can be categorised as belonging to the mechanical wood sector. In many cases, the wood products may be manufactured within primary and secondary wood processing industries. However, the distinction between these categories is often blurred by the fact that many operations are undertaken by companies engaged in different stages of the value chain, from raw material procurement to primary wood processing, secondary wood processing and even production of semi-finished products. However, these types of inter-related companies who utilise tight co-operation tend to be located nearer the source of the raw material, and are located in certain districts or regions of the EU.

Figure 4.1 Structure of the Mechanical Wood Sector in the EU



The mechanical wood sector is mainly comprised of Sawmilling and planning of wood and the manufacture of semi-finished wood products such as wood-based panels. It may also include the manufacture of carpentry and joinery components and flooring products, plus the manufacture of wooden containers, other wooden products and related articles of wood and cork etc.

The structure of the mechanical wood processing and wood product industries is shown in figure 6.1. The mechanical wood sector is characterised by a very large proportion of Small and Medium-sized Enterprises (SMEs). In fact, about 90% of the companies employ less than 20 persons. And although there are a number of large companies – such as sawmills located in Austria, Germany, Sweden and Finland - the mechanical wood processing and wooden product industries are widely distribute across Europe.

Due to the nature of the mechanical wood sector (wide and varied groups of products and companies), and availability of data, we have opted to describe only a selection of the main industries. Hence, in the following section we will concentrate on providing a general overview of Sawnwood and Wood-based panels industries within the EU.

4.2 Mechanical Wood Processing Sector

Within the supply of forest products, Eurostat lists several categories, which they term as major products, and indeed this list is commonly used by many of the main forest organisations around the world, such as the UN Food and Agriculture Organisation (amongst others). Adopting this list, production figures for the EU15 in 1996 were as follows, Sawn-wood 67 million m^3, Wood-based panels 34 million m^3, Wood pulp 30 million metric tonnes (m.t), Printing and writing papers about 26 million m.t and finally Newsprint around 8 million m.t. However, pulp and paper industries are covered later in more detail in a separate chapter.

Of the 67 million m^3 sawnwood total, Sweden and Germany were the largest producers each having about the same shares. France, Finland and Austria were also major producers of sawn-wood and have similar large shares. Some 60 million m^3 sawnwood was coniferous, which was distributed as per the sawnwood total, however, France was the most significant producer of non-coniferous sawnwood.

Table 4.1 Sawnwood Production and Trade in the EU, 1996 (1000 m³)

Country	Produc-tion	Exports	Export ratio	Imports	Apparent Consumption
Belgium-Lux	1209	516	42.7	1932	2625
Denmark	583	87	14.9	1630	2126
Germany*	**14334**	**1845**	12.9	**4798**	**17287**
Greece	337	10	3.0	466	793
Spain	3262	50	1.5	1591	**4803**
France	**9307**	1003	10.8	2178	**10482**
Ireland	687	269	39.2	285	703
Italy	1650	97	5.9	**6208**	**7761**
Netherlands	367	351	95.6	3380	3396
Austria	**7804**	**4100**	**52.5**	1030	**4734**
Portugal	1731	460	26.6	162	1433
Finland	**9270**	**7036**	**75.9**	149	2383
Sweden	**14370**	**11648**	**81.1**	213	2935
United Kingdom	2111	64	3.0	**5918**	**7965**
European Union (EU15)	67022	27536	41.1	29941	73288

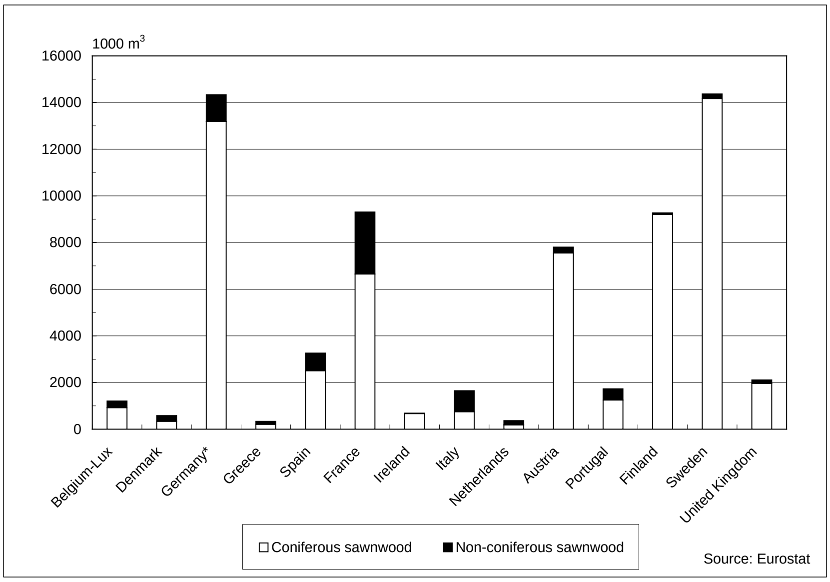
Source: Eurostat. *Federal Republic of Germany (including ex-GDR).

Table 4.2 Wood-based panels Production and Trade in the EU, 1996 (1000 m³)

Country	Produc-tion	Exports	Export ratio	Imports	Apparent Consumption
Belgium-Lux	**3248**	**2128**	**65.5**	672	1791
Denmark	432	124	28.7	525	833
Germany*	**10382**	**2088**	20.1	**3700**	**11994**
Greece	363	34	9.4	151	480
Spain	**2894**	654	22.6	765	**3006**
France	**4015**	**1824**	45.4	1179	**3370**
Ireland	434	212	48.8	75	297
Italy	**3907**	640	16.4	1039	**4306**
Netherlands	99	253	255.6	1497	1343
Austria	**1961**	**1274**	**65.0**	348	1035
Portugal	1215	691	56.9	111	635
Finland	**1538**	**1157**	**75.2**	93	474
Sweden	971	378	38.9	580	1172
United Kingdom	**2578**	390	15.1	**2881**	**5069**
European Union (EU15)	34037	11846	34.8	13615	36821

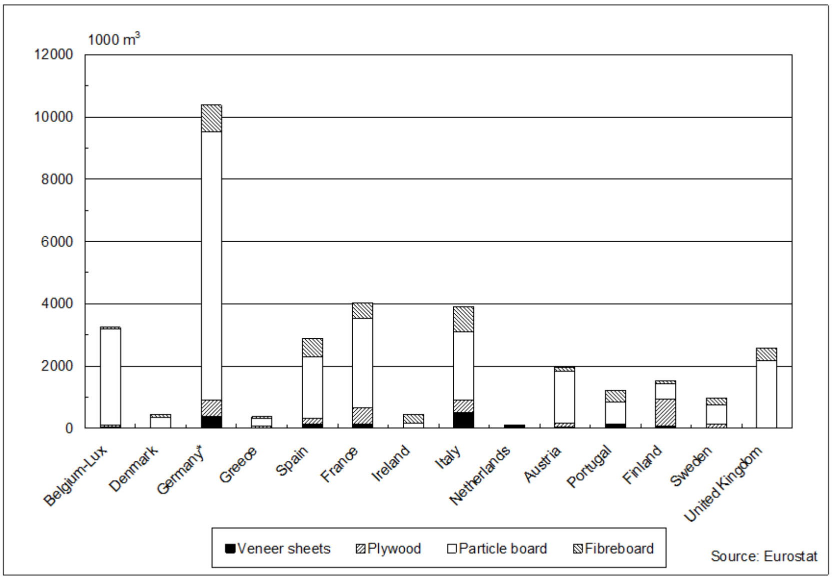
Source: Eurostat. *Federal Republic of Germany (including ex-GDR).

Figure 4.2 Sawnwood Production in the EU, 1996 (1000 m³)



Of the total 34 million m³ of wood-based panels produced within the EU, some 25 million m³ was particleboard, (Germany the major producer) fibreboard adds a further 4.5 million m³ (dis-

Figure 4.3 Production of Wood-based panels in the EU, 1996 (1000 m³)

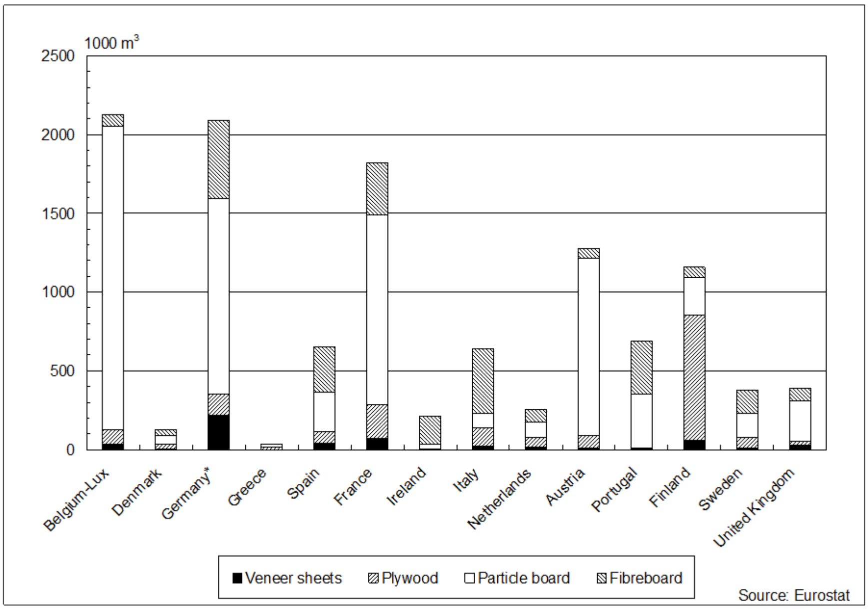


tributed widely), plywood another 3 million (Finland the largest producer) and veneer sheets an additional 1.4 million m³(Italy the biggest).

In terms of trade within these major forest products, imports from EU countries has, in most cases, more than doubled or at least grown by a third between 1992 and 1996. At the same time, imports from third countries have declined by between 20-60%, although they do still represent between 40-70% of total imports. The major declines in imports from third countries occurred in the UK and Germany, and to a lesser extent in, Italy, France and the Netherlands.

Exports of the major forest product categories originated in many countries of the EU. Sweden, Finland and Austria were the largest exporters of sawn-wood, (mainly coniferous sawn-wood, 95%). Within wood-based panels, particle boards made up about 60% of exports, with Belgium and Luxembourg the largest exporter, followed by Germany, France and Austria. Between 1992 and 1996, exports to third countries have more than doubled in wood-based panels and have grown by 60% in sawnwood categories. It is interesting to note that by far the biggest growth in consumption of any of these products was witnessed in fibreboard, which grew by more than 40%.

Figure 4.4 EU Exports of Wood-based panels in 1996 (1000 m^3)



Germany is the most important producer of wood-based semi-finished products in Western Europe. It is the largest producer of particle board panels, producing 8.7 million m^3, and accounts for about one-third of production in Europe. At the same time it also accounts for about 19% of fibreboard panels, and 30% of wood-based panels. Germany is second only to Sweden in the production of sawnwood and to Finland in the production of plywood, accounting for 18%.

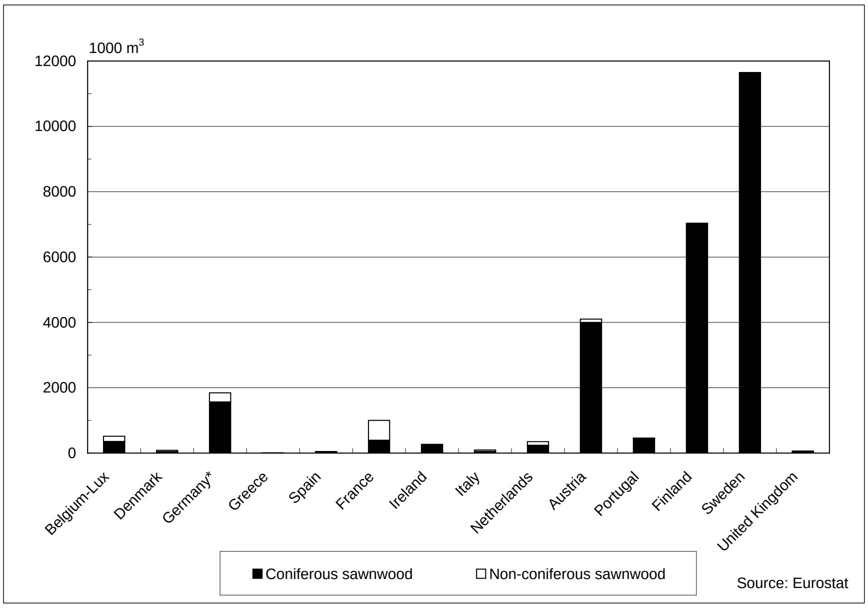
Germany consumes more than it produces in each of the main wood product categories; sawnwood, wood-based panels, plywood, particle board with fibreboard, which are almost in balance. Therefore, Germany is a net importer of semi-finished wood products. In 1996, it had a negative trade balance for all types of semi-finished products except fibreboard panels. Germany is the biggest importer of particle board. In 1997, imports increased by 8%. Germany is also the leading European exporter of veneered panels and the second largest exporter of particle board panels, accounting for 45% and 16% of exports, respectively.

Domestic demand for wood-based semi-finished products is very high, demonstrating how important the woodworking industry is the German economy. In 1997, consumption of particle board panels rose to 9.2 million m^3. Germany is also the leading producer of MDF, producing some 1.8 million m^3 in 1997, an increase of 46% since 1995. It is also worth pointing out that most of these products are used in the production of furniture.

Sweden is the leading producer and exporter of semi-finished wood products in Europe. Sawnwood accounts for about 88% of production and 94% of exports of the total semi-finished wood products in Sweden. Sawnwood production amounted to 14.4 million m^3, in 1996, with exports totalling 11.7 million m^3. In the production of wood-based panels and particle board Sweden produced some 970 thousand m^3 and 630 thousand m^3, respectively. However, imports are twice the level of exports in both these categories, covering about half the demand of domestic consumption. Both plywood and fibreboard production is relatively small. In 1996, Sweden imported woodworking machinery worth 44 million ECUs, mostly from Italy and Germany.

In the production of semi-finished wood products, ***Finland*** plays a major role as a producer and exporter of sawnwood. In 1996, Finland produced some 9.3 million m^3 of sawnwood and exported as much as 80% of this. Wood-based panels are also a very important

Figure 4.5 EU Exports of Sawnwood in 1996 (1000 m³)



export. In 1996, about 1.2 million m³ of the 1.5 million m³ of wood-based panel production was exported. Moreover, in the production of plywood, Finland is the leader in Europe, producing 869 thousand m³ and exporting as much as 794 thousand m³, in 1996. In fact, Finland has about 50% of the export market and over 30% of production of plywood in Europe. Although, the production of particle board and fibreboard is of less importance, in comparison with other semi-finished wood products, Finland nevertheless produces some 475 thousand m³, and about 120 thousand m³ of each, respectively, 50% of which are exported.

Austria is also a major producer of sawnwood and wood based panels. Although Austria is the fifth largest producer of sawnwood, it is the third largest exporter, and has an export ratio of around 53%, behind Sweden and Finland's export ratios of 81% and 76%, respectively. At the same time Austria also produce and export more wood-based panels than Sweden or Finland, and is one of the biggest exporters of particle boards. However, with the exception of plywood, wood-based panels are generally produced more in central Europe, since distance to markets is more of a factor for semi-finished 'bulky' products such as wood-based panels.

Nonetheless, the wood processing industries in Austria have become very competitive and very capital intensive, incorporating large-scale machinery investments. In fact, research has discovered the existence of a timber/paper-cluster in Austria, which is one of the most competitive industrial clusters in Austria. Moreover, it was found that most of the innovations stem from the R&D embodied in processing machinery, since very little R&D is carried out within the sector, demonstrating the importance of machinery. Box 4.1 provides some details of this forest cluster.

If we examine levels of productivity as measured by value-added per employee, we find that Austria and Sweden are amongst the countries with higher levels of productivity. However, in many instances sawmills in Sweden, Austria and Finland are built to achieve scale economies and so this should be no surprise. However, what may be of some surprise is that, according to this data, productivity is the highest in Ireland. But as the case study material will reveal in chapter 10, Ireland has received substantial amounts of foreign investment plus government incentives towards investment within Irish forest based industries. Levels of investments in machinery and equipment are also shown below and indeed these reveal that levels of productivity are linked to investments in machinery.

Figure 4.6 Productivity within Sawmilling and Planning of Wood in the EU

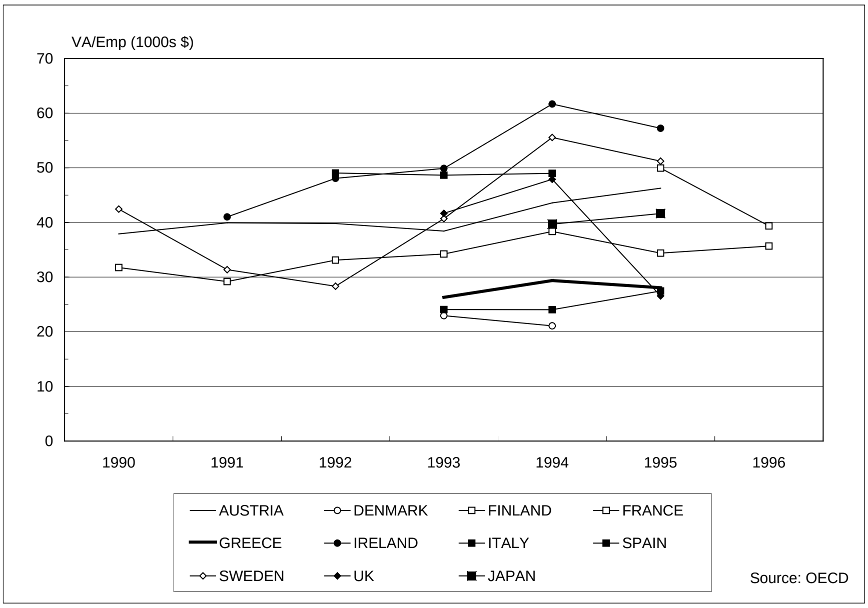
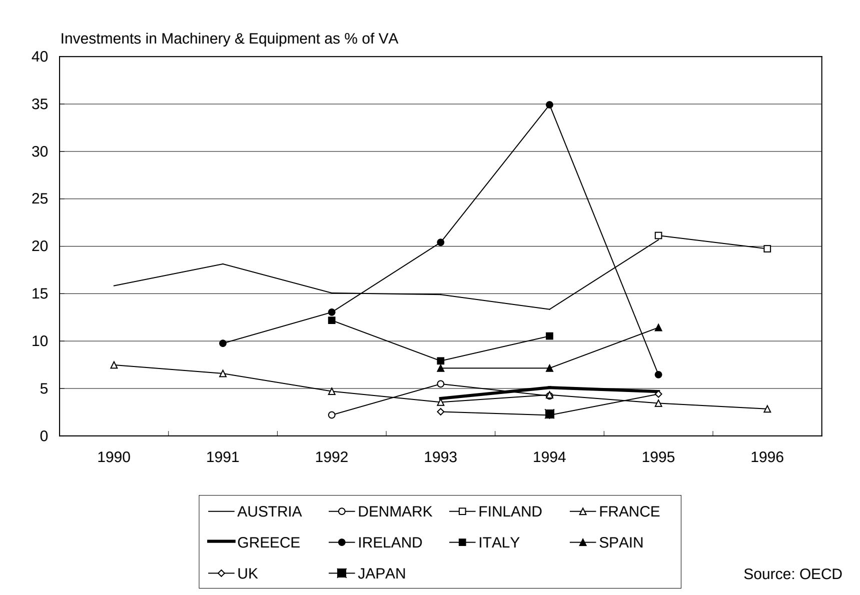


Figure 4.7 Investments in Sawmilling and Planning Machinery & Equipment



Box 4.1 The Austrian Forest Cluster [1]

'Already during the 1980s, some economists in Austria had proposed that, along with flexible specialisation of production, interaction among producers, services and public institutions was an increasingly important determinant of enterprises' competitiveness. Hence, following Porter, Austria began to look more systematically at the organisational mechanisms used to gain external (increasing) returns to scale focusing on the synergistic effects due to interaction networks and catalyst mechanisms'.

'At the same time, along with the recognition that traditional regional policies had partially failed the new models being adopted had given endogenous regional factors more weight. More emphasis was placed on production-related services, vertical integration and networking structures. Dynamic interaction within economic structures was recognised as a crucial factor for long term regional policies'.

---

1 Draws heavily on 'Austria: Industrial Clusters by Austrian Institute of Regional Studies and Spatial Planning, pp 159-166, in Networks of Enterprises and Local Development – competing and co-operating in local productive systems – OECD 1996.

'Austria was also undergoing a period of fundamental restructuring (especially amongst the state-owned industries sector), brought about by the globalisation of the economy, the opening up of the eastern borders to former communist countries and the acceleration of integration into the EU. The consequence of these changes was a shift in policy focus towards small and medium enterprises (SMEs), who received more assistance to offset their lack of capital resources, particularly in relation to innovations and export markets'.

The competitiveness of the entire Austrian industrial sector was profiled and grouped into clusters by product groups of the SITC foreign trade statistics using: market share, trade specialisation, comparative price advantage, export price level, spread of export markets. It was found that 46 product groups were not competitive in international markets (representing 7% of total Austrian exports of material goods); 135 product groups were of average competitiveness – able to maintain positions on international markets (80% of Austrian exports); and 13 product groups were identified as being highly competitive in international markets'.

'Based on this analysis it was concluded that in general, dynamic national clusters in Austria – dense networks of interrelated vertically integrated branches that are able to attain high levels of international competitiveness – are either very small are hardly exist as national clusters. They are instead embedded in international clusters. Numerous products manufactured in Austria are part of transnationally organised production branches (e.g. automotive industry) owned mainly by foreign enterprises managed according to global location strategies. However, the main exception to this was the *timber/paper industry* and the manufacture of railway transportation vehicles and tracks. Moreover, according to the Austrian Institute of Regional Studies and Spatial Planning, the success of these clusters reflects the fact that Austria's industry has managed to adapt especially well to the international division of labour'.

'Technology clusters were also researched whereby, Austrian companies were grouped by the criteria of their similarity to the structure of registered patents. Economic statistical cluster categories were not used in this case, but the technology clusters were created based on the exogenous statistical cluster analysis according to the basic units of the international patent classification system. Special attention was paid to ensure that similar patenting activity could be grouped to one area of technology, but the value and quantity of patents were not considered'.

'From this analysis, it was observed that there were five large areas of innovation. One of these five groups was 'construction and housing, construction materials, heating and ventilation, doors and windows and furniture fittings etc'. The results of the study showed that a significant number of highly specialised enterprises with intensive patenting activities exist. These companies do not actually seem to have any technological connections, at least not horizontally, with other enterprises'.

'There are no systematic studies on geographical or regional clusters in Austria yet available. Nevertheless it is well known that Austrian industries and the economy in general have a markedly geographical distribution pattern. If geographical clusters are understood to be the specific regional form of economic clusters, one can easily give an overview of the more important ones. The timber and paper cluster was one of the main ones listed'.

The Austrian Timber-Paper Cluster

'The heart of the timber and paper cluster consists of sawmills and wood processing facilities (construction, boards, packing, furniture, paper production, paper processing). The cluster also includes parts of the machinery industry such as firms making wood processing machines. Forestry is another branch which supplies basic resources. Other businesses which are connected to the cluster are printing shops and publishing firms, the furniture fittings industry, paints and adhesives, viscose fibres and design'.

Type of cluster	Location	Current Status
Timber and Paper	Upper foothills of the Alps and the area of Bruck/Graz in Styria	The dynamic of increasing returns as well as the minimum optimum sizes of enterprise have resulted in relatively large industrial units

The timber and paper cluster plays a special role within Austria's economy because it covers the entire production process and value-added from raw material to the distribution of the finished product. The timber-paper cluster is integrated with respect to processing technology, but not to organisation and ownership rights. Only a few of the production stages are interrelated. Most activities take place within numerous production and service enterprises, research institutions, sector associations and interest groups, which have complex competitive relations and supply interdependencies'.

'In 1991 the output value of the timber-paper cluster was 114 billion Sch accounting for almost 4% of the Austria's economic totalled 49 billion Sch. The export surplus is generated by the sawmill industry (8 billion Sch) and the paper industry (16 billion Sch)'.

'The internal core of the timber cluster (excluding forestry, printing, publishing and machinery) consisted of 10,700 enterprises in 1988 with roughly 125000 employees (i.e. 5.7% of employees of the entire trades and industries sector). The employment share was larger than the value-added share because productivity is below average on the whole, namely 80% in relation to the total sector of trades and industries. Labour productivity of paper production and board manufacturing was almost twice as high as the cluster's average. Wooden board manufacture and the paper industry are very capital intensive. The cluster's investment share was 18.1% in 1989. The cluster's average enterprise size was 12 employees per enterprise - but naturally this was above average in paper production'.

'The core area makes up a share of 9.5% of the total industrial production, measured by net production value. Including printing and the relevant machinery production, the cluster's total share of net production value reaches 14.4%. In comparison with Germany, the Austrian timber-paper cluster is more specialised in the relatively low priced segments of the basic materials sector. In recent years, the collapse of the east European markets, over capacities and price drops have led to considerable problems'.

'The timer-paper cluster as a whole is a sector in which little research and innovation occurs. This cluster spends only half of the industry's average on R&D. The relatively low level of innovative activities is also illustrated in the below average participation of the timber and paper industry in the relevant technology programmes of the federal government. The core of the timber and paper cluster acquires its technical advances from the outside, especially from the machinery industry, and for the paper branch, from the chemical industry. For this reason, the rate of technical advance is illustrated more clearly by investments in machines rather than by research efforts'.

'The internal flexibility of the cluster consists therefore in the innovative organisation of the production processes. For example new environmental standards and waste water reduction and treatment in the production of boards and paper were the remain the most important incentives for technical innovation. On the whole, the innovation system of the cluster may be described as relatively insignificant. Not only is little research carried out within the enterprises, but also the demands made on the Austrian Institute for

'Dramatic changes have taken place in the ownership structure of the Austrian Paper and cardboard industry in recent years. Domestic enterprises have been taken over by foreign companies. At the end of the 1980s, the share of foreign ownership in Austria's paper industry was 57% and this has probably risen further since then. Several Austrian firms have actively pursued internationalisation. The changes in ownership are probably one of the reasons for rising cellulose imports and stagnating domestic production. It is believed that the changes in ownership might be connected to the relative wage losses suffered, and the concentration on the lower segments of the product range'.

'In spite of serious problems, the timber-paper cluster on the whole is a technically well-equipped and internationally competitive sector of the Austrian economy. Increasing competition will lead to further concentrations and also to closures. The long-term opportunities of this cluster are based on the local availability of renewable raw materials and are generally assessed as positive'.

Industrial Clusters in Regional and SME Policy

'Empirical results show that industrial clusters i.e. dense networks of interrelated branches and companies, are able to attain high levels of international competitiveness. However, in Austria these clusters tend to be rather small or are embedded in international clusters of transnational enterprises. Analytical efforts in recent years are concentrated on identifying technologically or economically defined clusters within the Austrian production sector. Only in a few cases could the clusters identified be shown to be working as networks of firms, actively building on the strength of the cluster by using synergetic effects'.

'It must be noted that clustering does not necessarily have a positive effect on adaptability and therefore on the competitiveness of firms. The close relations between enterprises within a cluster can also lead to mutual confirmation of unrealistic views or to a particular vulnerability of the whole cluster if external (market) shocks occur. The case of 'old industrial areas' has often been quoted in this concept. In addition, the question of whether the cluster concept is not losing its value in view of the fact that we have entered an age of global data and information networking. This question should be given serious consideration: do important innovations continue to need informal contacts in order to be discovered, developed and marketed'.

have a markedly spatial dimension. This is particularly the case with training but also with the use of common organisations, be they in the field of R&D or in other extramural functions. Above all, the network of downstream suppliers does not seem to be spatially indifferent'.

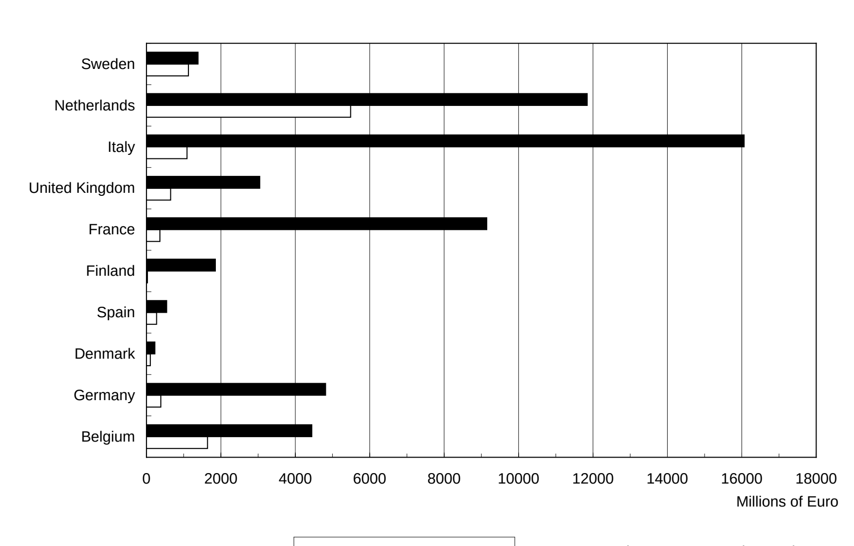
'Regional development policy in Austria therefore has built on clustering in at least three ways.

- First, regional policy has tried to build on regional strengths rather than on external impulses.
- Second, innovation, technology and incubator centres at a regional level have been used to foster the clustering of economic activities and to create external effects to reinforce regional development.
- Third, initiatives were taken recently in a number of regions to establish and run networks of enterprises, public institutions and social partner organisations. These networks have various aims. Some are geared to lobbying for the region or a state or on national level; others seek to generate regional profits from externalities. An area not yet fully developed is that of vocational training and joint R&D projects'.

'Regional policy measures which have a clear affinity to clusters have recently been described and proposed in the regional development programmes that the Austrian government prepared for many regions in the wake of the country's entry into the European Union and given its structural financial policy, In these development programmes, which cover a large proportion of the Austrian territory, the combination of SME policy with regional policy has been pursued to a very great extent'.

Italy is a significant producer of semi-finished wood products, many of which are used in the production of furniture. In 1996, it produced about 4 million m^3 of wood-based panels. Italy is the second largest European producer of fibreboard panels, after Germany. After Germany, France and Belgium, Italy is the fourth largest producer of particle board panels, producing some 2.2 million m³, in 1996. However, in 1997, this figure has grown by 25%, putting Italy into third place. Nonetheless, Italy remains a net im-

Figure 4.8 External Trade in Tropical Wood in 1996, (millions of Euro)



Source: The European Business Directory (quoting Eurostat)

porter of particle boards, with a large trade deficit in this area. Italy is also a substantial producer of MDF, producing 1.2 million m³, in 1997. In fact, Italy is the second largest producer of MDF with a share of about 20% of MDF production, its production has risen 27% since 1995.

It is also interesting to note that Italy is the largest importer of tropical wood. In 1996, it imported more than 16 billion Euro worth of tropical wood. However, this is more than likely related to Italy's furniture manufacturing industries, which are the largest exporters and second largest producers in the EU.

France is one of the leaders in the production of semi-finished wood products in Europe. In 1996, the production of sawnwood totalled 9.6 million m³, while that of wood-based panels grew to nearly 4.2 million m³. After Germany, France is the second largest producer of particle boards in Europe, producing some 3 million m³ of particle boards in 1996. At the same time, France was also one of the leading exporters of particle board. However, figures for 1997, reveal that particle board production and exports have grown in France, making it the second largest producer and third largest exporter in Europe. In the production of MDF, France produced 463 thousand m^3, in 1997, making it the fourth largest producer in Europe.

The ***UK*** semi-finished wood products market is the second largest in Europe. In 1996, sawnwood production totalled 2.3 million m^3, while that of wood-based panels was 2.5 million m^3. However, domestic supply can only satisfy a small part of the domestic demand. For example, imports of sawnwood amounted to 5.9 million m^3, while imports of wood-based panels were 2.7 million m^3. In addition, plywood is also an important semi-finished wood import, supplying 100% of the 1.1 million m^3 of consumption. This high import share also accounts for as much as 26% of the total plywood imports in Europe. A significant amount of particle board panels, 2.1 million m^3, are also imported, but domestic production, at 2.1 million m^3, covers about two-thirds of domestic consumption. In 1997, the UK produced some 430 thousand m^3 of MDF, an increase of 14% on 1995.

In the production of semi-finished wood products, ***Spain*** is an important producer of particle board panels, accounting for about 8% of European production. In 1996, Spain produced about 2 million m^3, satisfying almost all of domestic demand. In the production of MDF, Spain is the third largest producer in Europe, manufacturing some 472 thousand m^3 in 1997. Spain is also a large producer of wood-based panels, producing some 2.7 million m^3, in 1996, but with domestic consumption slightly higher imports result in a small trade deficit being recorded. Spain produced about 3.3 million m^3 of sawnwood, in 1996, however, as exports are very small and imports are around 1.6 million m^3, most of the production is domestic orientated.

Unlike the other Scandinavian countries, ***Denmark*** is a large importer of semi-finished wood products. For example, Denmark imported some 1.9 million m^3 of sawnwood to satisfy a domestic consumption of 2.4 million m^3. In the same way, Denmark imports most of its plywood and fibreboard consumed domestically. Imports of wood-based panels and particle board are also quite substantial, however, Denmark also produces about 430 thousand m^3 and 330 thousand m^3, of these products respectively. Denmark is also a large consumer of wood-based panels and particle board, consuming some 890 thousand m^3 and 580 thousand m^3, respectively.

However, as with Italy, Denmark is a large producer and exporter of wooden furniture, hence the large consumption of wood-based panels.

Summary Conclusions:

- The Mechanical wood sector is comprised 90% of SMEs with less than 20 employees
- Wood products manufactured within the mechanical wood sector are wide and varied and range from semi-finished to final products of low and high value-added
- The production of Sawnwood is mainly located in the countries where the largest forest resources are located, namely, Sweden, Germany, France, Finland, Austria and Spain. Most of the sawnwood produced in the EU is coniferous.
- The production of wood-based panels is widely distributed across Europe, with some non-traditional forest industry countries being amongst the largest producers (e.g. Belgium and Italy) although Germany is by far the largest producer.
- Different countries have specialised in the production and export of different types of wood-based panels – e.g Belgium/Luxembourg specialise in particle board and are the biggest exporters in the EU; Finland specialises in plywood, Germany specialises in veneered panels and is also the biggest exporter of MDF.
- Levels of productivity within the mechanical wood processing industries are related to the levels of investment in machinery and equipment.
- A competitive forest cluster, which is based on wood processing industries, has been detected in Austria in previous research.
- It is believed that technological advances within the wood processing industries are derived from R&D embodied in processing machinery and equipment and hence investments in machinery and equipment are more representative of the rate of technological advancemnt, than by R&D.
- Regional development in Austria has been based on the strengths of existing clusters

- A significant amount of tropical wood is imported by countries engaged in the manufacture of furniture and related industries

Chapter 5. Wood Furniture Industry

5.1 The European Wood Furniture Industry[1]

Western European furniture production accounts for around 45% of the world supply. Asia countries (Japan, China and South East Asia), account for another 25%, whilst North America makes up a further 19%. According to CSIL, 'in comparison to other productive areas, the furniture sector in Europe can currently be described as a mature market, showing little potential for growth and not very dynamic'. However the European wood furniture sector can also be

Table 5.1 World Furniture Trade in 1996 – Top twenty Exporters and Importers

Country	Exports	Country	Imports
Italy	9038	United States	10200
Germany	4784	**Germany**	6846
United States	4086	Japan	3453
Canada	3112	**France**	3378
France	2198	**United Kingdom**	2209
Denmark	2024	Canada	1951
China	1892	**Belgium**	1859
Taiwan	1736	**Netherlands**	1841
Belgium	1635	Switzerland	1826
Poland	1617	**Austria**	1596
United Kingdom	1552	Russian Federation	1244
Sweden	1441	Hong Kong	1055
Mexico	1359	**Sweden**	751
Spain	1269	**Italy**	740
Malaysia	1119	Norway	651
Austria	1041	**Spain**	630
Netherlands	971	Mexico	582
Indonesia	953	Singapore	512
Hong Kong	789	**Denmark**	473
Switzerland	766	Australia	423

Source: CSIL.

1 This section draws heavily from: 'The Furniture Industry in the European Union, CSIL (Centro Studi Industria Leggera, 1999).

seen as a very dynamic entity capable of competing successfully in a tough market.

In 1997, furniture production in the European Union amounted to 62.7 billion ECUs. Germany is the largest producer, accounting for about 28% of production. Italy is the next largest producer followed by France and the UK. About one-third of EU furniture production (19.8 billion ECUs) is exported, whilst imports are less, (15.5 billion ECUs) hence the EU furniture industry provides a positive trade surplus to the EU.

Furniture consumption in the EU was around 58.4 billion ECUs, in 1997. Germany is the biggest consumer of furniture, accounting for one-third of furniture consumption in the EU. Italy is the second largest consumer followed by France and the UK.

The top two furniture products, upholstered and kitchen furniture account for about 8.5 billion ECUs each of furniture consumption. Office furniture follows closely with a consumption of around 7 billion ECUs. Other furniture products make up the remainder of consumption.

Table 5.2 The Furniture Industry in Europe – Production and Trade in 1997 (million ECUs)

Country	Production	Consumption	Imports	Exports	*Export Ratio %
Germany	**17600**	**19276**	**4855**	**3180**	18,0
Italy	**15381**	**8552**	516	**7344**	**47,7**
France	**6689**	**7542**	**2362**	1509	22,6
UK	**6521**	**7363**	**1869**	1027	15,7
Spain	3857	**3251**	441	1047	27,1
Denmark	2153	1004	474	**1624**	**75,4**
Netherlands	2067	**2741**	**1221**	547	26,5
Austria	1839	2160	1086	766	41,7
Belgium #	1784	2149	**1489**	1124	**63,0**
Sweden	1507	1064	543	986	**65,4**
Portugal	1111	1045	187	253	22,8
Greece	1072	1205	160	27	2,5
Finland	828	754	164	238	28,7
Ireland	266	327	163	102	38,3
Total	**62675**	**58433**	**15530**	**19774**	**31.6**

Source: CSIL, with ETLA calculations, # including Luxembourg.
* Export Ratio = [Exports/Production] x 100.

Over the past two decades, European demographic trends have remained relatively unchanged in many respects. Consequently, the house building booms of the past, have all but disappeared. This now means that furniture purchases are competing with purchases of other goods and services, and tend to lose out.

Furniture imports into the EU totalled some 15,5 billion ECUs, in 1997, with Germany absorbing more than 30% of this. France was the second largest importer of furniture imports. The UK and Belgium are also major markets for imports. In fact, Germany, France, the UK, Belgium, the Netherlands, Switzerland and Austria are among the top ten furniture importers in the world.

Of the 62.7 billion ECUs of furniture produced in the EU, about 15% is upholstered furniture, 15% is kitchen, 13% is Office, and the remaining 57% is other types of furniture. Other furniture is comprised of home furniture (beds, living rooms, tables), and furniture for hotels, shops etc.

EU countries play a major role in world furniture trade. Italy, Germany, France and Denmark are amongst the top ten furniture

Table 5.3 The Furniture Sector in Europe 1997 - by Product (million ECUs)

Country	Up-holstered	Kitchen	Office	Other furniture	Total
Germany	2252	3415	2343	9590	17600
Italy	3014	1911	1340	9115	15381
France	855	815	808	4210	6689
UK	1187	941	1362	3031	6521
Spain	586	563	361	2347	3857
Denmark	344	181	223	1406	2153
Netherlands	176	248	372	1270	2067
Austria	118	349	198	1175	1839
Belgium #	329	188	197	1071	1784
Sweden	218	351	306	631	1507
Portugal	141	16	116	838	1111
Greece	59	36	85	892	1072
Finland	168	162	99	399	828
Ireland	64	41	29	132	266
Total	**9511**	**9217**	**7839**	**36107**	**62675**

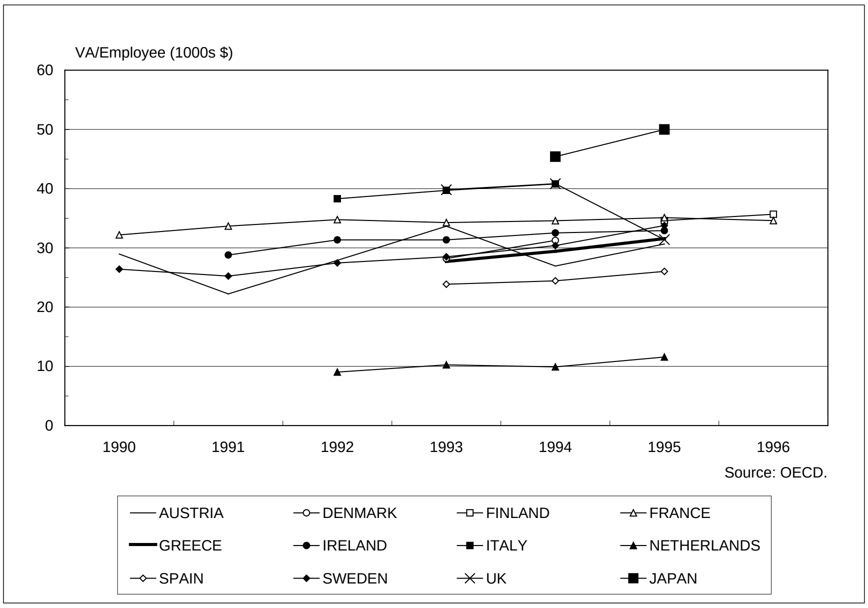
Source: CSIL, # including Luxembourg.

exporters in the world. The biggest exporter is Italy, accounting for more than 37% of EU furniture exports. Although Italy is the second largest consumer of furniture in the EU, almost half of its furniture production is still exported. This, together with the fact that Italy only imports a mere 3% of the EU furniture imports, demonstrates Italy's strength. *(See sections 5.2.3 The Italian Furniture Industry, and 5.2.4 Italian Furniture Districts).*

Denmark is the sixth largest producer of furniture in the EU with a production value of 2.5 billion ECUs in 1997. Denmark has the highest export ratio of all the EU countries, exporting some 75% of its production. As with Italy, the Danish wood furniture industry is a story of success, and which has been sustained for many years.

Referring to levels of productivity (as measured by value added per employee), it would appear that Italian firms are amongst the most productive. However, Danish firms are not amongst the most productive furniture manufacturers. So how is Denmark able to export such as large proportion of its production. In fact, this has been the focus of much research. Competitive advantage also derives from other intangible factors, many of which are unique

Figure 5.1 Productivity within the Furniture Industry

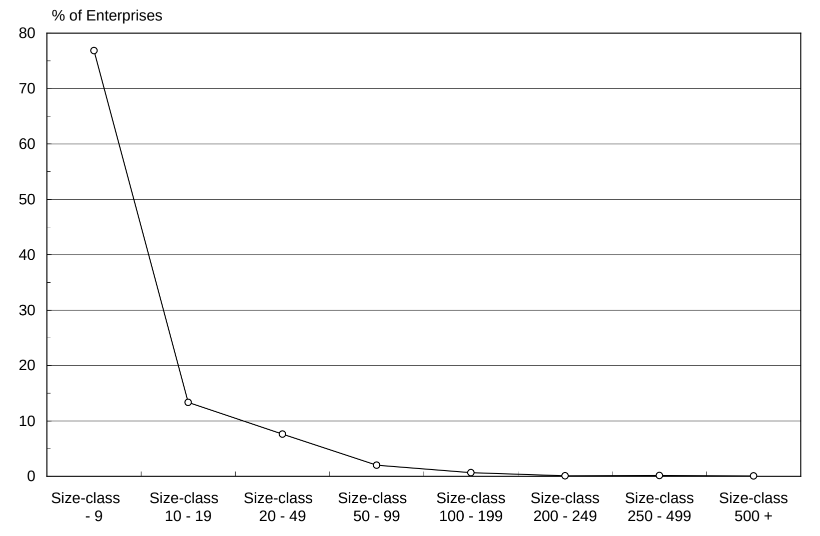


to certain regions or even districts (*See box 5.5 - The case of the wooden furniture industry in Denmark*).

The European furniture industry is characterised by the large proportion of small and medium sized enterprises (SMEs). For example, SMEs with less than 20 employees account for 90% of wooden furniture enterprises. Moreover, SMEs account for 90% of employment and more than 80% of the total value added in wooden furniture. Although most of the furniture enterprises are often family-run, recent trends point to an increase in listings on the stock exchange. In comparison with competitors in the United States and Japan, the European furniture industry is less concentrated. Moreover, low levels of supply concentration are not uniform in Europe. In southern Europe, particularly Spain and Italy, the supply is extremely fragmented, but in Germany and to a lesser extent in the UK and France, there is a much greater concentration of supply.

Over the past few years, there has been a decline in international furniture trade within Western Europe. In contrast, there has been a strong growth in trade flows to and from Eastern Europe. Western European furniture exports to Eastern Europe rose from 8% in 1996,

Figure 5.2 Enterprise structure of the EU Wooden furniture industry



Source: Eurostat.

Table 5.4 Major Furniture Producers in Western Europe 1997

Company	Country	Main Sector	Production (mill ECU)	% of total supply
Schieder	Germany	home, upholstered, office	1094	1,7
Welle	Germany	home, upholst., kitchen, office	894	1,4
Natuzzi	Italy	Upholstered	553	0,9
Samas Group	Netherlands	Office	508	0,8
Alno	Germany	Kitchen	455	0,7
Nolte Mobel Group	Germany	Home, Kitchen, Upholstered	439	0,7
Steelcase Strafor	France	Office	429	0,7
Steinhoff	Germany	Upholstered, Home	408	0,6
Wellmann Group	Germany	Kitchen	391	0,6
Nobilia	Germany	Kitchen	371	0,6
Christie Tyler	UK	Upholstered	365	0,6
Spring Ram	UK	Home, Upholstered, Kitchen	337	0,5
Magnet	UK	Kitchen, Home	335	0,5
Silentnight	UK	Beds, Home	332	0,5
Parisot	France	Home, Upholstered, Kitchen	300	0,5
Hukla	Germany	Upholstered, Beds	266	0,4
Poggenpohl Group	Germany	Kitchen	250	0,4
Hülsta	Germany	Home, Office	244	0,4
Haworth Europe	USA	Office	242	0,4
Tvilum Invest	Denmark	Home	228	0,4
Kruse & Meinert group	Germany	Kitchen	223	0,3
Skandinavisk Industries	Denmark	Office	218	0,3
Ahrend Group	Netherlands	Office	211	0,3
König & Neurath group	Germany	Office	208	0,3
Isku	Finland	Office, Kitchen	205	0,3
Cauval	France	Upholstered, Kitchen, Beds	200	0,3
Lista Holding	Switzerland	Office	185	0,3
Hygena & Schreiber	UK	Home, Kitchen, Bathroom	184	0,3
Kinnarps	Sweden	Office	180	0,3
Snaidero	Italy	Kitchen	166	0,3
TFM – Tibro Forenade	Sweden	Home, Upholstered, Contract	162	0,3
Klose	Germany	Home, Upholstered	153	0,2
Walker & Homer	UK	Upholstered	146	0,2
Mostoles Industrial	Spain	Home, Kitchen	140	0,2
Airsprung	UK	Beds, Upholstered	134	0,2
Cornwell Parker	UK	Home, Upholstered	133	0,2
Valois Habitat	France	Kitchen, Home, Bathroom	133	0,2
DLW Group	Germany	Office	132	0,2

Ekornes	Norway	Upholstered, Home	131	0,2
Habemat	Germany	Kitchen	130	0,2
Molteni Group	Italy	Home, Office, Kitchen	130	0,2
Doimo Group	Italy	Home, Upholstered	129	0,2
Bernstein Group	UK	Kitchen, Home	125	0,2
Häcker Kuchen	Germany	Kitchen	123	0,2
Bauformat & Burger	Germany	Kitchen	123	0,2
Martela Group	Finland	Office	119	0,2
Dauphin Holding	Germany	Office	117	0,2
Wade Group	UK	Upholstered	116	0,2
EFG Group	Sweden	Office	116	0,2
Roset	France	Upholstered, Home	113	0,2
Total top 50	-	-	13347	20,8
Others	-	-	*50733*	*79,2*
TOTAL	**-**	**-**	**64079**	**100,0**

Source: CSIL.

to 10% in 1997. However, imports from Eastern Europe increased by 15%. At the same time, Far Eastern producers are also increasing their presence on European markets. Imports of furniture from the Far East grew by 34% between 1996 and 1997.

A list of the major furniture manufacturers in Europe is provided in table 5.4. In addition, table 5.5 is provided to give a general idea

Table 5.5 Selection of Leading European Wood *and* Furniture Groups in 1997

Company	Country	Turnover (millions of Euro)
Rugby Group	UK	1794
Strafor Facom	France	1517
MFI	UK	1258
Lapeyre	France	937
DLW	Germany	818
Samas Groep	Netherlands	786
Skane-Gripen	Sweden	631
Alno	Germany	540
Spring Ram	UK	462
DFS	UK	381
Rubicon	UK	346
Silent Night	UK	311
Cauval Industries	France	310
Famco	UK	263
Strategem Group	UK	235
Tableros de Fibras	Spain	221

Source: The European Business Directory.

of the type of turnover which is generated by companies manufacturing wood *and* furniture products. On this list and the previous list, it is interesting to note that Germany, France, the UK, Italy, and the Netherlands tend to dominate the industry, at least as far as large enterprises are concerned.

5.2 Furniture manufacturing companies and districts in the EU

The furniture industry, belongs to a sector of production which can be termed as a 'supplier-dominated' industry. This means that innovations are mainly process innovations, embodied in capital equipment and intermediate inputs originated by firms whose principal activity is outside these sectors. For supplier dominated sectors, like the furniture industry, the process of innovation is primarily a process of diffusion of best practice capital goods and innovative intermediate inputs while in-house R&D expenditures and other endogenously generated opportunities are rather limited.

In this section, we have adopted two approaches to show how the furniture industry is strongly connected to the forest-wood chain, and why it is considered a key element of the forest-based and related industries. Firstly, we describe the production of semi-finished wood products and then several major furniture companies in a selection of EU countries. Secondly, we adopt a case study approach to demonstrate how the wood furniture industry is concentrated in many regions of Europe, within industrial districts, and which essentially behave as clusters of industries.

In fact, it is evident that the wood furniture industry is very dynamic and for the most part, very competitive. In many cases, the source of competitiveness is not due to machinery, R&D, or technology, but more on specialisation and localisation of intangible assets (such as trust and business culture etc, which have developed over long periods of time). As a consequence, these sources of competitive advantage may not be imitatable, or reproduced elsewhere.

5.2.1 Germany

Germany is the biggest furniture producer in the EU, and by far the largest consumer. It is the second largest exporter of furniture, after Italy. At the same time it is also the largest importer of furniture in Europe and the second largest market for furniture imports in the world, the US being the largest.

Germany is the most important producer of wood-based semi-finished products in Western Europe. It is the largest producer of particle board panels, and one of the main producers of fibre-board panels. Germany is second only to Sweden in the production of sawnwood and to Finland in the production of plywood.

Germany is a net importer of semi-finished wood products, such as sawnwood, wood-based panels, plywood, particle board. However, Germany is also the leading European exporter of veneered panels and the leading producer of MDF. Domestic demand for wood-based semi-finished products is very high, demonstrating how important the woodworking industry is the German economy. It is also worth pointing out that most of these products are used in the production of furniture.

Germany (together with Italy) is also one the world's leading producers and exporters of woodworking machinery (see chapter 8), again it is worth making the connection between the large domestic base of production and related machine building industries.[2] In 1996, exports were more than 1.2 million ECUs. The main export markets are; the US, Austria, Belgium and Italy, which is also one of Germany's major suppliers, of woodworking machinery.

In 1997, furniture manufacturing in Germany employed some 170,000 people. As in many other European countries, employment has been on the decrease over recent years. Although one of the main causes for this contraction can be attributed to the overall decline of employment in manufacturing industries, there has also been a noticeable decentralisation of production units amongst the larger companies such as Schieder, Welle, Alno etc. German producers have been keen to take advantage of the privatisation of the large Polish furniture factories to acquire majority

---

[2] The Malaysian Timber Council organised a mission to Germany to expose Malaysian manufacturers to the latest developments in wood processing technology. The visit was also to promote technological improvements in wood-based industry. Delegates visited selected German wood-working industries to see the application of modern machinery and the operation of automated production systems. Source: New Straits Times, Malaysia, 30/3/1999.

interests and to transfer their production lines to Poland, targeted at low-middle market ranges.

Within the German furniture industry, large industrial groups operating in numerous segments and in different price ranges, predominate. Common tendencies among these groups are strong productive decentralisation towards lower labour cost countries.

In the past, purchasing associations were the dominant distributor of furniture. However, in recent years, purchasing associations (consortia of independent retailers) have been losing their share, whilst large showrooms have been gaining in share. The growth in large showrooms is apparently linked to the trend towards lower prices on the market and to difficulties independent retailers are experiencing in tackling this problem.

Sales in knocked-down furniture increased by some 50% over three years, the market share is now around 25%. This growth is seen as a significant tendency towards contained prices on the market. The DIY channel has also shown strong growth over the recent years.

The German wood and furniture industry reported a turnover of DM 77 billion in 1998. The furniture industry accounted for DM 43 billion and was boosted by sales of chairs and kitchen furniture. The furniture industry exported goods worth DM 7.4 billion in 1998, and imported DM 14.8 billion.[3] About 65% of German exports are to the EU, (the Netherlands, Austria, Switzerland and Belgium). The Netherlands is the main destination for German furniture exports.

Between 1993 and 1997, German furniture exports to eastern Europe have grown from 7% of total furniture exports in 1993, to 11% in 1997. The Czech Republic and Russia were responsible for the largest increases in exports to eastern Europe. German exports to the Czech Republic were worth 113 ECUs in 1997, while those to Russia were worth 100 million ECUs.

In terms of furniture imports, Germany absorbed some 4.9 billion ECUs in 1997. The EU is the main supplier accounting for 51% of imports, followed by Eastern Europe with 31%. Italy being the main supplier of furniture imports to Germany. However, Poland, the Czech Republic, South Africa and Slovenia are becoming

3 Handelsblatt, 31/3/1999.

more important. Poland is the second largest supplier of German furniture imports. Furniture imports from Poland, are primarily from German producers who are operating in Poland. Nonetheless Poland's share has grown rapidly at the expense Denmark.

Some of the top producers of furniture in Germany are; Schieder, Welle, Alno, Nolte Möbel Group, Steinhoff, Wellmann Group, Nobilia, Hukla, Poggenpohl Group, Hülsta and Kruse & Meinert, some of which are discussed below.

In 1997, **Schieder** was the leading German producer of furniture. With a turnover of 1094 million ECUs, accounting for 6.2% of the production in Germany, it has remained the leader for several years. Eastern European markets are a substantial contributor to the company's sales. About 25% of its production is from abroad in Poland, Hungary, the Czech Republic and Slovenia, where annual turnover has growth rates in double figures. Schieder has set up a number of production plants abroad, especially in Eastern Europe, employing more than 7,000 of its total 10,000 workforce. In 1998, it was expected to open up a production plant in Russia.

Welle, is the second largest major furniture producer in Germany, it has a turnover of 894 million ECUs, and holds about 5.1% of the German market. Welle operates in each of the main furniture segments; home, upholstered, kitchen, and office, via its group of companies. 3K produces kit furniture, Leicht and Alsa, kitchens, and Rolf Benz, Himolla and Nordica, upholstered. Welle, has also relocated its production to nearby Poland – especially lower range upholstered furniture. Penetration of the Polish market has been assisted by the acquisition of local companies. For example, KFM, a Polish firm producing wood furniture, was acquired in 1997.

In kitchen furniture, the leading German producer is **Alno**, occupying premier status for the past twenty years but more recently in Europe. In 1997, the company had a turnover of 455 million ECUs.

In addition to Alno, the **Wellmann Group** has also become one of the largest groups in kitchen furniture. In 1997, the company's turnover amounted to 390 million ECUs. Some of the company's products have also achieved success through significant developments in sales of kit furniture and to important increases in the export markets The Wellmann Group has 8 factories, with an output of 230,000 kitchens per year, and employs over 2,700. The company has had significant growth. In 1978, it employed about 500 and had a turnover of 96 million ECUs, i.e. less than one-quarter of its present size.

Haworth Inc., is one of the world's largest designers and manufacturers of office furniture and seating, and is based in the USA. The company has recently expanded its European products, distribution and customer base by acquiring several furniture companies in Germany and Spain. These include DLW, Dyes, Nestler, Roder and Art Collection in Germany and Kemen in Spain. Combined the five companies had more than 900 employees with sales of over 100 million Euros, in 1998. The acquisition puts Haworth among the top three furniture manufacturers in Europe, giving it a major leadership position in

Germany (Europe's largest office furniture market), and making it the largest office furniture producer in Spain.[4]

Homag AG, the leading systems provider in the wood and furniture industry from Germany, is planning to go public by being listed on the Frankfurt and Stuttgart stock exchanges. In 1998, Homag had a turnover of DM 800 million.[5]

WFM furniture factory (Wielkopolskie Fabryki Mebli SA) of Poland, has signed a 12 million DM agreement on the sale of solid wood bedroom furniture to a German company. The furniture design-pattern is from the German firm Pro Night, a long term partner of the Polish company. Export sales account for about two-thirds of WFM's revenues, most of which are to Germany.[6]

5.2.2 Italy

Italy is Europe's second largest producer of furniture, after Germany. In 1997, furniture production amounted to 15.4 billion ECUs. Italy is also the second largest consumer of furniture in Europe and is also the world's leading exporter of furniture. In 1997, it exported about 7.3 billion ECUs of furniture, (about 50% of its production). Imports of furniture represent only 6% of the domestic furniture market in Italy.

Italy is a significant producer of semi-finished wood products, particularly wood-based panels, many of which are used in the production of furniture. Italy is the second largest European producer of fibreboard panels, and the third largest producer of particle board panels. Nonetheless, Italy remains a net importer of particle boards, with a large trade deficit in this area. Italy is the second largest producer of MDF with a share of about 20% of MDF production, its production has risen 27% since 1995.

Italy is also one of the world leaders in the manufacture of wood-working machinery (see chapter 8). In 1996, it exported some 1077 million ECUs worth of woodworking machinery. The main destinations for Italian woodworking machinery are Germany, the US and France.

The furniture industry in Italy employs some 215,000 workers, and consists of about 36,000 companies. 'Italy has more than

---

4 PR Newswire, 17/5/1999.
5 Borsen-Zeitung, Germany, 11/2/1999.
6 Polish Press Agency, 19/7/1999.

110,000 SMEs active in the sector of timber and furniture, and 10,000 of them have ten or more employees.[7]

Furniture distribution in Italy is very fragmented. There are some 22,000 sales outlets, and as many retailers, employing some 66,000 people.

In terms of furniture trade, more than half of Italy's exports is exported to the EU, and in particular to Germany, France and the UK. However, the United States is also Italy's second largest outlet market for furniture exports. Russia has also become an important export market of Italy. In 1997, Italian exports to Russia were worth some 400 million ECUs. In fact, Eastern European markets are becoming the emerging markets for Italian producers. Exports to this area have increased at an annual rate of 43% over the past five years.

Furniture imports to Italy are provided mainly by France and Germany. Increasing shares of furniture imports are also provided by Spain, Switzerland and Austria, with Spain's exports to Italy growing rapidly. At the same time, imports from Eastern Europe have also increased, but these are still much less significant than exports. Major suppliers are Romania, Slovenia and Poland.

The top furniture producers in Italy are; Natuzzi, Snaidero, Molteni Gruppo, Doimo Gruppo, Scavolini, B&B, San Giacomo, Atma, Chateau D'Ax, Veneta Cucine and Clligaris, to name but a few.

Snaidero is the second largest furniture producer in Italy behind Natuzzi and it is active in the kitchen furniture and trading segments. In 1997, it had a turnover of 166 million ECUs, accounting for 1.1% of furniture production in Italy. Other leading kitchen furniture specialists include Scavolini, Veneta Cucini and Lube.

There is also a number of leading companies operating in a number of segments. The **Molteni group** operates in the top range – Molteni SpA produces home furniture and exports 50% of its produce, whilst Dada produces kitchen furniture and Uniform office furniture. The group also has a joint interest in Citterio. In total, the group employs about 600 people and has 5 production plants.

The **Doimo group** operates through 12 companies in the home furniture, upholstered and kitchen furniture segments. The **B&B group** is active in home, upholstered and community furniture (hotels, offices, ships) segments. B&B group has 4 production plants and employs about 450 persons.

---

7 Antara – The Indonesian National News Agency, 3/3/1999.

Other multi-product companies include San Giacomo, Florida, Petrovitch and Berloni operating in the kitchen and bathroom segments as well as in the office segment through the subsidiary Iterby. In the office furniture segment specialists include Las Mobili, Castelli (Haworth Group), DE-TA, and Faram. Specialising in chairs and tables are Calligaris and Grup Sedia.

The Italian furniture industry is active in expanding into other regions, to gain access to new markets, raw materials and production facilities. For example, 'delegations of Italian businessmen have recently visited Malaysia to forge collaboration in the timber, woodworking and furniture industries. This also included the transfer of technology between Italian and Malaysian companies. The Italians are keen on the ancillary and supporting industries such as machine tools, machinery and equipment.'[8] This demonstrates how important European expertise in supporting industries has become to the wood-based industries.

5.2.3 The Italian Furniture Industry[9]

With about 220,000 employees, and 36,000 furniture firms (78% of which are small-sized, the remainder, 22%, are industrial), furniture production is without a doubt a very important Italian industry. Today, the furniture industry is in fact the industry with the third largest impact on the Italian export balance, after the mechanical and fashion industries.

The success of Italian furniture firms may be ascribed to their ability to innovate products and processes. Due to these competencies and high quality products, achieved partly through utilisation of highly skilled workers, the Italian furniture firms have been able to create a strong competitive advantage on export markets. For example between 1989-95, the Italian furniture firms had an average export rate of 53%. Italy has a strong tradition for furniture production. Modes of production include both mass-production and tailor-made production.

Italian furniture production is highly localised, as the bulk of production takes place in industrial districts in regions like Veneto, Lombardia, Marche, Toscana, Campania, and Basilicata. Only few furniture producers exist outside of these regions, and even fewer have not externalised some activities to other Italian, possibly lo-

---

8 The Star, Malaysia, 28/4/1999.

9 Draws heavily from: External economies and value net strategies in Italian furniture districts – Gabriella Lojacono and Mark Lorenzen, in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 71-91, Handleshojskolens Forlag, 1998.

cal, producers. It is very difficult to generalise concerning an Italian furniture district in the above regions, because the districts are structurally very different. All Italian industrial districts (whether furniture-producing or not) contain both artisanal and industrial firms – but of different ages, sizes, and export shares.

5.2.4 Italian Furniture Districts

There are some districts where the firms all produce the same product, and have internalised most of the of the value chain activities; there are other districts where specialised (legally and financially autonomous) production units focus only on one phase within the value chain. In the latter case, it is common that a relatively large firm (a district leader) co-ordinates all activities of the value chain, reserving for itself only design, assembly and marketing of the finished products. Many export markets for industrial districts have a high emphasis on design, and the typical district firm has a greater success probability on mature markets characterised by non-aggressive and fragmented distribution.

Italian furniture production is highly localised and is recognised as a classic example of the industrial district. In such districts, most value chain activities (product cycle phases) in the production of furniture are performed through particular division of labour amongst local firms. Thus, the single firms achieve competitiveness

Table 5.6 Italian Furniture Production - Specialised Areas

Area	No of Firms	Employees	Turnover (bill Lire)	Export (bill Lire)	Degree of Exports
Alto-Livenza	400	6000	2000	600	17.5
Bassano	500	3500	1000	175	17.5
Brianza	9100	30000	5000	900	18.0
- Cantu	1525	9427	-	-	-
- Lissone	2759	15226	-	-	-
Cerea-Bovolone	3000	15000	1300	120	9.2
Manzano	800	2500	1250	812	65.0
Matera	80	2120	400	80	12.5
Pesaro	1000	10000	1600	200	12.5
Poggibonsi	396	2700	-	40	-

through reaping external economies. However, there are differences between industrial districts in terms of size, specialisation, and degree of concentration, and the very nature of the local firm's utilisation of external economies such as localised production of furniture are performed through particular division of labour amongst local firms. Thus, the single firms achieve competitiveness through reaping external economies. However, there are differences between industrial districts in terms of size, specialisation, and degree of concentration, and the very nature of the local firm's utilisation of external economies such as localised production knowledge, skills and localised learning. Hence there is no single 'district model' of external economies.

The specialisation and size organisation within the various Italian furniture districts has co-evolved closely with strategies of internalisation and externalisation applied by the local furniture producers. They achieve external economies in various ways. They utilise the localised production factors and couple with localised institutions differently. Thus, there are significant differences in the degree to which the low-tech competitiveness of the Italian furniture producers depend on localised capabilities, skills and learning.

Localised learning is a fragile trait, depending on both local and global (market) conditions. The Italian furniture industry has been notoriously strong on the export markets for decades, but during recent years, the Italian furniture producers have, as have many other European furniture producers, come under competitive pressure. Apart from price competition from low-cost producing countries, the pressure has arisen as a result of significant demand changes and growing concentration within distribution. Correspondingly, during recent years, there has been a concentration within the Italian furniture industry.

Box 5.1 The Evolution of a Furniture Industrial District – The Case of Poggibonsi in Tuscany[10]

The furniture industry is widespread throughout Italy. Despite its coverage, the Italian furniture industry does however tend to be

number of Industrial furniture districts have been identified. Poggibonsi industrial district is the centre of one of the territorial

10 Draws heavily on: The evolution of a furniture industrial district – Giacomo Bambi, in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 59-67, Handleshojskolens Forlag, 1998.

clusters of the Italian furniture industry. Other main clusters, which have been identified, are the Pesaro area (located in the Marche region), in Brianza (Lombardy), and in some other districts in Veneto in Northern Italy.

The Poggibonsi district (also called Alta Valdelsa) is situated in the middle of Tuscany, near Florence. It was formed in the first years after the second world war. Considerable domestic demand offered an opportunity of development for the pre-existing nuclei of industry and wide-spread local craftsmanship. The localised furniture industry experienced significant growth during the 1950s and 1960s, based on the increasing number of new small firms, which were sustained by immigration (initially from the nearby countryside, then later from the southern Italian regions).

The small and medium firms were independent end-product companies specialising in products or subcontractors specialising in phases of the furniture production process. A large number of these firms were established by ex-share-croppers and then by ex-workers.

By the early 1970s, the localised wood and furniture industry constituted the primary industry of the district. At the same time, other localised sub-sectors, considered complementary and subsidiary to the furniture industry, developed around this line of activity.

Complementary sectors of the mechanical industry included the production of woodworking machinery and tools, metal fittings for furniture, whilst the production of plane glass mounted onto wooden boards was also considered a supporting branch of industry. Furthermore, around the localised furniture industry other connected activities were developed: marble transforming, painting, glue & varnish, specialised printing works, industrial photographic, furniture designing studios and transportation companies.

The core of the local principal industry was characterised by a set of final companies of a relatively larger size (70-100 employees), each performing all the fundamental phases of the furniture cycle, and mostly producing ‘blocked’ bedrooms, living-rooms and kitchens. In spite of the presence of these quasi-vertically integrated firms, the Poggibonsi system was showing the typical characteristic of an industrial district because of a large presence of independent artisans crafting customised products and operations

At the beginning of the 1990s, the Poggibonsi furniture system employed 2,700 workers, equal to 27% of those involved in the manufacturing and almost 12% of total employment in the district. There were almost 400 plants (the furniture industry had 259 plants and 2109 employees; the wood industry 137 and 591 respectively); hence the average size of the firms was about 7 workers per firm.

The structure of firms is characterised by a nucleus of final small and medium firms, which now have a less important role in the district than in the past. The main activities of the 'final firms' are to produce and sell finished pieces of furniture by means of specialised marketing networks. 'Subcontractors' carryout processing phases for both finished and semi-finished furniture products (they manufacture either finished furniture for other businesses or components and semi-finished goods). A great number of subcontractors carry out the major part of the production process, but most of them are very small artisan firms.

The Products and the Market

The Poggibonsi furniture system does not have a strong product specialisation. In fact there is a certain differentiation of products offered by the final firms: bathroom, kitchen, bed room and living room furniture, lounge and upholstered furniture, chairs and tables, and reproduction of antique-style furniture. The production is medium-high quality, design-intensive and utilises high quality raw wood.

Very rarely do the products of Poggibonsi localised industry have standardised characteristics typical of mass production: no firm produces large series on a stock basis, but only order by order, with a quick delivery time. Very often, a large part of furniture is 'customised'. Generally speaking, the final firms survive by putting themselves in high niches of the market. Their competitive advantages can be found in quality (i.e. utilising solid wood or special design) as well as customer services.

The most important final market for the Poggibonsi district is the domestic market. The lack of export-oriented firms in a high competitive advantage sector for Italy, such as wooden furniture, can partially be explained by the large success obtained during the 1960s in the domestic market that drove the entrepreneurs to neglect markets abroad.

A large number of the final firms now have a de-verticalised production cycle. Only the most strategic functions are performed inside these firms: i.e. designing, the last phases of finishing and marketing, while for the most part manufacturing is done by subcontractors. Therefore the stock of woodworking machines is quite small in final firms. However, investments are made in the painting phase, which is often performed internally in these firms, with flexible plants. Here better control of quality is necessary to maintain a competitive advantage.

Sub-contractors are specialised in phases of the furniture production process (i.e boards processing, painting, finished doors, incised elements, solid wood processing), but there are units producing finished furniture for end-market firms which only design and sell these products. The main phases of the wooden furniture production process are carried out by subcontractors, and are: manufacturing of boards; cutting and gauging of boards; veneering and pressing of boards; squaring, flanging and drilling boards (as per designs); assembling components and marketing.

Relationships between firms within the district

Materials such as solid wooded boards, chipboard, medium density boards and veneers come from outside the district, as well as a great part of metal fittings, paints etc, whilst plane glass mirrors for bathrooms and marble tops for kitchens, are also produced locally. Woodworking machines are bought from external specialised firms and from site producers.

A few firms de-centralise the processing of boards outside the district to subcontractors located in other Italian furniture districts. Other important subcontracting local relations are concerned with finished (painted) or semi finished doors, veneer working, furniture frames, solid wooden components, and standard finished products such as chairs and tables. Local final firms utilise subcontractors outside the district when standardised or quasi-standardised components are required (i.e. very cheap board processing).

Relationships among the end-product firms and subcontractors are maintained on the basis of face-to-face contacts, and are generally based on co-operation and trust. This co-operation reduces costs and sometimes permits the introduction of small modifications on products with subsequent diversification and innovation.

The evolution of the localised furniture industry of Poggibonsi can partially be explained by the interaction between the multiplicity of capacities, new ideas and availability of the human and technical resources, which previously belonged to companies in the traditional sectors of the system (i.e. blocked bedrooms and living rooms).

However, other factors also played and continue to play a fundamental role. Firstly, the district environment, through its social and political institutions, orientates and supports the behaviour of the furniture system. Secondly, the production of codified knowledge (research and development) in the Poggibonsi district. For example, activities of local producers (and/or sellers) of wood processing machines and their relations with local furniture companies and the provision of real services, offered through local business centres or consortia of furniture industries (training, providing knowledge and valuable information to local business).

The final type of factor affecting the processes of change is the conditions of the market and technologies. Competitive advantages for firms of the Poggibonsi system, have grown thanks to specialisation both in markets with variable and differentiated demand, and in technologies which are widely decomposable into different phases. In particular, the production of machines and equipment for wood-processing companies, has achieved a great deal of success abroad.

5.2.5 France

In 1997, furniture production in France totalled 6.7 billion ECUs, making France the third largest manufacturer of furniture in Europe, behind Germany and Italy. Consumption of furniture amounted to 7.5 billion ECUs, making France a net importer of furniture. The French furniture industry employs some 102,000 workers, and comprises about 17,000 firms, the vast majority of which (95%) are firms with less than 20 employees.

France is one of the leaders in the production of semi-finished wood products in Europe. After Germany, France is the second largest producer of particle boards in Europe. France is also one of the leaders in particle board, whilst in the production of MDF, it is the fourth largest producer in Europe.

France is the number one destination for woodworking machinery in Europe, and also one of the largest importers in the world, with imports amounting to 154 million ECUs. The main suppliers of woodworking machinery to France are Italy, and Germany, with the US and Spain providing much less.

About two-thirds of France's furniture exports are sent to the EU. Germany is France's main trading partner in furniture exports, but Belgium/Luxembourg are also significant. However, the UK, Spain and Switzerland are also sizeable markets for French furniture exports. As in other EU countries exports to Eastern Europe have grown over recent years.

In regards to furniture imports, the EU is the biggest source of imports accounting for 75%. However, imports from Eastern Europe and the Far East now account for about one tenth, each. Within the EU, Italy, Germany and Belgium/Lux are still the leading suppliers. Nonetheless, there has been a rapid growth in furniture imports from Spain.

The main furniture manufacturers in France are; Steelcase Strafor, Parisot, Cauval, Valois Habitat, Roset, SALM (Société Alsacienne de meubles), Gautier, Groupe Fournier Frérnes & SSM, Capdeville, Grange & Geka.

With an annual turnover of 429 million ECUs, **Steelcase Strafor** is the leading French furniture manufacturer. The company is joint owned and controlled (50/50) by Forges de Strasbourg (France) and by Steelcase Inc (USA), and operates in the office furniture sector.

Steelcase's French furniture subsidiary group Strafor Facom, which is aiming to expand in the office furniture sector, recently announced the acquisition of Germany's second largest office furniture group Werndl BuroMobel AG. The group, annual sales of $ 115 million and about 420 employees, specialises in wood office furniture and operates near Munich. The acquisition should enable Steelcase Strafor to become the top office furniture supplier in Germany and one of the biggest in Europe, with a 6% share of the market.[11]

The **Cauval group** operates in the kitchen furniture segment through Espalux and Savoyarde du Meuble, and in the upholstered area via Dumeste, Diva and Mocaer. Valois Habitat is also active in the kitchen furniture segment via Sofiseb, ICM and Ranger in home furniture and in the bathroom segment with Nautine.

Other groups, who specialise only in the kitchen furniture segment, are; **SALM** (Société Alsacienne de meubles), and Groupe Fournier Frérnes. The SALM group has grown quickly during the nineties, form a turnover of FF 500 million in 1990, FF 733 million in 1997.

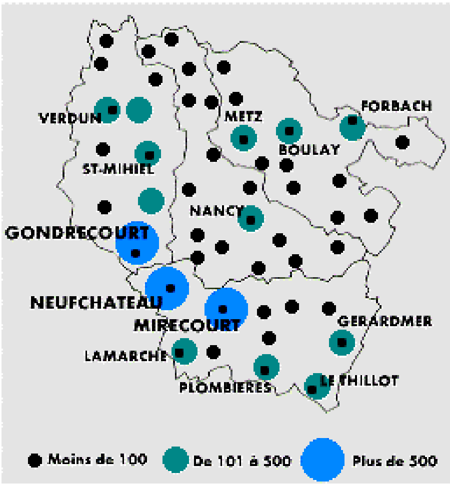
---

[11] Dow Jones Online News, USA, 17/12/1998.

Gautier, turnover in 1997 of 106 million ECUs, operates in the home kitchen and office furniture segments, and is the leader in children's furniture. It belongs to the Seribo Group who is involved in furniture and woodworking.

There are several major forest-based industry regions in France. Acquitaine, and Limousine, have access to massive tracts of forest resources. However, within the furniture industry, there are also several wood furniture industrial districts, one of the main ones is located in Lorraine, in north-east France. Some basic features of which are outlined in box 5.2 below.

Box 5.2 The Furniture Industry in Lorraine[12]



Lorraine is situated on the north-east corner of France, bordering Belgium, Luxembourg and is located in close proximity to Germany. Lorraine is the second largest region in France in terms of employment in furniture. The Lorraine wooden furniture sector, employs some 6700 people, representing 1% of the total working population in the Lorraine region. Of the 483 firms in the Lorraine wooden furniture industry, about 390 employ 10 persons or less. At the other end of the scale, however, there are 9 firms employing more than 100 persons, providing as much as 45% of the total employment in the furniture industry.

Within the Lorraine region the wood furniture industry is geographically distributed across four main sub-regions, with dissimilar structures. Meuse, in the western part of Lorraine, accounts for about 16% of the firms and provides some 22% of employment. Moselle, in the east, accounts for 22% of the firms and about 15% of the workforce. Meurthe-et-Moselle, in the central area, has 18% of the companies but provides as little as 5% of the employment. However, Vosges in the south is the most important area containing more than 44% of the firms and providing almost 60% of the jobs.

---

12 CTAB, France.

Within the Vosges area, there are two main districts with very high levels of employment in the wood furniture industry. Neufchateau is the principal district of the furniture industry, employing more than 1800 workers within 109 firms, which are either self-employed craftsman or SMEs. Within this district the area of Liffol-le-Grand is the main area for manufacturing of chairs, accounting for 25% of the national production. Mirecourt is another large wood furniture district in the Vosges area, which employs some 1200 people. Gondrecourt in the Meuse area is also an important district, which has a high concentration of furniture producers, with 18 companies and around 840 employees.

5.2.6 United Kingdom

The UK is the 4th largest producer and consumer of furniture in the EU. In 1997, it produced over 6.5 billion ECUs worth of furniture. To a large extent the furniture market in the UK is driven by domestic demand.

Imports are almost double the value of exports, at around 1.9 billion ECUs, and although exports have grown fast imports are growing even faster. However, the continued rise in the strength of sterling has probably affected furniture exports. But how firms react to this situation will be of crucial importance to the future of the industry in the UK.

"The demise of the North London furniture firms (in the late 1980s) provides a lesson on how not to respond to the new competition. Faced with shrinking sales, the North London firms sought to maintain market share by cutting prices and costs. The result was a worsening in labour relations, slimmer margins and, eventually, insufficient financial capacity to survive. Unfortunately, the North London furniture manufacturers failed to identify the roots of the problem until it was too late."

"They perceived the problem in terms of excessive wages and competition from their neighbours in the same or nearby industrial estates. So they reacted to the perceived excessive wage rates by hiring less skilled workers, increasing the intensity of work and substituting machines for labour. And they reacted against their perceived competitors by cutting prices in order to drive them out of business, after which they could pick up their order books."

"In fact, both responses left North London firms less able to respond to the real problem. The real problem was neither their labour force nor their local competitors but the emergence of foreign competitors organised around new principles."[13]

The UK semi-finished wood products market is the second largest in Europe. Imports of sawnwood and wood-based panels are very substantial. Plywood is also an important semi-finished wood import, with 100% of consumption being satisfied with imports. This high import share accounts for as much as one-quarter of the total plywood imports in Europe. A significant amount of particle board panels, are also imported, but domestic production, covers about two-thirds of domestic consumption. The UK is also a sizeable producer of MDF.

The UK is the third largest importer of woodworking machinery, after France and Germany. Woodworking machinery imports reached 124 million ECUs in 1996. Italy and Germany are the major suppliers of British companies.

Exports of British furniture are mainly to the EU and North America with office furniture the main product exported. The main export markets are the US, Ireland, Germany and France. Exports to Ireland have grown rapidly, averaging 40% per year recently – and by 60% from 1996-1997, alone.

In terms of imports, worth some 1.9 million ECUs in 1997, most is from the EU with Italy being the main trading partner. Germany is the next most important, whilst both France and Belgium/Luxembourg are also significant.

Some of the main furniture producers in the UK are; Christie Tyler, Spring Ram, Magnet, Silentnight, Hygena & Schreiber, Walker & Homer, Airspung, Cornwell Parker, Bernstein Group, Wade Group and the Bullough Group. A few of these companies are briefly described below.

Christie Tyler is the leading British furniture producer with 5.6% of the British furniture market. In 1997, it had a turnover of 365 million ECUs. The company specialises in upholstered furniture and controls a number of companies in the UK and France.

---

[13] Source: 'Industrial Development Through Small-Firm Co-operation – Theory and Practice', by Frank Pyke, pp 17, International Labour Office, Geneva, 1992.

Spring Ram, which had a turnover of 337 million ECUs in 1997, operates in kitchen, home and bathroom furniture. **Magnet** is another large producer specialising in kitchens. In 1997 it had a turnover of 335 million ECUs.

The leading British furniture distributor, **MFI**, is also present in the manufacturing sector with Hygena and Schreiber, specialising in production of home, kitchen and bathroom furniture. In 1997, Hygena and Schreiber had a turnover of 184 million ECUs, accounting for around 3% of the British furniture supply.

With a turnover of 103 million ECUs in 1997, the **Bullough Group** is the leading specialist in the production of office furniture. The group controls Pentos and Project, which is one of the oldest British companies in the office furniture sector.

5.2.7 Spain

With a production value of 3.9 billion ECUs, in 1997, Spain is the fifth largest producer of furniture in the EU. Spain is a net exporter of furniture, exporting over a quarter of its produce, and importing only a relatively small proportion of its total consumption of furniture. Exports have been growing strongly over recent years.

This rapid growth is also confirmed in a Spanish Furniture Technology Institute-commissioned study, 'Spain's furniture industry has grown steadily over the past few years, and now represents a $9 billion US business for the country (up from $6 billion in 1993). Spain's furniture exports have soared 200% in the past five years, from $0.5 billion in 1993, to nearly 1.4 billion in 1997'.[14]

In the production of semi-finished wood products, Spain is an important producer of particle board panels, satisfying almost all of domestic demand. In the production of MDF, Spain is the third largest producer in Europe. In terms of sawnwood, most of the production is domestic orientated. During 1996, Spain imported some 85 million ECUs worth of woodworking machinery. Major suppliers were Italy and Germany.

In Spain, the furniture industry employs some 113,000 workers and over 12,000 companies. The Spanish furniture industry is concentrated in several areas; about 20% of the companies are located

---

[14] HFN 12/10/1998.

in the Valencia region, where production specialises on the home and upholstered furniture segments; in Barcelona there are a large number of small exporting companies, specialising in design furniture; whilst Madrid and the Basque country are the locations of the leading producers of kitchen and office furniture.

In 1997, exports of furniture from Spain amounted to 1.0 billion ECUs, mostly to the EU. The majority of these exports went to France, with a substantial share also being sent to Germany. Portugal is also an important market for Spanish exports, however, Russia is rapidly becoming an important export market for Spain. At the same time, the Eastern European market is generally becoming a more important market for Spanish exports, having grown from 2% in 1993 to 10%, in 1997.

Furniture imports to Spain are much less than exports, worth 441 million ECUs in 1997. The main suppliers of furniture imports are France, Italy, Germany and Portugal. The EU accounts for over 80% of Spain's imports.

Some of the main furniture producers in Spain are; Mostoles Industrial, Alvic, Kemen, Xey, Jevit (Dyna Mobel), Ofita, Permasa Group, Mobel Linea and Ofitres.

The leading furniture producer in Spain, **Mostoles Industrial**, is owned by the leading furniture distributing group, **EL Corte Ingls** (who has 4% of the distribution market). In 1997, Mostoles had a turnover of 140 million ECUs. The company has about 25% of the kitchen furniture market in Spain, and also produces particle board panels. **Xey** also specialises in the kitchen furniture segment, and had a turnover of 29 million ECUs, in 1997.

Many of the top furniture producers in Spain specialise in office furniture. One of the leading office furniture producers is **Kemen**, who, in 1997, had a turnover of 30 million ECUs. The company is also part of the German group DLW. Other leading office furniture producers include **Jevit**, **Ofita**, **Permasa Group**, **Mobel Linea** and **Ofitres**.

5.2.8 Denmark

Unlike the other Scandinavian countries, Denmark is a large importer of semi-finished wood products. In the same way, Denmark imports most of its plywood and fibreboard consumed domestically. Denmark is a large consumer of wood-based panels and particle board. In terms of woodworking machinery, Denmark is also a major importer, importing over 45 million ECUs worth, from Italy and Germany.

Denmark is the sixth largest producer of furniture in the EU with a production value of 2.5 billion ECUs in 1997. Denmark has the highest export ratio of all the EU countries, exporting some 75% of its production. The EU is the main destination for exports accounting for over 75% of Danish furniture exports. Germany, absorbs most exports, followed by Sweden and the UK, however, both Norway and the USA are also significant markets outside the EU. Furniture imports, worth around 745 million ECUs in 1997, are mainly from the EU, however, Eastern Europe and the Far East are also significant suppliers.

Tvilum Invest, turnover of 228 million ECUS in 1997, employs more than 1500 workers and is one of the biggest furniture produces in Scandinavia. The company was founded in 1997, after a merger between Tvilum Gruppen and HLJ Industri, and is controlled by the holding company Axcel Industri. The new company produces knock down furniture for various price ranges, and has more than 4% of the furniture production market in Scandinavia.

Skandinavisk Industries is part of the Skandinavisk Holding company. The company specialises in the office furniture segment, with sales of around 218 million ECUs in 1997, it has a market share of 4.2%. The group includes other companies in the office furniture segment, with the majority of sales being achieved through operations in Germany, the Netherlands and the UK.

Within the kitchen furniture segment, the Danish **HTH Kokkener** and **Invita** and the Swedish **Nobia Nordisk** are the main specialists. During 1997, the Swedish group Stora sold Stora Building Products to the Danish holding as part of its reorganisation process, to focus only on its core businesses in the wood, paper and packaging sectors.

5.2.9 Localised low-tech learning in the furniture industry[15]

What constitutes a high-tech industry. The OECD defines a high-tech industry on the basis of R&D effort or more precisely, R&D expenditure per unit of production. Technology intensive industries with R&D expenditure/production above 6% are termed ‘high-tech’ industries.

[15] Source: in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 71-91, Handleshojskolens Forlag, 1998.

These research-intensive industries are characterised by sharp learning curves and a significant degree of internationalisation of production, thus facilitating considerable economies of scale. In addition, these industries have experienced growth rates well above average in recent years. Moreover, high technology industry's share of world manufacturing exports has risen from 12%, in 1970, to 25% in 1995. Hence, it is no surprise that this has led to an international obsession with high technology industries.

Nonetheless, is national specialisation towards high technology industries the only option for developed countries to maintain and augment their economic position. Only the largest of the developed economies: USA, Japan and the UK have in fact an export specialisation in high-tech industries. Moreover, in contrast to the prevailing assumptions that countries without a specialisation in high technology industries are doomed to economic decline, many industries experience an above average economic performance even when specialising in the bottom end of the low-tech industries.

One example of how a high-cost country can benefit from specialisation in low-technology industries is the Danish wood furniture industry.

Box 5.3 Development of a low technology industry in high-cost environments - The case of the wooden furniture industry in Denmark.

The wooden furniture industry is undoubtedly a low-tech industry according to the OECD's classification of high-technology products and industries (OECD 1995). However, regardless of the low-tech status of the industry, and the fact that the wooden furniture industry is dominated by SMEs, much incremental product innovation takes place.

The increased competition between producers has escalated efforts to automate production processes, and some progress has been made in the production and assembly of rectilinear furniture from coated panel boards. However, the production of furniture is still rather labour intensive and labour productivity and unit labour costs are therefore of particular interest to this industry.

With this in mind it is perhaps somewhat surprising that the highest export ratio per capita in the whole of Europe is found in the parts with some of the highest labour costs (i.e. in parts of Germany, Belgium, Northern Italy and in Denmark). Denmark

opment in the relative unit labour cost against other EU countries has not been favourable. Moreover, despite having only 1.5% of the EU's population, Denmark accounts for as much as 20% of the EU's wooden furniture exports. Furthermore, this export specialisation pattern also revealed that the Danish wooden furniture industry has a long track record.

The Danish furniture industry and the factors of competitiveness

The sustainable industrial competitiveness of the Danish furniture industry is not reached via any outstanding production technique or application of superior technologies. Neither the production processes employed, nor the types of machinery utilised, distinguish the Danish wooden furniture manufacturers from their competitors. At the same time, Danish producers do not possess any specific property right to protect their products from competitors, nor can their competitiveness be explained by economies of scale.

In general, the wooden furniture industry consists of two distinctive and technologically different processes, the process of manufacturing the furniture and the process of painting it. Manufacturing of furniture includes wood-cutting, drilling, shaping, grinding and assembling. Although the process of painting and lacquering furniture only accounts for 5-6% of the total production cost of wooden furniture, the cost of the entire coating process, which includes smoothing, priming, painting or lacquering, drying/defuming, polishing etc, can exceed 50% of the total production costs.

However, both manufacturing and painting of wooden furniture are normally integrated in the same firm. The reason for this is that paints and lacquers are often customised to the individual plant, its product range and its paint spraying equipment, thereby making the painting/lacquering process an important and integral part of the firms core competence.

Firms in the Danish wooden furniture industry are mostly small, with an average size of 35 full-time employees over the last 25 years, in spite of acquisitions which have taken place. Notwithstanding this fact, some types of furniture are increasingly produced in an automated way. However, firms producing commodities less suited to automation often specialise in a limited range of furniture products for use in bedrooms, lounges, offices, shops, kitchens or gardens etc. for mainly targeted groups of customers.

Many firms function as subcontractors, and use a greater or smaller proportion of their capacity to produce specialised, finished or semi-finished inputs to other furniture producers –

rooted and long lasting. Within the Danish wooden furniture industry, a survey revealed that relations are very stable with many business partnerships between firms and their customers and suppliers lasting as long as 13 years on average, and the main customer bought 39% of the total output. On the supply side, the firm's main supplier delivered 23% of its total purchase.

More than 80% of the firms interacted with their customers in developing new products, sometimes leading to temporary exchange of personnel, loans of machinery or expertise or coordinated investments in production equipment. However, only half had any sort of written contract or other formal legal framework for this interaction.

The business culture is maintained from one generation of managers and owners of firms to the next by new firms being established mainly by the skilled workers of the industry. At the same time it is this upbringing in the industry and the carefully acquired tacit knowledge of these homespun mangers that has enabled the industry to overcome the problems of poor quality, rejections and higher manufacturing costs to a higher degree and more consistently than their foreign competitors.

Nonetheless, the financial vulnerability of small firms and the low level of commercial managerial competence does show in the high degree of closures and in the low survival rate of new firms, although this appears to increase with age and size. However, the low entry barriers and constant stream of entrepreneurs, has maintained almost the same number of firms and same size structure.

As with all small and medium sized firms, Danish producers of wooden furniture have difficulties in reaching culturally distant markets. Due to their production volumes it is difficult to build and maintain an international oriented sales organisation. The limited managerial and financial capacity means that it is difficult to maintain contacts with previously important markets during periods of low demand. This often results in 'hit-and-run' export strategies being employed. As an alternative to this method, many firms in the Danish wood furniture industry choose to deliver to large international orientated furniture retailers like IKEA. Others join with local producers of supplementary commodities and form some sort of temporary or permanent combined sales organisation. Hence, a group of firms can be both competitors on the labour market, rivals on some product markets, and partners on others.

The most important input to the wooden furniture industry is

other Scandinavian countries, but increasingly also from countries

The domestic suppliers of wood processing machinery (cutting, shaping and grinding etc) were important once, but not anymore. Before the war, about half the machinery in the furniture industry was produced in Denmark, but today more than 90% are imported, mainly from Italy and Germany. Similarly, a large proportion of paint spraying machinery is imported from Italy, even though the largest Scandinavian producers are located in Denmark.

However, the paint and lacquer used for wooden furniture are partly produced in Denmark, but mostly by subsidiaries of the large multinational producer AKZO NOBEL, while other foreign producers are represented by their own distributing and service enterprises, such as BECKER, KLINTEN, HESSE LING, VORTLE. The increased environmental pressure on the wooden furniture industry to reduce its emissions of volatile organic compounds (VOCs), has resulted in rapidly growing demands for new types of paints and lacquers with high content of solids and/or based on water. The interaction has been intense between the wooden furniture industry and the producers of paint and lacquer or their local representatives, in order to ensure the same surface quality. In fact, this process of knowledge creation embarked upon appears to have enhanced competitiveness.

Why is the competitiveness not eroded by imitation ?

The absence of any strong specialised domestic industrial environment to support and supply the wooden furniture industry might indicate that the revealed international competitiveness of the many small producers originates from their ability to create and accumulate knowledge internally because of business acumen and organisation.

However, it is argued that successful firms would be followed by competitors, which would imitate them. Yet, the persistent competitiveness of firms within the Danish wood furniture industry indicates that, there are three important factors, which prevent imitation:

- Asset mass efficiency,

- Time compression diseconomies and
- Interconnectedness of asset stocks.

Firms that already have a large stock of R&D or experience-based know-how, a specialised labour-force, and an operational line of machines, are often better positioned to make further breakthroughs to add to their own stock of knowledge. In addition, there may also be some other extra-firm, but intra-industry, elements of asset mass efficiency. Spatial agglomeration of related economic activities does promote competitiveness by condensing the effects of a common culture, a specific language, and a set of informal, but essential institutions.

First of all, entrepreneurs within a given business sector will concentrate in areas where the sector is already strongly represented. Secondly, a geographical agglomeration of firms within a given business sector in a region will make the region especially suited to meet the specific location requirements of the firms within the sector. The optimal location would usually be exactly the region with the proven track record of servicing firms in just that sector.

Time compression diseconomies

To communicate tacit knowledge will normally require a high degree of mutual trust and understanding, which in turn is related not only to language but also shared values and culture. Trust has to be built and that takes time, hence time compression diseconomies also hinder competitors from imitating established successful behaviour. A firm can not simply plug into the information channels of a local business system like the wooden furniture industry. Some knowledge cannot be bought, on the contrary knowledge is often traded. One needs to produce knowledge in order to obtain knowledge.

Interconnectedness of asset stocks

The complex web of linkages between the firm's internal resources and the actual or potential resources it has access to in its surroundings is a further barrier inhibiting imitation. A foreign competitor may be able to acquire some of the vital components in this entangled web, but will often find it difficult to duplicate all the relevant elements. Formal and informal inter-firm resources may interact with formal institutions within the region, thus making it difficult, if not impossible to understand, never mind imitate those traits which provide the region with its source of competitive ad-

Conclusion

The main implication of the brief analysis of the Danish wood furniture industry is that 'proximity matters'. The social and cultural dimension is also related to proximity. To communicate some types of knowledge will require a high degree of mutual trust and understanding, which in turn is related not only to language, but also to 'shared-values' and 'culture'.

The benefits of proximity can be translated into a force of spatial agglomeration in relation to firms engaged in interactive processes, some of which might be learning. In such places, knowledge tends to become embedded, not only in individual skills and in routines and procedures of organisations but in the milieu as such, or rather, in the relations that connect firms to each other and to the wider institutional context.

The case illustrates that it may be highly complicated and in reality perhaps even impossible to transplant all economic characteristics, intra-firm as well as inter-firm, successfully from one environment to another.

5.2.10 Sweden

Sweden is the leading producer and exporter of semi-finished wood products in Europe. Sawnwood accounts for about 88% of production and 94% of exports of the total semi-finished wood products in Sweden. In the production of wood-based panels and particle board Sweden is a major producer. However, imports are twice the level of exports and satisfy about half of domestic consumption. In 1996, Sweden imported woodworking machinery worth 44 million ECUs, mostly from Italy and Germany.

In terms of furniture trade, Sweden exported 986 million ECUs and imported around 540 million worth of imports, in 1997. More than half of Sweden's exports are to the EU, however, as much as one quarter are directed to Norway. Within the EU, the main destination of exports is to Germany. Imports mainly come from the EU and Eastern Europe, with Denmark the leading importer.

In the distribution of furniture, **IKEA** is the largest distributor in Sweden and Europe, with a turnover in 1997, of 540 million ECUs, which mostly consists of furniture sales. In the early 1990s, IKEA acquired Swedwood, a Swedish furniture manufacturer, increasing its share of own furniture production. IKEA, which employs nearly 4100 in Sweden, recently acquired the French group Habitat (turnover of 420 million ECUs from sales in outlets in many European countries). The company has launched a major expansion into Eastern Europe (including Russia, Poland, Hungary, Slovakia and the Czech Republic).

For example, **Sweedwood**, a leading furniture producer and a subsidiary of IKEA, will set up a $15 million woodworking and furniture enterprise in Vitebsk, Belarus. Sweedwood will gradually set up a lumber company, a sawmill and a furniture plant in the Polotsk district. It is estimated that the company will need about 200,000 cubic meters of logs, and Sweedwood plans to fell trees in locations that are difficult to access, i.e. where Belarusian manufacturers do not work.

'The company will manufacture furniture under the IKEA trademark and export it to Europe. Sweedwood expect to produce $25-30 million worth of furniture in exports. The new enterprise will create 600 to 700 jobs in the region. Sweedwood will also import equipment for the enterprise for wood processing etc.'[16]

Kinnarps is one of the oldest and most important producers of office furniture in Europe. It employs about 1200 workers and had a turnover of some 180 million ECUs in 1997. The company has two factories in Sweden, one in Kinnarps (office furniture) and the other in Skillingaryd (seating and upholstered furniture). Scandinavian markets account for most of Kinnarps sales revenues.

Tibro Forenade Mobelfabriker, or TFM, is a public limited company, which is controlled by some 54 furniture producing firms, located around the Tibro area of Sweden. The company, which was founded in 1961, has an annual turnover of around 160 million ECUs and employs over 1400 persons. The majority of the companies within the consortium, are fairly small SMEs with only seven having more than 50 workers. They produce home, upholstered, and office furniture, with exports generally accounting for about 35% of sales.

5.2.11 Finland

In the production of semi-finished wood products, Finland plays a major role as a producer and exporter of sawnwood. In 1996, Finland produced some 9.3 million m^3 of sawnwood and exported as much as 80% of this. Wood-based panels are also a very important export. For example in the production of plywood, Finland is the

[16] Interfax, Russia, 9/3/1999.

leader in Europe, exporting about 90% of it's production it maintains half of the export market and over 30% of production in Europe. In terms of woodworking machinery, Finland imports relatively little for the size of its industry, importing about 23 million ECUs, mainly from Italy and Germany.

Exports of furniture from Finland were worth 238 million ECUs in 1997. However, imports have grown quickly in recent years. Finland's main export markets are the EU, and Eastern Europe (36%). Russia is the most important market, accounting for one quarter of the total exports, then Sweden, Germany and Estonia. In terms of imports, Sweden is the dominant supplier, providing over one third of imports in 1997.

In the Lahti region of Finland an agglomeration of the furniture industry has been identified. Although good potential exists, its' development has been restricted for a number of reasons (see box 5.4).

Isku is the largest Finnish furniture producer, which is active in office, home and kitchen furniture segments. Office furniture accounts for about one-third of the company's production and in 1997, it had an annual turnover of 205 million ECUs. **Martela** is also an important company in Finland producing office furniture.

Box 5.4 Agglomeration of the furniture industry in the Lahti Region[17]

Located in southern Finland, the Lahti region is one of the central cities forming the heart of what is called industrial Finland. The city of Lahti has been known as the city of carpenters since the furniture industry has traditionally been one of the cornerstones among other industries of the Lahti region. Since the 1930s, the town and its surroundings has been the leading region of the furniture industry in Finland. Some of the factors behind agglomeration appear to be obvious; there was abundant resources of high-quality birch in the neighbouring lake Päijänne area, a number of skilled employees moved to the region for a number of reasons, there was a tradition of craft education and Lahti became an important transport and logistics hub.

However, during the last two decades, the local furniture industry has not experienced any continuous growth and progress. Instead,

---

17 [illegible] the European Furniture Industry, pp 95-121, Handleshojskolens Forlag, 1998.

ditional export market to the Soviet Union collapsed, the furniture industry has become even more polarised than before. Some medium-sized firms have had to cut their work force and three important medium-sized furniture manufacturers went bankrupt during the worst period 1991-1995. The result was the loss of nearly 300 jobs in SMEs during that time, and in large companies the decline was about 600 jobs in the period from 1990-1992.

Today, the Lahti region is highly specialised in mechanical wood industries, and especially in the furniture industry. In 1992, the total employment in the furniture industry in Finland was 10500; in the Lahti region it was nearly 4000. Due to the worst crises ever, the total employment declined sharply and is currently about 3,500. Despite this, about half of all furniture made in Finland is still produced in the Lahti region, with about 30% of the total furniture industry work force also being located in this region. In 1992, the total turnover of the industry was about FIM 3.6 billion, with the Lahti region accounting for FIM 1.5 billion. However, the two largest manufacturers were responsible for about one billion of this total turnover.

Altogether, the mechanical wood furniture industries form a substantial agglomeration in the Lahti region. In 1994, other branches of mechanical wood employed about 2,300 workers, where production of sawn goods was the most important with its 1700 employees, the manufacture of wooden houses about 200, and other wood manufacturing about 400. The problem from the small furniture manufacturers' point of view is that most large sawmills and plywood factories are oriented towards large customers with mass-production and they also export most of their output. Hence, there can actually be shortages of suitable wood material for smaller firms as they are not such attractive customers as larger firms.

The two major enterprises, ASKO FURNITURE OY (established in 1918, 1000 employees) and ISKU OY (established 1928, 1700 employees) have formed for decades the backbone of the industry in the region. These two have relied on vertical integration and searched for economies of scale by means of mass production. In fixtures, one manufacturer with about 200 employees (NOVART OY) has a leading role in the region.

Regarding the smaller firms, most have been established as spin-offs by former employees and managers. Often the younger generation formally managing a company has not been allowed to make any significant changes to company strategy due to the more conservative views of older entrepreneurs. During the recession, this was sometimes a major hindrance for the required change.

In conclusion, there are several strong arguments supporting the

tures, producers of machines and equipment for the mechanical wood industry and many producer services etc. However, for such a large centre like the city of Lahti, there are some crucial shortcomings, such as the lack of a university and the lack of any advanced technology organisations have, resulted in the slow adoption of technologies which are not so easily transferred or diffused. The Lahti region is thus specialised in furniture manufacturing, however, within this industry it is not specialised in any products or customer groups.

Table 5.7 SMEs of the Lahti region furniture industry – by main product (1995)

Main Products	Manufacturing Firms	
	Total	Subgroup
Fixtures	13	
Furniture for Public Premises	18	
Home Furniture	55	
- Upholstered furniture		21
- Board furniture		10
- Massive wood furniture		19
- Plastic furniture		3
- Metal furniture		2
Sub-contracting	21	
- Boards, veneer preparation		2
- Wooden frames		3
- Other wooden components		9
- Plastic and foam components		1
- Metal parts and fittings		2
- Upholstery, paddings		2
- Surface coating		2
Total	107	107

5.3 Competitiveness within the European Furniture Industry[18]

Unlike the wave of vertical integration that has swept through most other industries in Europe, the size structure of furniture industry remains relatively unaffected. The main explanation for this is that furniture markets continue to be fragmented and fluctuating, and so the typical producer tends to be small or medium sized, producing for market niches. Another explanation is that specialisation is prominent amongst furniture firms because the production processes are very different, and the skills of producers encompass only a few types of tasks. Moreover, manager-owned managerial style appears to reproduce itself, as start-ups often spawn from existing ones.

Internationalisation has brought about significant developments within the furniture industry at many levels. For example, developments in transportation technology and opening up of the economies in Southeast Asia and Eastern Europe, have increased the degree of international competition. Some recent important trends within the furniture industry include:

- Internationalisation of Sales
- Internationalisation of Production
- Internationalisation of Information of Knowledge
- Continuous Fluctuations in Demand

Internationalisation of Sales rose dramatically in the 1990s, with chain stores such as IKEA and HABITAT establishing outlets in a growing number of countries. Accompanying this, traditional exports from a national production base have also risen significantly in a number of countries. Although previously produced for domestic markets, furniture segments such as kitchens, office furniture and even home furniture are the main exports. This has meant that many single furniture producers have had to meet international standards, keeping up with styles, as well as establishing contacts, partnerships, and sales channels abroad.

Internationalisation of production encompasses both semi-finished goods and finished products. One factor assisting this is

---

18 Draws heavily on: Specialisation and Localised Learning in the European Furniture Industry, pp 9-27, Handleshojskolens Forlag, 1998.

that a growing number of countries produce and export furniture, both as sub-contractors and independent exporters. A growing number of producers in Mexico, Southeast Asia, and more recently, Eastern Europe, produce furniture at very low costs. West European chain stores – distributors of furniture – utilise them for sub-contracting assignments.

IKEA, in its pursuit of an outsourcing strategy, in which it preserves its core strategy of design and distribution only, utilises a growing number of East European sub-contractors, making its other sub-contractors in Sweden and Denmark compete for their status. German furniture retailers and producers are investing heavily in Polish sub-contracting firms, contributing to a ten-fold increase in exports of both semi-finished and final furniture products over the last five years.

Internationalisation of information and knowledge has resulted in products, designs and styles flowing almost freely amongst producers. Even if many high-quality, design oriented producers attempt to protect themselves, by establishing brands and registering patents, copying of styles – part or full product designs – is widespread, internationally. This also includes knowledge of production processes. For example, Eastern European plants producing solely for Western chain stores are highly automated, hence a substantial transfer of technology takes place to these countries.

Continuous fluctuations in demand have not been reduced by producing for an international market. For example, the internationalisation of sales has not significantly decreased the fluctuating nature of the volume of furniture demand, since the volume of furniture purchases is strongly dependent on socio-economic features. For some furniture producers in Finland, and some of the former soviet republics, the collapse of the Soviet Union, resulted in the virtual disappearance of a stable market almost overnight.

In their struggle to attain and maintain competitiveness in this environment, single furniture producers follow different organisational pathways. The emphasis on internal scale economies is rarely seen to be combined with strong external economies, whereas an emphasis on specialisation and flexibility usually is. In general, firms within the European furniture industry choose different strategies to maintain competitiveness. These trajectories range from those based on 'cost-cutting' to those based on 'localised learning'.

5.3.1 Competitiveness based on cost-cutting

As furniture producers now compete internationally, differences in labour costs matter. Thus, the cost competitiveness of furniture producers from the Third World or Eastern European countries can be ascribed to their significantly lower labour costs. This has placed great pressure on OECD countries and especially those with high labour costs. To this end, many West European countries have saw waves of mergers and acquisitions.

In other countries, most notably Great Britain, wages have come under attack. Here, deregulation of the labour market has undermined the rights of labourers, lowering the wages significantly. This policy has had very limited success in making the industry competitive. Therefore, while some OECD countries have eroded the skills of the labour force by pursuing a labour cost-cutting strategy, labour costs in the Third World countries and in Eastern Europe have continued to be much lower.

The low average wages in many Asian or Eastern European countries are in many cases connected to less regulations of markets (labour) and lower environmental restrictions. Industrial growth in new industrial spaces within nations is mostly due to newly started furniture production, not re-localisation of existing production. Re-localisation mostly takes place through outsourcing production internationally, to producers in low-cost countries. In recent years, Western chain stores have shifted towards using subcontractors from such countries, whilst some furniture producers have started to utilise subcontractors from Eastern European countries.

Outsourcing of some production processes to firms in foreign countries seems to be little used by smaller OECD furniture producers. There are great barriers of both a cultural and practical nature to forming subcontracting agreements, let alone partnerships, with firms in Third World or East European countries. Thus the model of achieving cost advantages seems to be reserved for the largest players, with clearly formulated subcontracting strategies, as well as competencies of operating internationally.

Related to both production and distribution, localisation often matters for transportation costs, as many furniture products – especially finished products like wooden furniture that cannot be 'knocked down' and are shipped as they are – are quite cost-intensive regarding transportation.

Other types of costs relate to the costs of demand fluctuations. Furniture producers in Eastern Europe previously produced for the former Soviet Union. However, due to the substantial drop in demand, firms can not sustain the costs of maintaining and up-grading their production machinery which is often huge or to keep their large work forces employed.

In OECD countries, frequent fluctuations in volumes of both domestic and international demand result in additional costs of keeping stocks. Keeping capital tied up in this way, places greater stress on those firms who do not produce standardised products – not to mention the risk of products becoming outdated due to style changes. To counter these problems some firms have resorted to numerical flexibility of their workforce through hiring and firing or temporary lay-offs. Other firms achieve this flexibility of output volume through establishing co-operative relations to other furniture producers. For example, by reducing one's own production to a minimum, subcontractors are used as buffers during market fluctuations.

Automation is another means of lowering costs of keeping stocks. In many OECD countries many furniture producers have introduced new production technologies such as CNC machines in production lines to raise levels of quality and to increase outputs whilst retaining flexibility and in a many cases, skills. Automation should be seen as a strategy of attaining flexibility of product types rather than flexibility of overall output volumes. The large sunk costs in capital equipment implied by following an automation strategy necessitate a continuously high output.

5.3.2 Competitiveness based on external economies and localised learning

Automation cannot meet the demands of quality and customisation of all markets. Thus many firms utilise highly skilled labour in order to achieve flexibility. With a growing number of firms, customisation is obtained by designing standard elements or modules of furniture that can be supplemented by a range of add-ons. Co-operative relations between specialised firms may be utilised as a strategy to achieve this kind of product flexibility. Specialisation subcontracting in co-operative arrangements between strongly specialised firms that depend on each other, provides producers of final goods great product flexibility since new product lines and huge amounts of add-ons are made possible.

This type of arrangement also solves the problems of producers keeping stocks of semi-finished goods. Instead, their partners dedicate themselves to delivering on time. Because of the just-in-time nature of this system, vertical integration is rarely an option for firms. Many specialisation subcontracting arrangements achieve their flexibility and dynamism because of their low degree of formalisation (agreements are usually oral). Through an institutional environment of trust and reciprocity, such a flexible system may operate with the low transaction costs.

Specialisation subcontracting arrangements have the scope for interactive learning – i.e. product and process innovation through user-producer interactions. Continuous revisions of product designs and features, may ensure competitiveness of furniture firms participating in specialisation subcontracting arrangements. Incremental interactive product innovation may be a more efficient way of sustaining competitiveness than establishing brand names or protecting patents. This kind of product innovation is closely coupled to production stages rather than design or marketing stages.

Know-how of production processes is sustained and augmented by specialisation and user-producer process innovations. Know-how, know-who of managers is sustained and augmented by continuous building and combining co-operations with other firms. Competitiveness that results from these capabilities is not only collective, it is absolute. It is therefore difficult, if not impossible, for other furniture producers to utilise or imitate it. Hence, because of the non-imitatable nature of knowledge and skills of particular furniture producers, they may experience sustained competitiveness.

One of the most important factors for the creation of low-tech competitiveness, whether based on cost-cutting or on localised learning and skills, is the institutional environment for furniture production. Supranational agreements or regulations, such as EU or NAFTA greatly influence trade as well as internationalisation of furniture production. National economic and industrial policies and labour market regulations are important for national specialisation within furniture production. Purely regional or local labour markets, or less tangible institutional environments of culture, trust, co-operativeness and informal information sharing between agglomerated (geographically clustered) producers are of importance for co-ordination and localised learning amongst specialised furniture producing firms.

Conclusion

With growth in the world economy and the opening of new markets in Eastern Europe and the Third World countries, much scope appears to exist for future furniture production and export. However, competitive pressures have increased considerably on the world markets due to the mainly cost-based competition of new furniture producers in, for example, Southeast Asia, and Eastern Europe.

Within the OECD furniture industry, competitiveness based mainly on cost-related issues seems to be a game most profitable for huge retail chains. Suppliers to such retail chains are low-cost producers, be they producers localised in low-cost countries, or OECD producers that follow a strategy of cutting labour costs. However, such a trajectory may lead to de-skilling and in the long run, loss of competitiveness. On the other hand, competitiveness based on product quality, flexibility, and customisation through automation or specialisation subcontracting is a trajectory that many OECD furniture producers have followed for a number of years.

This type of competitiveness, based on localised learning, is strongly dependent on a particular institutional environment for furniture production, promoting co-operation and information exchange between firms and providing SMEs with real services. In many cases, these institutional traits are provided within geographical boundaries, i.e. they are confined to regions within nations.

The institutional environment for this trajectory towards competitiveness within the furniture industry should be strengthened by emphasising education, up-skilling, supporting networking activities and other policies aimed at SMEs and entrepreneurship, such as financial services. Moreover, the majority of these support activities should now be aimed at existing local agglomerations of producers, supplying local specialisations within the furniture industry with what they need in each specific case – 'real' services.

Summary Conclusions:

- European furniture production accounts for more than 45% of world supply
- EU country's are the top furniture exporters (over one-third of EU production is exported), Italy and Germany are the top two exporters in the world
- The Danish wood furniture industry exports as much as 75% of its production
- The EU furniture industry provides a trade surplus to the EU
- The EU furniture industry is dominated by SMEs (SMEs with less than 20 employees account for 90% of the total employment)
- The EU furniture industry is less concentrated than its competitors in North America or Asia
- Furniture production and distribution is becoming more international, and less fragmented (chain store type distributors are leading this trend – outsourcing to low-cost producers)
- Furniture trade with Eastern Europe (especially imports) is growing rapidly. Production is also being relocated to Eastern Europe
- Furniture manufacturers are distributed across the EU
- Agglomerations of wood furniture manufacturing tend to be concentrated in industrial districts throughout regions of the EU (numerous examples have been identified in many areas)
- The wooden furniture industry does not derive its competitiveness from tangible assets (such as high-tech machinery etc); it is the intangible assets (specialisation, trust, local business culture, localised learning) that provide the basis for success
- Related and supporting industries such as woodworking machinery are strong in two of the largest furniture producing countries, Italy and Germany
- The furniture industry is low-tech and supplier dominated: i.e. innovations are mainly process innovations, embodied in capi-

tal equipment and intermediate inputs originated by firms whose principal activity is outside the industry

- There are two different strategies adopted to maintain competitiveness: cost-cutting-based or localised learning-based
- Specialisation contracting, which takes advantage of localised learning and skills, facilitates incremental product and process innovations through user-producer relationships
- Competitiveness based on localised learning relies on institutional traits which are confined to regions within nations, and as such, it is difficult to imitate or reproduce elsewhere.

Chapter 6. The Pulp and Paper Industry within the EU

Western Europe plays a key role in the global Pulp and Paper industry. After North America, Western Europe is the second largest producer and consumer of paper and board. Within the European Union about 78 million tonnes of paper and paperboard were produced in 1998, accounting for about one quarter of the world's total paper and paperboard production[1]. In fact, this was 20% higher than five years earlier, and reflects greater demand within national markets as well as greater demand for exports.

In 1998, the pulp and paper industry in the EU provided work for some 236,000 employees. This means that on average one employee produces about 330 tonnes of paper per year, and clearly demonstrates the very capital-intensive nature of the industry. The figure below shows how widespread the industry is across the EU.

Figure 6.1 Companies and mills in the EU (1998)

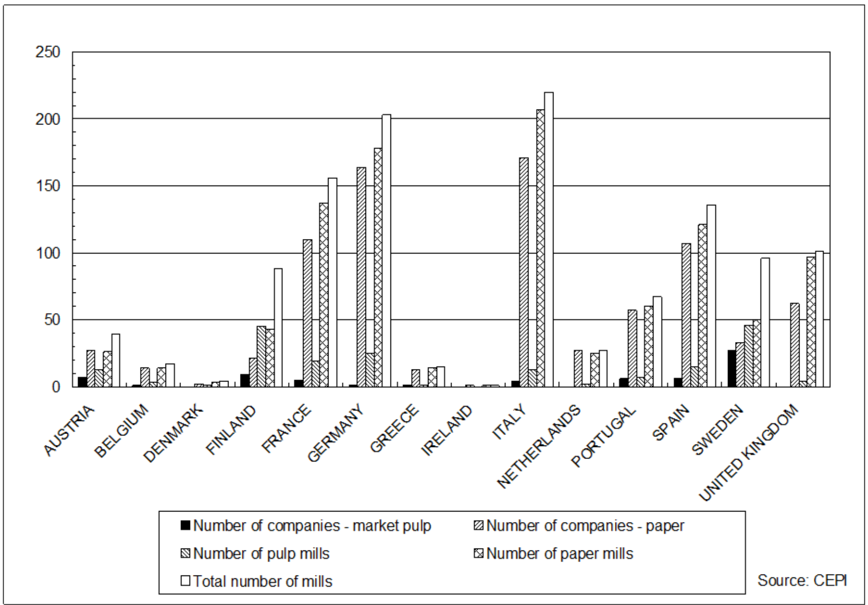
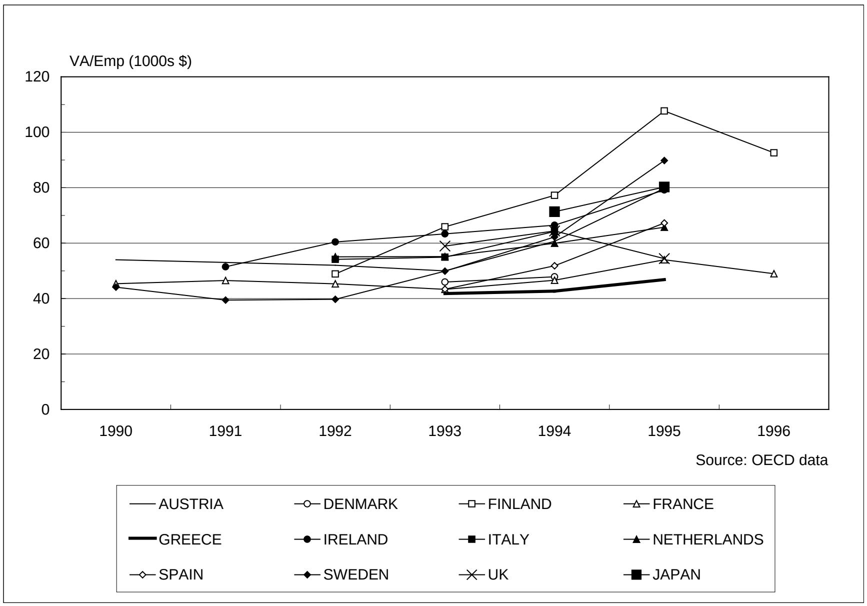


Figure 6.2 Productivity in pulp and paper production within the EU

[1] CEPI Annual Statistics 1998 (Confederation of European Paper Industries).



Within pulp and paper production, productivity is generally found to be higher amongst the producers who operate utilising economies of scale via massive production units. In Sweden and Finland, more than 50% of the pulp and paper mills have capacities in excess of 100,000 tonnes per year. Figure 6.2 shows productivity across the EU, in terms of value-added per employee. Given the scale economies and capital intensity of Swedish and Finnish production, it is no surprise to find these amongst the highest in terms of value-added per employee. However, producers with a large number of small-scale mills are also just as productive (Italy). It is also worth mentioning that average wage levels have increased with higher levels of productivity, in most cases, but the large-scale producers do not have the highest average wage levels.

6.1 The Western European Pulp Market

In terms of pulp production, the Europe Union also has a significant role, producing some 33 million tonnes of woodpulp in 1997, representing almost one fifth of the world's total supply.[2] Pulp supply consists of market pulp producers and of companies incorporating the majority of their pulp output into their own integrated paper

---

2 European Analyses & Forecast, PPI 1998.

production, selling any residual to the open market. In Western Europe, 'market pulp' is supplied by a few large mills, which are located in Finland, Sweden, Portugal, Spain, Austria, Belgium and France. In 1998, some 10 million tonnes of market pulp was produced in Western Europe. The dominating grade of market pulp is bleached sulphate, which accounts for three-quarters of the market pulp produced each year. Sulphite pulp accounts for about 13%, mechanical and semi-chemical pulp around 7%, with unbleached sulphate pulp a further 2%.[3]

Finland and Sweden are the major producers of both softwood and hardwood pulps, whilst Portugal and Spain provide significant amounts of hardwood pulp grades. Virtually all bleached softwood kraft pulp and nearly 90% of the bleached hardwood pulp used in

Table 6.1 Pulp Production and Trade in the European Union in 1998 (1000s tonnes)

Country	Production	Imports	Import penetration (%)*	Exports	Export Ratio (as % of prod)*	Apparent Consumption
Finland	11355	45	*0,5*	1642	*14,0*	9757
Sweden	10541	249	*3,0*	2787	*26,0*	8003
France	2675	1999	*47,0*	415	*16,0*	4258
Germany	1950	3820	*70,0*	339	*17,0*	5431
Portugal	1708	94	*12,0*	1037	*61,0*	765
Spain	1608	563	*39,0*	730	*45,0*	1441
Austria	1492	596	*33,0*	277	*19,0*	1811
UK	583	1506	*73,0*	18	*3,0*	2070
Italy	462	3076	*87,0*	13	*3,0*	3525
Belgium	381	424	*63,0*	132	*35,0*	674
Netherlands	129	1212	*118,0*	315	*244,0*	1026
Greece	5	134	*96,0*	0	*0*	139
Denmark	0	0	*0*	0	*0*	63**
Ireland	0	0	*0*	0	*0*	NA
Total (millions)	32,9	13,7	*35,0*	7,7	*23,0*	38,9

Source: CEPI 1998; *ETLA estimates; European Analyses & Forecast PPI 1998**.

Central Europe is market pulp. About 3.5 million tonnes per annum (Mt/a) of pulp come from Finland and Sweden, whereas Portugal and Spain export approximately 1.5 million tonnes of pulp each year

[3] CEPI Annual Statistics 1998.

to the EU countries. The biggest markets for delivered market pulp are Germany, France, Italy and the UK[4].

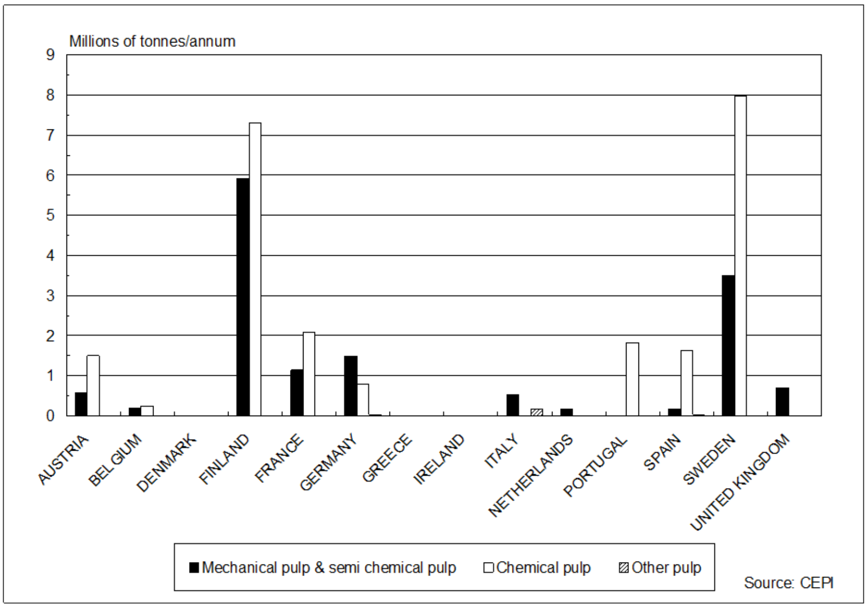
Table 6.2 Pulp Grades and End-Uses

Pulp Grade	Sub-Category	Production Process	End-Uses
Mechanical Pulps	Stone Groundwood	Pulp produced by grinding wood into short fibres.	Used mainly in newsprint and wood-containing papers, such as LWC and SC papers.
	Thermo-mechanical (TMP)	Produced in a thermo-mechanical process where wood particles are softened by steam before entering a pressurised refiner.	Same as above.
Semi-Chemical Pulps	Semi-Chemical	Pulp produced in a two-stage process, which involves partial digestion with chemicals, followed by mechanical treatment in a disc refiner.	Mainly used in production of fluting medium for corrugated board.
	Chemi-Thermo-mechanical (CTMP) (grouped under mechanical pulp in FAO statistics)	Produced in a similar way to TMP, but the wood particles are chemically treated before entering the refiner.	Pulp properties make it suited to tissue manufacture. Some CTMP is used in printing and writing grades.
Chemical Pulps	Sulphite	Pulp produced by cooking wood chips in a pressure vessel in the presence of bisulphite liquor.	Ranges from newsprint, printing and writing papers to tissue and sanitary papers.
	Sulphate (or Kraft)	Pulp produced by cooking wood chips in pressure vessels in the presence of sodium hydroxide (soda) liquor. The pulp may be bleached or unbleached.	End uses are widespread. Bleached pulp is particularly used for graphic papers, tissue and carton boards. Unbleached pulp is used in liner for corrugated board, wrappings, sack and bag papers, envelopes and other unbleached speciality papers.
Dissolving Pulps		Pulp, which is highly refined, bleached sulphite or sulphate pulp with a high content of alpha (pure cellulose) fibre.	Normally used in the production of rayon, cellophane, acetate, explosives etc (also in speciality papermaking).

Source: CEPI.

Figure 6.3 Pulp Production Capacity within the EU (1998)

4 IPPC – Draft Reference Document on best available techniques in the pulp and paper industry – 1998, by Institute for Prospective Technological Studies.



During 1998, the main grades of woodpulp for papermaking, in Western Europe, were bleached sulphate at 15.3 Mt/a, (representing about 42% of the total) and mechanical & semi-chemical pulp with 13.7 Mt/a, followed by unbleached sulphate with about 4.4 Mt/a and finally sulphite pulp, 2.7 Mt/a.[5]

Across Europe the geographical distribution of pulp production varies greatly both in terms of grade and amount produced, however, availability of raw materials is one of the main factors for this distribution. Sweden and Finland dominate in the production of woodpulp, accounting for around 30% of Europe's production each. Spain and Portugal together account for about one-tenth, with France and Germany producing more than one-tenth between them.

Within pulp grades, mechanical and chemical sulphate grades account for nearly three-quarters of pulp mills in the EU. Most sulphate production is located in Finland and Sweden, with Spain, Portugal, France and Austria making up the balance (total number of mills: 67). Most Sulphite production (total: 24 mills) is located in Sweden, Germany, Austria and France (Italy and Portugal also produce some).

Figure 6.4 Proportion of Pulp Mills in the EU (1998)

---

[5] CEPI Annual Statistics 1998.

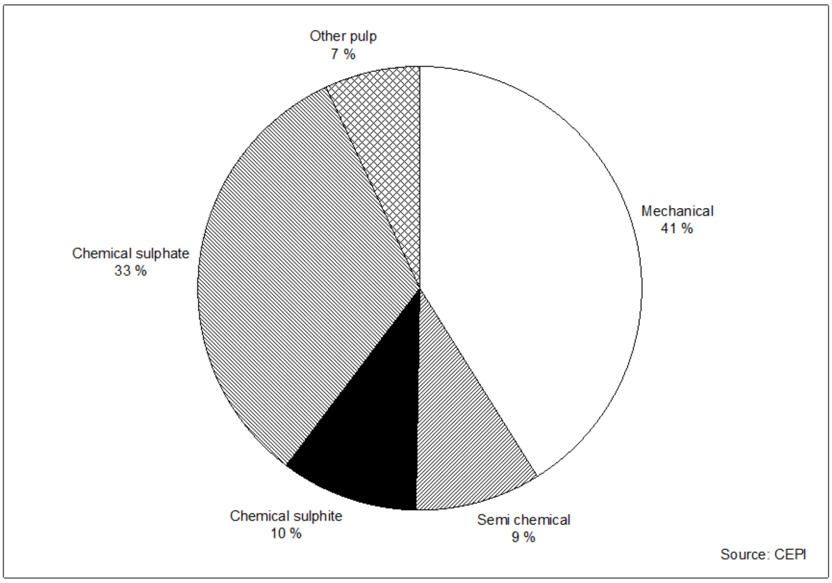
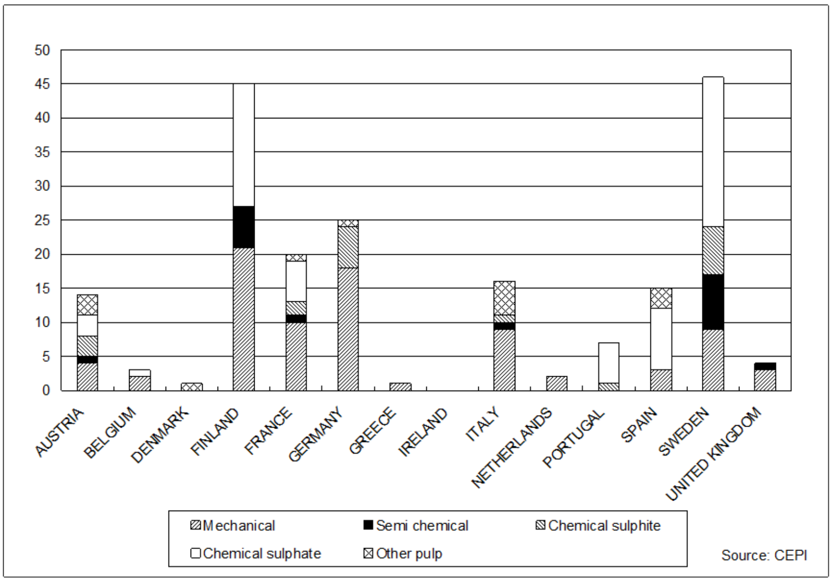


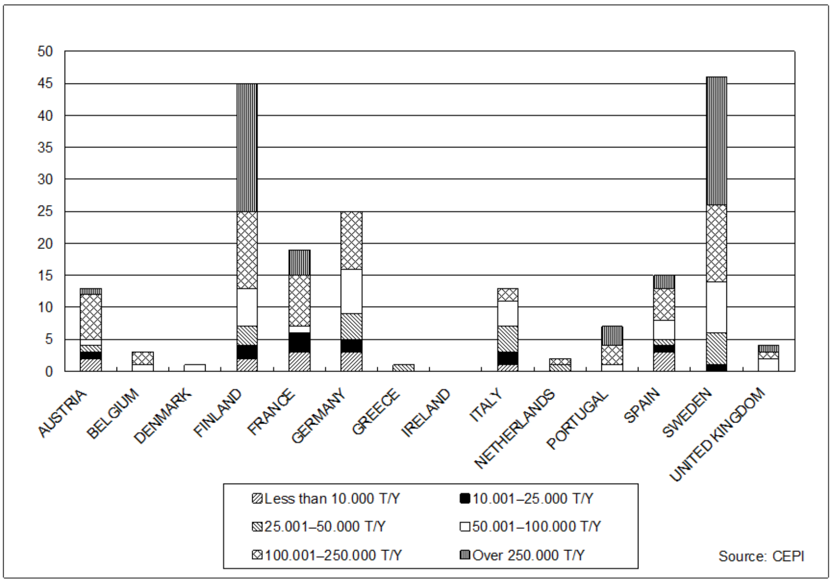
Figure 6.5 Number of Pulp Mills by Grade in the EU (1998)



In Western Europe there are more than 100 mills producing mechanical pulp, which are located in Finland, Germany, Sweden, France, Italy and Norway. The main producers of semi-chemical pulp in the EU are Sweden, Finland, and Italy.

There are about 220 pulp mills in Western Europe with around 70 producing market pulp. The average size of pulp mills in Western Europe is around 180,000 t/a. The size distribution is indicated in the figure below. Sweden and Finland have most of the larger mills over 250,000 tonnes per annum (t/a) capacity with very few mills in the size range of less than 10,000 t/a.

Figure 6.6 Pulp Mills by Volume in the EU (1998)



6.2 The Paper Industry

In 1998, paper production in the EU totalled about 78 million tonnes[6]. Throughout the 1990s, Europe has been a net exporter of paper and board, with the pan-regional export supply, more than doubling to about 9 million tonnes between 1992 to 1997[7]. The main producers are Germany, Finland, Sweden, France, Italy and the UK.

6 CEPI Annual Statistics 1998.

7 European Analyses & Forecast, by Mark Payne. Published by PPI (Pulp & Paper International), 1998.

Table 6.3 Paper and Board Production and Trade in the EU in 1998 (1000s tonnes)

Country	Production	Imports	Import penetration (%)*	Exports	Export Ratio (as % of prod)*	Apparent Consumption
Germany	16311	8429	49,5	8091	49,6	17040
Finland	12702	313	21,5	11435	90,0	1523
Sweden	9879	522	24,2	7878	79,7	2155
France	9161	5808	51,1	4287	46,8	11363
Italy	8246	3915	39,5	2242	27,2	9919
UK	6476	7408	59,4	1389	18,8	12474
Spain	4196	3097	51,0	1222	39,5	6072
Austria	4009	1082	60,3	3286	82,0	1795
Netherlands	3180	3381	77,2	2948	92,7	4380
Belgium	1545	2774	93,2	1053	68,2	2977
Portugal	1135	593	62,4	692	61,0	950
Denmark	340	1127	91,8	223	65,6	1228
Greece	322	658	69,3	30	9,3	950
Ireland	43	462	104,8	64	148,8	441
Total EU	77545	39567	54,0	44996	58,0	73267

Source: CEPI 1998; *ETLA Estimates.

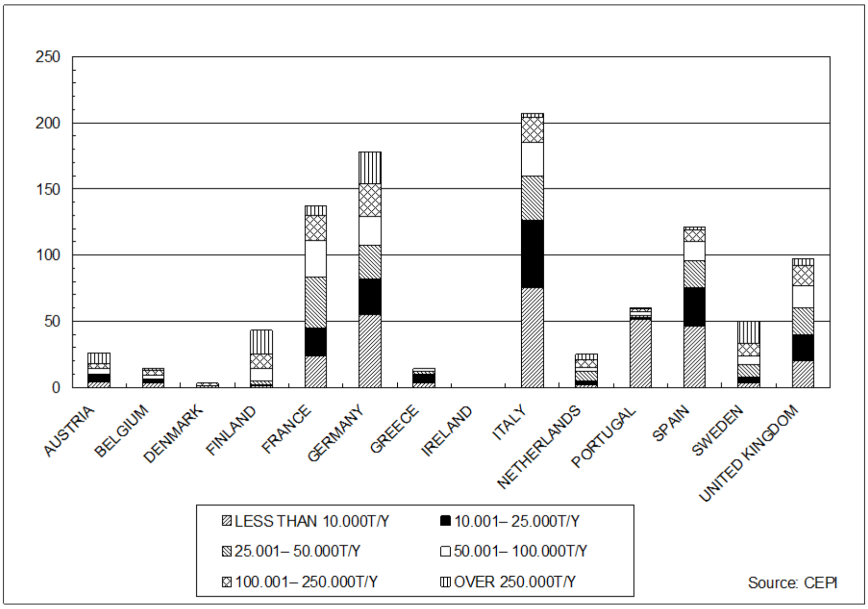
In 1998, total EU exports amounted to 45 million tonnes, with imports totalling 39.6 million tonnes[8].

In terms of paper and paperboard exports, Finland, Sweden and Germany are the largest, followed by France and Austria. Finland exports almost 90% of its paper and board production (about 11,4 million tonnes in 1998), with Sweden also exporting some 80% of its production abroad (nearly 8 million tonnes). Whilst both Germany and France are important exporters, their production is targeted more towards the domestic markets. Both these countries also import more than they export. Austria is also an important exporter, with an export ratio in excess of 80%.

In regards to the consumption of paper and paperboard Germany, the UK, France, Italy and Spain are the biggest consumers within the EU. Germany consumed some 17 million tonnes of paper and paperboard, in 1998, whilst the UK consumed more than 12 million tonnes. France and Italy are also major consumers of paper and paperboard.

Figure 6.7 Paper Mills by Volume in the EU (1998)

8 CEPI Annual Statistics 1998.



There are over 1060 paper mills in Western Europe, with most of these (about 680) being located in Italy, Germany, France and Spain. Within the very large size class, more than 250,000 t/a, there are only 66 mills. However, at the opposite end of the scale in the small size category, 10,000 t/a, there are more than 340 mills. Hence, compared to pulp production, a relatively high number of small and medium-sized paper manufacturing facilities are in operation. More than three-quarters of paper mills within the EU have an annual capacity of less than 100,000 tonnes. In fact, about one-third of the paper mills have a capacity of less than 10,000 tonnes per year.

Of the 78 million tonnes of paper and board produced within the EU, during 1998, 39% was paper for packaging, 11% for newsprint, 39% other graphic papers - such as printing and writing papers - about 6% was for Sanitary & Household papers (tissues) and the remaining 5%, for other papers. The table below gives an outline of some of the main functions and uses of paper and paperboard, plus some important trends.

Figure 6.8 below shows how the paper manufacturing industry is more widely dispersed across Europe than the pulp industry, in terms of mills and paper grades. In this figure, *graphic papers* include:

Table 6.4 Function and Use of paper and paperboard

Functional Use	Typical Grade	Typical End Products	Important Trends
Information -Collection -Distribution -Storing	-Newsprint -Coated and uncoated - magazine (SC and LWC) -Coated and uncoated wood-free (printing & writing)	-Newspapers -Magazines -Journals -Books -Computer printouts -Xerographic copies -Inserts -Illustrations	-Increased use of multicolour printing & copying -Electronic media taking over banking & trading documents -Increased use of additives
Packaging -Transportation -Distribution -Protection	-Liner -Sack -Corrugated medium -Folding box board -Liquid packaging board -Wrapping	-Bags -Boxes -Wrappings -Containers	-Increased use for distribution of food -General increase in recycling of packaging materials -Increased use of composites
Hygienic -Personal care -Disease prevention	-Tissue -Towel -Sanitary	-Toilet tissue -Diapers -Facial tissue -Industrial towels -Hospital clothing	-Use increases with general living standard -End of chain for recycling of fibres -Use of virgin fibre for top-end products
Speciality -A great variety	-Official papers -Filter papers -Fire resistant papers	-Notes -Stamps -Air filters -Coffee filters -Baking paper	-An ever-increasing number of new applications

Source: IPPC – Draft Reference Document on best available techniques in the pulp and paper industry – 1998.

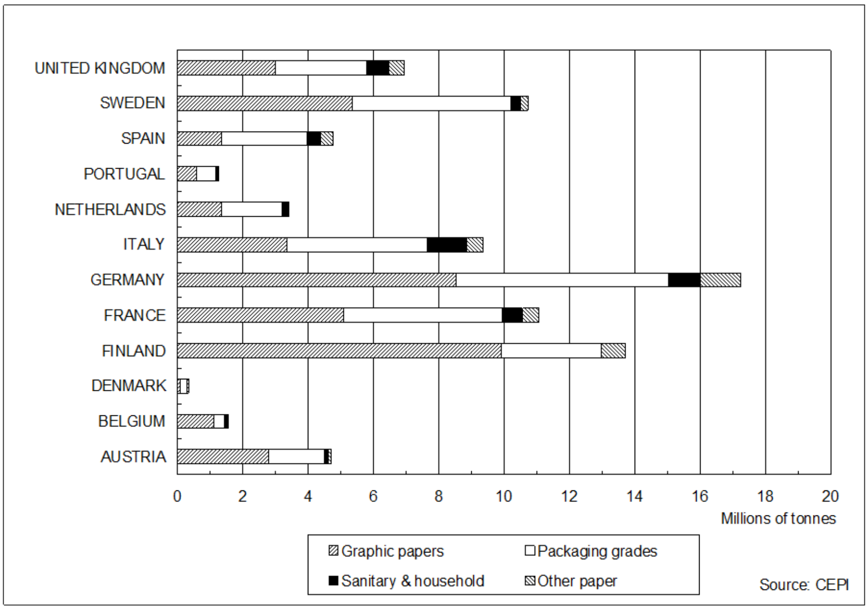
newsprint, uncoated mechanical, uncoated woodfree, coated papers, *sanitary and household papers* include: tissue and other hygienic papers, whilst *packaging papers* include: case materials, folding boxboard, wrapping up to 150 g/m^2 and other papers mainly for packaging.

The increased use of recycled fibres by the Central European producers has caused the location of industry to shift to the large consumer centres, such as Germany[9]. Due to the nature of newsprint, as a commodity paper grade, production units are large per machine capacity, amounting to an average of 145,000 t/a in Western Europe. Newsprint production has traditionally concentrated in Finland and Sweden, however, in recent years this situation has been rapidly changing.

Figure 6.8 Paper Production Capacity in the EU (1998)

---

9 IPPC – Draft Reference Document on best available techniques in the pulp and paper industry – 1998.



In 1990, Sweden and Finland were the top two producers of newsprint in Western Europe accounting for 29% and 16% of production, respectively. By 1995, Sweden's share had dropped to 25% and Finland's to 13%. At the same time, shares for Germany and France had grown to 19% and 9%, respectively. Moreover, by the year 2000, it is forecast that shares for both Sweden and Finland will have declined further, whilst Germany and France will have become even more important via capacity increases. Furthermore, shipments of Canadian newsprint to Europe are expected to rise in the near future.[10]

Within the production of graphical papers (printing and writing), some 42 million tonnes were produced in Western Europe, in 1998. Of this total, one-quarter was newsprint, 18% was coated mechanical, 20% coated woodfree, 24% uncoated woodfree, with uncoated woodfree accounting for a further 12%. The main producers of graphic papers in the EU are Finland and Germany, followed by Sweden, France, Italy and the UK.[11]

Table 6.5 Printing and Writing Papers (Graphic Papers)

---

[10] CEPIPRINT Demand – Supply report Newsprint and Magazine paper grades 1999-2001, Feb 1999.

[11] CEPI Annual Statistics 1998.

Paper Grade	Printing Process	Paper Usage and Composition	Weight	Brightness ISO and Colour
Newsprint (uncoated wood-containg)	Used in reels for Letterpress, Offset or Flexo Printing	Primarily used for Newspapers. It is made largely from mechanical pulp (not less than 65%) and or/waste paper. It is machine finished or slightly calendered.	Standard: 40-57 g/m² But upto 65 g/m²	Standard: Max 59 Improved: Max 71 white or slightly coloured
SC Magazine Paper (uncoated mechanical – groundwood or wood-containing)	Using Gravure, Offset or Letterpress Printing (also Rotogravure)	Primarily used for the publication of consumer magazines, catalogues, advertising material. It is made from mechanical pulp with a large content of mineral filler. It is super-calendered (as name SC implies).		SC B Magazine: Max 68 SC Standard: Min 71 The paper is white
Coated Mechanical Paper in Reels (LWC is coated woodcontaining) (Coated papers)	Using Gravure or Offset Printing	Mainly used in the publication of catalogues, magazines and advertising material. It is made from a blend of chemical and mechanical pulp with a content of fillers and is mineral coated on both sides (with china clay, calcium carbonate etc), either on or off machine.	LWC (light weight coated) - up to 72 g/m² Beyond 72 g/m² - either MWC or HWC (medium or heavyweight coated)	The paper is white and either glossy or matt finished.
Other Uncoated Mechanical Papers in Reels		Includes high brightness newsprint paper, directory paper, thin printing grades, MF magazine paper and paper for paperback books etc. Capacity for these grades is often interchangeable. Contains all other uncoated mechanical reels apart from SC Magazine and Newsprint papers.		Varies up to high brightness

Data source: CEPIPRINT, 1999; CEPI 1998.

Wood containing printing and writing papers are mainly produced in Finland and Germany, which together account for about 60% of the total production. Wood-containing papers are supplied by large-scale integrated mills. In the manufacturing of woodfree printing and writing papers Germany, France, Finland, Italy, Sweden and Austria are the main players. The majority of the market consists of a small number of concentrated producers.[12] The table above provides some details of the main grades within printing and writing papers and their uses.

In recent years, however, technological advancements in the production of paper grades continue to blur the boundaries between traditional paper definitions, thus it is often difficult to classify the products of new paper manufacturing projects, which enter the market. According to CEPIPRINT, the following guidelines should be followed:

Improved Newsprint for Roto-Gravure – Soft-Calendered	=	SC Magazine, SC-B
Improved Newsprint for Offset	=	Newsprint, Improved Newsprint
Improved Newsprint for High Brightness (min ISO 71)	=	Other Uncoated Mechanical Reels

Whilst the above classifications help to explain some of the basic relationships with the printing and publishing industries, they should also demonstrate that the printing processes involved are an important consideration for paper manufacturers. To add to this, the versatility demanded of new paper products by the rapidly changing printing technology, posses many challenges to paper manufacturers. Clearly, this can only be achieved through close co-operation between companies in the respective industries, and indeed this collaboration is the norm rather than the exception. However, product customisation may bring even higher demands on paper producers to be closer to their customers and may thus cause a shift in the industry to the main centres in Europe (since logistics and distribution will become even more critical).

One large-scale example of this tight co-operation is a major initiative between five key European companies and a leading technical university, to develop a new generation of high performance ink jet printing on both paper and film. The 4.6 million ECU project, is one of the largest being part-funded by the European Commission's BRITE-EURAM programme. The project brings together the combined expertise in ink jet printing processes of the partners: Zeneca Specialist Colours; Arjo Wiggins Fine Papers; EKA Nobel; Olivetti-Cannon, Celfa and the Helsinki University of Technology.

---

12 IPPC – Draft Reference Document on best available techniques in the pulp and paper industry, 1998.

Zeneca Specialist Colours, provides research into colorant systems; Arjo Wiggins Fine Papers, is responsible for the papermaking process to enhance printing performance; EKA Nobel provides research on paper chemicals to improve printing performance; Olivetti-Cannon is prototyping ink jet printheads and examining consumables; Celfa is researching the coating systems and the Helsinki University of Technology is studying the ink/substrate interactions and image correction techniques.

It is anticipated that key innovations and benefits will be the production of bright, high quality colour prints without the use of expensive coated papers, increased print speeds from reduced drying speeds, improved durability of prints by enhanced water and lightfastness, improved appearance by automatic image correction, and enhanced printer reliability from optimised ink and nozzle characteristics.[13]

Within the packaging grades, the major producers of liner and fluting are Germany and France, who account for more than a third of total production. Recycled fibre-based production, concentrated in Central Europe, has grown more rapidly than virgin fibre-based production. In the manufacturing of cartonboards, both recovered and virgin fibres are used as a raw material. Recycled fibre-based grades are predominantly supplied by countries of Central Europe, whereas in the virgin fibre-based folding boxboard and liquid packaging board grades, production is concentrated mainly in the Nordic countries (this is more a function of raw material availability, than choice). Production capacity consists mostly of small mills and machines with an average machine capacity of about 30,000 t/a. An exception here is that mills located in Sweden and Finland tend to have an average machine capacity of 110,000 t/a.

Tissue production is concentrated in four countries with France, Germany, Italy and the UK producing over 70% of Europe's tissue. Although there are over 60 companies in total producing tissue, three multinationals dominate, with over 60% between them, two are American and one Swedish. However, there are still many small companies producing 10,000 t/a or less, which are private or family-owned businesses. The average machine size is very small, approximately 19,000 t/a.[14]

---

13 Press release from Arjo Wiggins Appleton, December 1998.

14 IPPC – Draft Reference Document on best available techniques in the pulp and paper industry, 1998.

Table 6.6 Packaging paper and board

Packaging Grade	Sub-Category	Production Process	End-Uses
Case Materials	Kraftliner Testliner Semi-chemical Fluting Waste-based Fluting	Made from any combination of virgin and recovered fibres and can be bleached, unbleached or mottled	Papers and boards mainly used in the manufacture of corrugated board
Folding Boxboard	Cartonboard	Made from virgin or recovered fibres, and has good folding properties, stiffness and scoring ability.	Used mainly in cartons for consumer products such as frozen food and for liquid containers
Wrappings (up to 150 g/m²)	Sack Kraft Wrapping Krafts Sulphite and Grease Proof papers	Made from any combination of virgin and recovered fibres, bleached or unbleached. May be subject to various finishing and/or marking processes.	Wrapping and Packaging Papers
Other Papers for packaging purposes		Mostly produced from recovered fibres e.g. greyboards, and go for conversion, which may be for end uses other than packaging.	Papers and boards for packaging purposes other than above.

Source: CEPI.

Some 30% of the paper mills are integrated with pulp production. Within the mechanical paper grades such as newsprint, SC and LWC, mills are usually integrated with mechanical pulp and often purchase only small amounts of chemical pulp. Integration is especially high for recovered paper manufacturing. Nearly all recovered paper mills include recovered paper processing, some of them adding purchased pulp. In Central Europe, fine paper production is mainly based on purchased pulp, whereas in the Nordic countries, paper mills have mostly been built adjacent to a pulp mill.

Historically, pulp and paper mills were, and mostly still are, located close to some body of water, since water is a major input in the manufacturing process (as demonstrated via the earlier input-output analysis in chapter 2). Rivers were used to generate the power required for pulping, to supply process water and also as a recipient for discharges from the mills. Waterways were used for the transportation of both raw materials and products. As consumption of paper and board increased, the size of the mills started to grow and frequently mills were developed close to the raw material source. However, nowadays, the global marketing of pulp and the increased use of recycled fibre now tends to favour locating new paper mills close to the market.

In terms of recovered paper, some 35 million t/a of recycled fibre, representing about 45% of the total fibres used for paper making, are used in Western Europe. Utilisation rates vary depending on the grade of paper, but in general, the utilisation rate is relatively high in newsprint (58%), tissue and other hygiene papers (64%), liner and fluting (90%) and cartonboards (52%). In contrast, graphic papers use very little in comparison, having a utilisation rate of only 7%.[15]

The production of recycled fibre is highest in countries with a high population density and per capita consumption, such as Germany, France, Italy and the Netherlands. About two thirds of the recovered paper is used for non de-inking purposes and about one third of the recovered paper is used for de-inked paper grades like newsprint, other graphic papers and hygienic papers.

EU pulp and paper companies are becoming more important in a worldwide context. The table below shows the largest pulp and paper companies in the EU, and provides world rankings by sales, as of 1998. From this table it should be evident that EU companies are growing stronger in the worldwide stage, with most of them rising up through the rankings, since 1994.

In fact, of the top 150 companies in the world, there are 58 European companies who, generate about 32% of the total sales, produce 24% of the market pulp, and manufacture 32% of the paper and board. On the other hand there are 47 North American companies who account for 46% of the total sales, produce about 50% of the market pulp, and manufacture about 45% of the paper and board. Of the top 50 pulp and paper companies, 25 are North American, 13 are from the EU, and 9 are Asian. In terms of sales from pulp, paper and converting operations, the US-company International Paper is the largest in the world with US $15,3 billion in 1998. However, in terms of production output, Stora Enso is the largest with 11,8 million tonnes of pulp and paper, in 1998.

Despite the economic turmoil in Asia, Latin America and Russia during 1998, North American and European pulp and paper pro-

[15] CEPI Annual Statistics 1998.

Table 6.7 Top Pulp and Paper Companies in the European Union - 1998

Company (Sales from pulp, paper and converting operations only)	Sales ($ million)	Sales by Segment ($ millions)			Production 1997 (1000s Tons)		Employees	World Rank 1998	World Rank 1994*
		Pulp, Paper & Board	Converting	Merchanting	Market Pulp	Paper & Board			
Stora Enso (Sweden/Finland)	8,949	7,884	323	741	1,964	11,758	40,679	2	10/16
UPM-Kymmene (Helsinki, Finland)	7,789	5,318	1,874	0	0	7,499	32,351	5	4
SCA – Svenska Cellulosa (Stockholm, Sweden)	5,798	na	na	Na	0	4,921	32,082	7	21
Arjo Wiggins Appleton (Basingstoke, UK)	5,271	2,747	0	2,524	na	1,920	18,938	10	12
Jefferson Smurfit Group (Dublin, Ireland)	4,117	na	na	Na	0	4,222	25,430	14	22
Metsä-Serla (Espoo, Finland)	3,920	na	na	Na	na	3,446	14,611	16	36
AssiDomän (Stockholm, Sweden)	2,516	1,214	1,302	Na	283	1,829	17,543	22	31
Modo (Stockholm, Sweden)	2,139	na	na	Na	462	2,658	9,586	27	24
Haindl'sche Papierfabriken (Augsburg, Germany)	1,793	na	na	Na	0	2,235	4,191	33	38
Cartiere Burgo (Turin, Italy)	1,641	1,610	0	31	141	1,832	5,510	39	37
Kappa Packaging (Naarden, The Netherlands)	1,587	651	936	0	0	1,952	8,306	40	4
Frantschach (Vienna, Austria)	1,437	839	349	249	305	1,127	7,135	42	62
Myllykoski (Anjalankoski, Finland)	1,266	na	na	Na	0	1,634	3,328	46	Na
Mayr-Melnhof (Vienna, Austria)	1,006	657	409	0	0	1,124	5,240	50	53
David S. Smith Holdings (London, UK)	988	na	na	Na	0	1,000	10,200	52	46
Ahlstrom Paper Group (Helsinki, Finland)	905	784	120	0	0	710	5,363	59	85
Torraspapel (Barcelona, Spain)	727	370	0	357	0	662	3,420	67	68
MD Papier (Dachau, Germany)	675	na	na	Na	0	742	1,656	71	91
Schoeller Holding, Felix (Osnabrück, Germany)	648	648	0	0	0	294	2,437	73	81
Korsnäs (Gävle, Sweden)	590	415	175	0	106	508	3,866	77	83
Munksjö (Jönköping, Sweden)	569	441	129	0	126	307	2,558	80	115
INAPA (Lisbon, Portugal)	543	187	356	272	0	219	1,515	82	132
Portucel (Lisbon, Portugal)	536	440	95	0	679	498	3,061	83	86
Reno de Medici (Milan, Italy)	535	449	86	0	0	750	1,800	84	Na

Company (Sales from pulp, paper and converting operations only)	Sales ($ million)	Sales by Segment ($ millions)			Production 1997 (1000s Tons)		Employees	World Rank 1998	World Rank 1994*
		Pulp, Paper & Board	Converting	Merchanting	Market Pulp	Paper & Board			
Södra Skogsägarna (Växjö, Sweden)	534	534	0	0	1,194	0	2,600	85	89
Zanders Feinpapiere (Bergisch Gladbach, Germ.	521	na	Na	Na	0	376	2,789	87	78
Rochette, La (Paris, France)	484	na	Na	Na	0	250	2,289	91	75
Exacompta Clairefontaine (Etival, France)	436	na	Na	Na	0	135	2,567	97	119
Rossmann (Neuilly, France)	424	397	0	27	80	510	4,500	99	Na
Soporcel (Lavos, Portugal)	379	379	0	0	263	297	797	104	112
Papierfabrik Palm (Aalen, Germany)	369	na	Na	Na	0	475	1,900	106	Na
Trebruk (Uddevalle, Sweden)	352	352	0	0	0	397	1,677	108	117
BPB Paperboard (East Leake, UK)	310	193	117	0	0	418	1,688	114	101
Cartoinvest – Carrara group (Pistoia, Italy)	304	na	Na	0	0	320	948	115	146
Marchi Group (Vicenza, Italy)	303	na	Na	Na	0	354	1,123	116	142
Papierfabrik August Koehler (Oberkirch, Germ.	298	na	Na	Na	0	211	1,385	120	114
Papeteries Matussiére et Forest (Meylan, France)	265	265	0	0	0	361	1,281	122	127
Cartiere del Garda (Riva del Garda, Turin, Italy)	256	256	0	0	0	279	570	123	Na
VPK Packaging Group (Oudegem, Belgium)	254	58	196	0	0	280	1,700	124	Na
Empressa Nacinal de Celulosas (Madrid, Spain)	249	249	0	0	588	0	1,661	125	122
Emin Leydier (Oyonnax, France)	231	231	0	0	0	620	996	130	139
Inveresk (Alloa, Clacks., UK)	196	196	0	0	0	144	1,015	140	Na
Cartiere Miliani Fabriano (Fabriano, Italy)	195	195	0	0	0	115	955	141	137
Steinbeis Temming Papier (Glückstadt, Germ.	186	186	0	0	0	251	794	143	93
Rottneros Bruk (Karlstad, Sweden)	180	180	0	0	435	0	716	144	149

Source: Pulp & Paper International, 'PPI's Top 150 Companies', 1999, Miller Freeman. *PPI, International Fact and Price Book, 1997).

ducers experienced a slight increase in sales volumes which helped to boost earnings also. In contrast, Asian and Latin American producers experienced double digit slumps in sales volumes and huge drops in earnings, compared to the previous year. However, the subsequent currency devaluations, which resulted from the economic crisis, will likely place exporters from Asia and Latin America in a better position.

The process of consolidation and globalisation within the pulp and paper industries has far from reached its conclusion. The industry structure has already changed significantly. Over the last 25 years the number of paper machines in Europe has been reduced by about 60% while the total capacity has nearly doubled. Notwithstanding, concentration is expected to continue resulting in fewer companies in the future. Many companies have grown by investing in new capacity but also by consolidating a large number of small obsolete paper and board mills. Hence, the European Paper industry is now comprised of a relatively small number of very large multi-national groups at one end of the industry and a large number of small businesses at the other. This large number of relatively small-scale mills, have differentiated themselves by developing product niche strategies. In fact, this phenomenon is discernible in table 6.8 below.

Table 6.8 Change in Industry Structure since 1994

Company category (ranking)	% of Sales		% of Earnings		% of Market Pulp Production		% of Paper & Board Production	
	1994*	1998	1994*	1998	1994*	1998	1994*	1998
1-10	33,5	**36,4**	25,6	**47,7**	23,0	18,8	29,4	**31,1**
11-20	19,5	17,8	20,9	2,3	18,9	12,9	19,5	17,9
21-30	11,1	10,6	12,6	**18,6**	4,6	**12,7**	10,2	**12,0**
31-40	8,0	8,0	11,0	9,5	7,7	3,8	10,9	10,3
41-50	5,7	**5,9**	6,5	**12,6**	5,2	4,7	6,5	**6,7**
51-60	4,5	4,3	4,8	1,0	4,0	3,8	5,7	4,9
61-70	3,6	3,5	4,5	2,0	4,8	2,9	2,9	**3,4**
71-80	2,7	**2,9**	2,4	2,7	7,5	5,8	3,4	2,7
81-90	2,4	2,4	3,5	1,7	5,8	**9,5**	2,1	**2,2**
91-100	2,1	2,1	1,6	1,0	3,6	**9,2**	2,6	1,8
101-110	1,9	1,7	2,2	0,4	4,8	0,9	1,7	**2,3**
111-120	1,6	1,4	1,7	**2,5**	4,1	3,6	1,2	**1,6**
121-130	1,3	1,2	1,3	-1,6	1,6	**4,7**	1,3	1,2
131-140	1,1	1,0	1,0	-0,7	1,5	**3,0**	1,6	1,1
141-150	0,9	0,8	0,5	0,1	3,0	**3,7**	0,8	1,0

Data Source: Pulp & Paper International, September 1999, Miller Freeman.
* PPI, International Fact and Price Book, 1997.

Whilst table 6.8 provides some indication of the consolidation within the pulp and paper industry, there has been no effort to conduct any type of analysis. However, what is clear is that the industry is slowly consolidating in different ways. For example, paper and board producers are becoming larger and more dominant, with those at the top able to increase sales and to secure higher margins, whilst market pulp producers are becoming smaller, having lower sales and earnings. The net result is that companies appear to be specialising more on core activities. One example of this is SCA, which has stated that it intends to limit its operating risk by rebalancing its portfolio toward higher percentage operations that are less sensitive to fluctuations in the economy[16]. Market pulp is highly sensitive to economic trends, and although as recently as 1995, SCA produced some 375 tonnes of market pulp the company does not produce market pulp any longer. Hence, the company now focuses more on its hygiene and packaging business.

The ownership structure has also changed significantly during the past ten years or so. One of the main trends has been concentration of producers into larger companies and integration of paper mills with overseas pulp producers or acquisitions or financial co-operation relationships between European and overseas manufacturers. Companies from the US, South Africa or Indonesia have been integrated in or have established closer business relationships with European paper and board producers. At the same time, there has been more regional and local integration within and between EU countries, such as the merger between Stora of Sweden and Enso of Finland. Indeed, this merger is believed to have sparked off another new wave of M&A activity in Europe which will continue in the foreseeable future.

6.3 M&A Activity[17]

In Europe, there have been many large mergers and acquisitions during 1998 and 1999. Examples of recent M&A activity are; the merger of Stora Enso; the merger of fine paper operations of Modo and SCA; the acquisition of UK Paper by Metsä-Serla; the acquisi-

---

[16] PPI – September 1999.

[17] PPI – As companies get bigger are profits getting fatter?, pp 17-23, September 1999.

tion of Papierwerke Halstrick and Strepp Papierfabrik by Metsä Tissue; the acquisition of Portucel's Prado by Finpro; the alliance between David S. Smith and Kappa Packaging and Saica, and the takeover of the Smurfit Condat mill by CVC Capital Partners & Cartiere del Garda, to list but a few.

Despite the M&A activity there are a number of factors which will control the pace of consolidation in the future. Firstly, the question of whether shareholders are really benefiting from all the mega-mergers and acquisitions remains to be seen e.g. does 'bigger' mean 'better'. Secondly, there is the issue of whether the M&A activity is helping to reduce volatility in the forest products sector. Finally, there is also the question of how developments in Asia and Latin America present other opportunities in these regions.

According to PPI, "The main attraction and driving force behind consolidation is the search for synergies. Size makes for lower costs in external purchasing and helps optimise production, while on the sales side, synergies facilitate co-operation and help access wider markets. Consolidation also helps optimise investments, which is clearly very important for a capital-intensive industry."

According to a number of financial analysts, a general trend of M&A activity for smaller companies in Europe will emerge. For these companies benefits will be a cut in distribution, marketing and overhead costs, with better possibilities to transfer capacity to gain benefits of machine specialisation within Europe. At the same time, larger companies will be looking abroad.

Within the European paper industry, magazine paper and newsprint have become the most concentrated segments of all. Since 1995, the three largest producers of magazine and newsprint have increased their share from 35% to around 55%. Indeed, there are now only two major producers of wood-based publication papers in Europe, Haindl from Germany and Cartiere Burgo in Italy. However, even with this high level of concentration, it is believed that there is still room for further consolidation, even in Scandinavia.

Moreover, according to PPI[18], continued moves in this direction will further add to the competitiveness of the printed information channels, whilst it is also thought that it will be difficult for a small

---

[18] PPI – Viewpoint *Europe takes another crash course in consolidation pp 5, September 1999.

number of medium-sized mills to be capable of supplying the large international publishers of the future.

Within the European newsprint sector, the future is less clear. During the 1990s a differential developed in production costs between virgin fibre and recycled fibre-based newsprint. Producers who followed the fibre-based strategy have so far experienced the lowest margins. Subsequently, over recent years recycled fibre plants have emerged at mills across Europe. This wide cost differential between different regions and companies has led low-cost producers to believe that they can add capacity and yet stay profitable, regardless of how prices develop. Notwithstanding, producers not belonging to the low cost group feel compelled to join in to remain competitive.

In contrast, magazine producers are in a different position since the sector has a more uniform cost structure. For example, recycled fibre plays a very small part in the equation here. Hence, this situation means that these grades are more attractive, and that average profitability in magazine paper has been higher than in newsprint.

Nonetheless, there are a number of prime candidates where consolidation is more likely in Europe. The fine paper sector is one area and corrugated and containerboard, another. Uncoated fine paper could benefit from more consolidation, since below the top five producers there are many other manufacturers. Increased competition from outside Europe could mean that non-integrated producers may suffer worst, since fine paper prices will not move up as much as pulp prices. Already, the link-up between SCA and Modo is seen as paving the way in this sector.

In other areas of the globe activity has not been as high as in Europe, with American companies favouring M&As in North America, and with little activity in South America. However, Asia has been an active area for Europeans. For example, out of 12 major transactions (totalling over $2 billion) since 1997, nine of these were Nordic companies, only two were American and one was Japanese. Notwithstanding this activity, many analysts believe that alliances will become more preferred since these are seen as carrying less risk than large-scale mergers or acquisitions.

The above said, the question of whether big is better – is all the M&A activity actually boosting balance sheets or helping to balance supply and demand. Immediate benefits are proving difficult to pin point at present, with all the emerging market deals, which strictly speaking are long term performance strategies. Nonetheless, in the case of the Stora Enso merger, the synergies are believed to be quite substantial and can be seen quite quickly in shareholder value. For instance under-performing activities are likely to be sold off, whilst production costs can be driven down making core areas more profitable. On the other hand though, with acquisitions in emerging markets, the shareholder value is not realised until later - at least in theory.

In contrast to the above, some analysts also believe that companies will have to be leaner and more focused in the future. Therefore, bigger is not better, since this often leads management to spread itself too thinly, resulting in product or business areas not achieving their targets. Supporting this argument, is the increasing trend towards customisation in the printing and publishing industries, which suggest that paper manufacturing companies will have to get even closer to their customers.

Despite all the recent M&A activity, there are very few truly global link-ups. Nevertheless, as globalisation continues to effect the nature of the industry, it is anticipated that over the next 10 years, that the major markets of the North America, Europe and Japan, will be joined by Asia and in particular China and Indonesia. Moreover, Southeast Asian markets will likely grow and lead the world's paper consumption. International trade in paper and papermaking fibre is nevertheless expected to continue, especially from countries with fibre surpluses, which will endeavour to add value before exporting.

Fluctuations in price and demand are a typical feature of the pulp and paper industry. However, the price variation is not the same for all pulp and paper products. In general, the closer a company is to the end customer, the smaller the price fluctuations of the product. For example, the price of pulp is much more volatile than that of tissue paper. In addition, the smaller the transactions, and the smaller the customer, the smaller the variations tend to be.

The dominating pulp manufacturers are the industrialised countries of the Northern-hemisphere such as USA, Canada, Sweden, Japan, and Finland. In Europe, Finland and Sweden, still rely to some degree on the revenues from exports of pulp and paper products, although in recent years this reliance has become somewhat less. Nonetheless, the reliance is mainly due to the fact that very little import is required as a manufacturing process input before exporting the product.

6.4 Some Environmental Issues[19]

Historically, the pulp and paper industry has been considered a major consumer of natural resources, (wood), energy (fossil fuels, electricity), and water, whilst at the same time being a significant contributor of pollutant discharges into the environment. However, since the 1980s, emissions have typically been reduced by 80-90% in regions with well developed pulp and paper industries.

The main raw material, wood, is a renewable resource and in some countries sustainable forestry methods have already been implemented. The development of closed water circuits in pulp and paper mills has resulted in a reduction in discharges but further reductions can be expected especially towards 'totally' effluent free mills. In previous years, pulp mills caused serious acidification through emissions of sulphur, however, during the last few years sulphur emissions have been reduced considerably by significant advances in process technology.

Recycling of fibres from used paper in Western Europe has reached quite advanced levels, and for some grades, further progress is expected. In addition, the recovery of energy from wastes of pulp and paper manufacturing processes is possible thereby avoiding a waste disposal problem. However, there is still huge potential for increased use of efficient on-site techniques. In chemical pulping no external energy is required but the total demand of process energy is still on the high side. Mechanical pulping, recovered paper processing and papermaking in general are still energy-intensive processes caused by the fact that for papermaking the solid content of a dilute suspension of fibres (and possibly fillers) has to be brought to about 95% solids as a typical dry solid content in finished papers by means of pressing and drying (to evaporate the water).

In 1996, the overall consumption of pulpwood used for pulping in Western Europe was 119.5 million m^3 (solid under bark). The consumption of raw materials for papermaking amounted to 81.6 million tonnes. Of this total, about 46% is woodpulp, 39% recovered paper, 14% non-fibrous materials such as fillers, dyes etc. and 0.5% of other pulp.

During the 1970s-1980s, the pulp and paper industry discharged substantial amounts of waste water into receiving waters, sometimes

---

19 IPPC – Draft Reference Document on best available techniques in the pulp and paper industry, 1998.

depleting oxygen and killing fish. Moreover, from the 1970s until recently, chlorinated substances formed in the bleaching plant were the focus of attention. Thus, public concern about the potential environmental impacts imposed by the use of chlorine in the bleach plants has brought about a dramatic reduction in the use of elementary chlorine as a bleaching chemical in the last decade.

In many countries, environmental controls have been set by authorities to severely restrict discharges of chlorinated organics into the aquatic environment. Reductions in discharges have been achieved by a combination of different measures:

- The use of elementary chlorine has been replaced by chlorine dioxide and the introduction of other oxygen-containing chemicals such as molecular oxygen, peroxide and ozone.
- Due to the high reduction of chloride content of the effluents a closure of the mill system and recycling of the bleach plant effluent back to the chemical recovery system of the mill has been made possible
- Installation of external treatment plants of various designs has also decreased discharges of emissions and toxic compounds into receiving waters

To comply with market and environmental demands, the current trends within the pulp and paper industry is toward increased closure of bleach plants either by using ECF (Elementary Chlorine Free) or TCF (Totally Chlorine Free) bleaching of pulp. In paper mills an increased reuse of treated process waters by implementing advanced production-integrated wastewater treatment systems will be permitted. Wastewater discharges, environmentally friendly handling of wastes, energy saving and recovery plus reduction of odours from kraft pulp mills are expected to remain some of the future environmental priorities in the pulp and paper industry.

6.5 The papermaking process[20]

Essentially, paper is a sheet of cellulose fibres enhanced with a number of various constituents such as minerals, pigments and fillers to achieve the desired characteristics to suit its intended end use. In general, the terms paper and board are distinguished by the

[20] IPPC – Draft Reference Document on best available techniques in the pulp and paper industry, 1998.

weight of the product sheet. For example, paper is the term used to classify a product sheet which weighs less than 150 g/m², whereas a heavier sheet is regarded as a paper-board.

In general, the pulp for papermaking may be produced from virgin fibre by mechanical or chemical methods or may be produced by re-pulping waste paper into recycled fibre. During the pulping process, the raw material - containing the cellulose – is broken down into its individual fibres. Wood is the main raw material used, however, straw, hemp, grass, cotton and other cellulose-bearing material may be used. The exact composition of wood varies according to the type and species but the most important constituents are cellulose, hemicellulose and lignin.

Wood naturally contains about 50% water and 50% solids. The solid element comprises 45% cellulose, 25% hemicelluloses, 25% lignin and about 5% organic and inorganic materials. In chemical pulping, chemicals are used to dissolve the lignin and to release the fibres. Both the lignin and other organic substances are held in solution from which the chemicals and the energy content of the lignin and other organic substances may then be recovered. The actual degree of recovery depends upon the chemical base and process configuration utilised. In mechanical pulping, mechanical shear forces are used to separate the fibres, but most of the lignin still remains with the fibres.

Paper produced from waste paper, using recycled fibre, involves the cleaning of contaminants before use and may also involve deinking depending upon the quality of material recycled and the requirements of the end product. Depending on the quality of the recycled material and the purpose of the end product, the fibres may be reusable several times. In addition, the paper product may also contain up to 45% of its weight as fillers, coatings and other substances, such as kaolin (china clay).

Although there are numerous paper products manufactured by the papermaking industry, they can nevertheless be grouped into several main product categories:

- Newsprint
- Uncoated printing and writing papers
- Coated printing and writing papers
- Packaging papers
- Packaging paper boards

- Liner and fluting
- Tissue
- Speciality papers

In each of the above product categories, end use requirements of the product generally dictate the most appropriate manufacturing process to be adopted. For example, newsprint is required in high volumes, on a regular basis, but only needs to have moderate strength, opacity, printability, and a relatively short life. Thus a manufacturing process which involves a high yield of pulp at the expense of maximum strength, brightness and texture can result in more efficient use of raw materials.

On the other hand, the critical quality of packaging papers is their strength. Therefore, to achieve the required strength, it is necessary to accept a lower yield (from the raw material) inherent in the manufacturing process. Similarly, printing and writing papers require a different balance of brightness, texture and strength, and some can be required to last for many years. Tissue papers are made to have a good dry and wet strength for their weight and typically will be used once and are not likely to be recycled, in most cases.

Box 6.1 Fibre Supplies[21]

During the last decade, forest product companies have found it difficult to improve their profitability by raising prices. Indeed, companies have restructured the make up of their cost and capital basis, reducing overheads, postponing capital investments and divesting non-core business areas. However, for many companies, one area of as yet unrealised potential, is that of fibre procurement. Fibre accounts for between 10-30% of paper manufacturing costs, 40-60% of pulp manufacturing costs, and 70-80% of saw-timber manufacturing costs. To determine whether ineffi-

procurement strategy has often failed, due to lack of co-operation and partnerships within the fibre catchment area, or 'basin'. In gen-

[21] PPI – To restructure or to be restructured, pp 53, September 1999.

eral, procurement strategies may be inefficient if the best or most effective skills are not utilised in each basin, or simply because there is lack of co-operation between different sectors of forest industry located in the basin. For example, Sawmills and Pulp mills may have different, or even opposing, interests in terms of fibre materials. Hence the real challenge is to ensure that the correct fibre reaches the most appropriate processor i.e. best quality material should go to the sawmill, whilst the most suitable fibre should be sent to the pulp mill.

Fibre procurement lies at the very heart of the forest-based industries. The main issue is one of rising prices and diminishing power. For example, there are two emerging trends; increasing sophistication on the supply side and increasing power on the demand side. As both timber owners and end users increase their buying power and sophistication, forest products companies must deal with the problem of making acceptable returns for their shareholders. Supply and demand conditions are pushing the price of timber higher, while the relative share of power of the forest product manufacturers is declining in comparison to their suppliers and customers, hence forest product producers are unable to pass on price increases in fibre or raw materials.

On the supply side, the structure of timber ownership and the intermediaries that operate between the parties has changed over recent years. In many cases this has resulted on upward pressure on fibre prices. On the demand side, pulp, paper and saw mills have all witnessed increased consolidation of their respective customers they sell to, resulting in increased buyer power. For example, customers of pulp producers - paper & board manufactures - have consolidated, whilst for paper & board producers distributors, retailers and printing and publishing companies have also consolidated. In the area of solid wood products such as from sawmills, wood wholesalers, retailers and even furniture producers have also consolidated. To add to this environmental pressures are also on the increase. Powerful customers are demanding environmental performance guarantees, consumers are increasingly more environmentally aware, and government legislation is also being implemented in many areas, which impact on the forest products industry.

In terms of logging, the output of the logging company depends on their equipment, skills and management. In many parts of Europe logging is still labour intensive with many small family-run companies who are often capital-constrained, whereas in other are-

After wood timber has been felled, the problem of getting the right log to the right mill emerges. For example, to obtain the highest value from any timber, a particular log must be delivered to where its end-use will enable the realisation of its full value. Hence, saw timber should not be merchandised as pulpwood given the price differentials between each. This means that the timber selection process itself must be optimised. In areas where there is no automated technology for assessment of merchandising value, loggers must make the judgement by eye, but since the motivation of the loggers is often volume, there is little incentive to ensure logs end up at the right mill.

Therefore, with better co-operation throughout the value chain - between logging companies and buyers, and between the different groups of wood fibre buyers in any particular basin - more efficient operations can result in not only cost savings but also quality improvements.

6.6 Manufacturing Companies within the Pulp and Paper industry

Previously, in table 6.8, we provided a summary of some of the main pulp and paper producers within the European Union. Although we would prefer to describe these companies and many more in detail, space is limited so we have chosen to describe a selection of the some of the main producing countries in Europe. However, the reader should quickly observe that companies are not confined to national borders, in fact, most of the companies, previously listed, have tentacles stretching throughout many parts of Europe, via subsidiaries and acquired interests. Moreover, many companies are expanding into Eastern Europe and Russia. Some examples include: Stora-Enso, Metsä-Serla, SCA, Assi Domän, Munksjö, Södra, The Otor group and Rossman Group.

6.6.1 Germany

With over 104,000 km² of forest area, Germany has an abundance of pulpwood resources. However, the country has not developed a capacity in pulp production to match that of its huge paper and board industry. This is partly due to the German nation's affinity with the natural environment, which has grown stronger over the past decades. Germany has 19 pulp mills, 13 of which produce mechanical pulp, with an annual capacity of nearly 2 million tonnes per year, and an average mill size of 100,000 tonnes per year.

About three-quarters of wood pulp is imported by paper makers in Germany, with sulphate pulp (mostly bleached), which is not produced in Germany, the most important. The vast majority of chemical pulp imports come from Western Europe, with Finland and Sweden accounting for more than 40% of this. Both Canada and the USA are also significant importers providing about 30% of the total. However, the proportion of woodpulp of the total fibre requirements in paper and board production has steadily declined. For example, between 1992 and 1997, recovered paper consumption grew by 40%, with paper recovery also rising as much.

In Germany, the collection of paper and the use of recovered fibre has long since been considered important, since this not only helps to conserve forest resources and to reduce the imports of virgin fibre but also as it placates the recycling concerns of the environmentally conscious consumers. According to PPI, the strong growth in secondary fibre recovery in Germany has been initiated by the environmental movement during the 1990s. However, the growth has been facilitated via the introduction of legislation mandating the recycling of packaging.

The German paper and board production sector is the fifth largest in the world after the USA, China, Japan and Canada. In 1998, some 16,3 million tonnes of paper and board were produced in Germany. During the 1990s, the paper and board sector has grown stronger with output. The strongest production growth has occurred in the printing and writing paper sector. Throughout the 1990s, graphic papers have benefited by the growth in print advertising, in printing activity and in the demand for office papers for facsimile machines, computers and laser printers.

During the period 1992 to 1997, exports of paper and board from Germany (7,7 million tonnes) grew by 60%, producing a trade surplus in the sector for the first time. In 1997 alone, export shipments increased by more than 17%. The largest exports are printing and writing papers, particularly coated mechanical and woodfree papers, with case material also being considerable. The strong growth in exports is partly due to currency movements and the fact that German papermakers have improved costs and productivity through rationalisation and other measures and partly due to the strength of demand in several key export markets.

The proportion of exports to output has steadily increased over the 1990s and by 1998, the export ratio of paper and board had almost reached 50%. One of the most important export markets has been France, however the UK, the Netherlands and Italy have also been significant for German papermakers. Exports to Eastern Europe have grown by 60% in 1997.

In terms of imports, Germany is the world's second largest market for paper and board after the USA, with imports of 7,2 million tonnes in 1997. Sweden and Finland are by far the most important suppliers of paper and board, accounting for more than one-third of German paper and board imports in 1997.

In Germany, the distribution channels for the paper and board producers can be divided into four main areas such as exports (40%), to wholesalers (9%), to direct customers (38%), and for further in-house processing (13%). Individual grades generally follow this distribution, however, in this case of printing and writing papers, about 50% is exported, with 29% being supplied directly to customers, processors or end-users, and as much as 21% being dispatched to wholesalers.

The German paper and board industry is the most substantial in the EU. In 1997, it had about 200 mills and a capacity of around 17 million tonnes per year, and employed more than 45,000 persons. Notwithstanding the shear size and strength of the industry, the German paper and board sector has been the target of a significant amount of foreign involvement, particularly in the 1990s. Several of the world's largest multinationals from North America and Scandinavia have acquired or taken control of most of the leading German pulp and paper companies.

In the early 1990s, the Swedish group Stora took control of Feldmühle. In 1995, SCA, also from Sweden, took a majority interest of PWA, the largest German paper group at that time, subsequently taking full control in 1998. A number of other large multinationals now have controlling interests in the German pulp and paper industry. These include Mercer International, Sappi, Stone Europa Carton, Proctor & Gamble, Kimberly-Clark, Attisholz, International Paper, Metsä Serla, Myllykoski, Stora Enso, UPM-Kymmene, Jefferson Smurfit, and the Ahlström paper group.[22]

In fact, the German paper industry is largely in the control of foreign hands. Of the six German companies ranked in the World's 150 largest paper companies, in 1997, only one remains German, Haindl. This list of German companies includes Haindl'sche Papierfabriken (Haindl), Felix Schoeller Holding, MD Papier, Zanders Feinpapiere, Papierfabrik Palm, and Papierfabrik August Koehler.

In 1997, **Haindl** had a turnover of $1.8 billion US and employed some 4,200 people. Haindl is comprised of Haindl in Germany, Steyrermühle in Austria, Parenco in the Netherlands, and the Port Townsend Corporation in the US. The group operates in three main business sectors but is also active in a number of secondary areas. Newsprint and coated papers are the group's main sectors of activity, which are complemented by miscellaneous printing and writing papers. In 1996, the company acquired Steyrermühle to become the joint second largest European producer of newsprint (with Norske Skogindustrier) after UPM-Kymmene. At the same time the company also became the third largest European producer of mechanical publishing papers in reels. The company has made significant investments to add capacity in the area of lightweight coated papers.

The **Felix Schoeller group** is one of the world's largest specialist paper manufacturers, with operations in Germany, the USA and the UK. Schoeller has four main product categories, photographic base papers, papers for digital imaging, technical papers, and decor papers. In 1995, the company acquired the Glory Paper Mills in the UK. By the year 2002, the company plans to have increased its capacity for photographic base papers from 200,000 to 360,000 tonnes per year.

Papierfabrik Palm has a core strategy in its main sectors to supply products based exclusively on recycled fibre. The company has three paper mills, producing newsprint and paperboard, however considerable capacity increases (a new 250,000 t/a) were announced for its newsprint mill at Eltmann. In 1997, the company had a turnover of $370 million US and employed 1,900 persons.

Papierfabrik August Koehler is one of the leading producers of carbonless copy papers in Europe. In 1997, it had a turnover of $300 million US and employed about 1,380 people. In addition to carbonless copy papers, it also manufactures other fine technical and speciality papers.

6.6.2 Finland

In 1997, Finland had the largest pulp capacity in Europe. With 195,000 km² of commercial forest, covering about two-thirds of national land area, a substantial amount of fibre supplies are avail-

[22] European Analyses & Forecast, by Mark Payne. Published by PPI (Pulp & Paper International), 1998.

able. There are about 45 pulp mills with a capacity of almost 13 million tonnes per year. Since 1990, the average mill size has increased by 30%, apparently spurred on by the country's abundance of forest resources and relatively low-cost energy, although in 1998 the industry was becoming concerned over rises in electricity prices. However, merely possessing an abundance of resources does not equate to competitive success. In fact, the Finnish pulp and paper industry has rapidly developed due to other more important factors, more to do with 'competitive' advantage than 'comparative' advantage. See box 6.2 - Case Study 'The Finnish Forest Cluster'.

In 1997, pulp production reached 11.1 million tonnes, some 1.9 million tonnes of which was market pulp. From 1992 to 1997, pulp production increased by 30%. New capacity and higher levels of paper and board production helped to increase pulp output. Exports of pulp are as high as 1,74 million tonnes (mostly sulphate), with Germany absorbing about half of this, however, imports are negligible.

Woodpulp accounts for around 90% of the total fibre requirements of the Finnish paper and board industry. Indeed, the Finnish paper industry have increasingly focused on the higher quality products, in which the use of recycled fibre is not an economically feasible option. Of the total pulp production in Finland, about 60% is chemical sulphate (the vast majority of which is bleached), while the remainder is mechanical pulp.

Since 1992, production in the Finnish paper and board industry has grown by one-third. This sustained expansion has been brought about by the industry who have attempted to boost the overall and specific qualities of main grades even further. There has also been considerable consolidation of paper companies as the industry sought to achieve a critical mass.

Paper consumption has grown in Finland, but due to the relatively small population, it is does not absorb very much of the paper produced in Finland. In fact, production is fuelled by exports, which account for 90% of paper and board production, one of the highest in Europe. Moreover, exports have risen by 2,8 million tonnes per annum since 1992. Although Imports are relatively small, they have nevertheless doubled since 1992.

Of the 12 million tonnes of paper and board produced in 1997, printing and writing papers accounted for about 7 million tonnes of this, newsprint about 1,5 mt/a and other paper and board about 2,6 mt/a, with kraft paper less than 0,5 mt/a.[23] Within the printing and writing papers, uncoated mechanical grades account for the largest share. In fact, Finland have about 50% of the production capacity in Western Europe in uncoated mechanical reels, whilst within the SC Magazine grade, they have about 40% of the production capacity (although this share has dropped in recent years). In addition, coated mechanical grades also account for a major share of production output and again Finland have a large and growing share of the production capacity in Western Europe, 35%. Coated mechanical grades include LWC and MWC.[24]

A similar picture emerges in terms of exports of paper and board (11 million tonnes) in each of the grades mentioned above. For example, printing and writing papers account for about two-thirds of exports, folding boxboards and other packaging grades around 13%, whilst newsprint accounts for around 11%. However, coated mechanical grades are the most important reaching approximately 2,7 million tonnes in 1997. This includes LWC paper grades, a key area within Finnish paper and board production. Another area of strength is within uncoated woodfree grades which has continued to grow in importance. Theses grades include uncoated fine papers.

Most newsprint exports are supplied to the EU, the main customer being the UK who absorb about one-quarter of newsprint exports from Finland. Germany are also another major destination for newsprint exports. Similarly, the export markets of mechanical printing and writing grades are Germany, the UK and to a lesser degree France. However, the USA is the third most important market. Exports of woodfree printing and writing grades are again mainly to the EU, with the UK, Germany and France the main destinations. Exports of kraft and other paper grades are mainly destined for the EU but are more evenly distributed.

Throughout the 1990s the number of paper mills in Finland has remained stable at around 43. At the same time, though, capacity has risen by one-third to over 13,0 million tonnes per year, whilst the average mill size has grown by almost 40%, reaching above 300,000 tonnes per year. Along with the substantial increases in

---

23 European Analyses & Forecast, by Mark Payne. Published by PPI (Pulp & Paper International), 1998.

24 CEPIPRINT 1998.

productivity, the workforce has also been considerably reduced, a trend which has occurred in most manufacturing industries.

The leading pulp and paper companies in Finland are UPM-Kymmene, Stora-Enso, Metsä-Serla and Myllykoski. In recent years, the industry has witnessed a higher degree of consolidation. In 1996, Repola and its subsidiary United Paper Mills, merged with the Kymmene Corporation to create UPM-Kymmene. Also in that same year, Enso-Gutzeit and Veitsiluoto merged. In 1998, Enso and the Swedish group Stora merged to form the world's largest paper group, Stora Enso. At the same time, Metsä-Serla and Myllykoski have an alliance.

As of 1998, **Enso** had 30 pulp and paper mills in a number of companies distributed across Europe; such as in Finland, Sweden, France Germany, Spain and Latvia. In 1998, **Stora-Enso** had a turnover of 10.5 billion Euro, and a combined capacity of over 13 million tonnes per year and employed over 40,000. The company operates in three main sectors, fine papers, publication papers and pagkaging board. The company's strengths are in pulp, paperboard, fine paper and publication/newsprint papers.

In 1997, Enso acquired a majority stake in the German Paper company, E. Holtzmann & Co., later taking complete control, and by 1998 a new corrugated board mill was expected to come on stream in Balabanovo, Russia. Also in 1998, Enso acquired an interest in the Thai company, Advance Agro. Later an agreement between Enso and the Japanese company, Oji Paper, gave Enso the exclusive rights to market Advance Agro's pulp and paper worldwide, except in Thailand and Japan. This followed Enso's earlier proposal to construct a 500,000 tons per year pulp mill in Indonesia, where the company was establishing pulpwood plantations. During the same year, Enso was also involved in a feasibility study for the production of pulp from palm oil plantation fibre in Malaysia. In addition to foreign acquisitions, the company has also made substantial investments in Finland i.e. between 1997 and 1999, the company added at least 900,000 tonnes per year of extra capacity to pulp and paper mills.

In 1998, **UPM-Kymmene**, had a turnover of $7.8 billion US operating 17 mills in Finland, Germany, the UK, USA and France and employed over 32,000 people. The company's strengths are magazine paper, newsprint and fine papers. Up until 1998, UPM-Kymmene, with a total paper production capacity of 8,14 million tonnes per annum, was the biggest paper company in the world. It has a representation in 53 countries and 5000 customers in 110 countries around the world. However, the merger between Stora and Enso, changed the shape of the industry.

In 1996, when the company was formed, UPM-Kymmene was the world leader in both SC magazine paper and coated mechanical paper sectors. It was also the world's third-largest newsprint producer, the fifth-largest uncoated woodfree paper manufacturer and the sixth-largest coated woodfree paper company. The company was also the leading SC magazine paper, newsprint, coated mechanical paper and uncoated woodfree paper producer in Europe, while also occupying third position in coated woodfree paper manufacturing in Europe.

Subsequent to its formation, the company has expanded in Asia and North America. For example, the company established a strategic alliance with the Singapore-based Asia Pacific Resources International Holdings (APRIL), whereby the two companies set-up fine paper operations in Europe and Asia, respectively. In 1998, the group acquired Blandin paper from Fletcher Challenge Canada providing a 450,000 t/a lightweight coated paper mill and a foothold in the US magazine market.

The company has also expanded its operations considerably in Finland, making capacity investments in both pulp and paper lines. One of the most significant took place in early 1998, when the company started up a new 400,000 tons per year light weight coated paper machine at its Rauma mill, as part of an investment programme at the plant, which also involved installation of a new mechanical pulp line.

In 1998, **Metsä-Serla** had a turnover of $3.9 billion US and employed 14,600. Most of the company's mills are in Finland and Sweden, but it also controls or has interests in a number of mills outside scandinavia. The company is part of the Metsäliito group, and has alliances with Myllykoski and with UPM-Kymmene (in pulp production). Its strengths are in pulp, coated magazine paper, coated and uncoated fine papers, packaging board papers, and tissue papers.

Since 1996, Metsä-Serla has made a number of acquistions, which have increased the company's presence within the EU and particularly Central Europe. In 1996, the company's subsidiary, Sondra Vermögensverwaltungs Gesellschaft, bought the German coated paper producer, MD Papier. Afterwhich, it sold half its interest in MD Papier to Myllykoski. At the same time, Metsä-Serla took a 50% interest in Myllykoski's own German subsidiary, Papierfabrik Albbruck. Subsequently, a considerable amount of restructuring has taken place within the German subsidiaries. In addition, the company also acquired the Swiss paper producer, Papierfabrik Biberist, making Metsä-Serla the third-largest coated paper manufacturer in Europe.

The company is also active in Eastern Europe and the CIS. In 1995, the company acquired an interest in the Komsomolets integrated containerboard and corrugated board mill, near St. Petersburg in Russia. In 1996, the company acquired a new mill for the production of corrugated board in Estonia. During 1997, it purchased a controlling interest in the Polish tissue producer, Warsawskie Zaklady Papiernicze, and announced that it was planning to buy the Kuban corrugated board mill in Southern Russia.

Metsä-Serla also has a controlling interest in Metsä-Botnia, which is a joint venture with UPM-Kymmene that operates the Äänekoski pulp mill and the Joutseno pulp mill. In 1997, Metsä-Botnia had a production capacity of about 1,8 million tonnes per annum. During 1998, Metsäliito and the Swedish company Södra announced that they were conducting negotiations with the Latvian government over possible participation in a proposed 500,000-600,000 t/a greenfield market pulp mill in Latvia.

In 1998, **Myllykoski** had a turnover of some $1260 million US and employed over 3000. In addition to its Finnish operations and ventures with Metsä-Serla, Myllykoski owns the German newsprint manufacturer, Gebrüder Lang. The company is also a partner in the Madison Paper Industries in the USA and has acquired the Utzenstorf newsprint mill in Switzerland from Biber Holding. Myllykoski also has an interest in a joint venture with pulp producer Sunila, which is also partly owned by Enso.

The company's alliance with Metsä-Serla has strengthened its position. For example, a great deal of the Myllykoski's paper production is marketed around the world by Metsä-Serla. Moreover, the strong alliances between the two companies are thought to include further joint ventures and acquisitions. Indeed, there has even been speculation that a full merger could take place, as the European paper industry consolidates further resulting in fewer but larger multinational regional and global players.

The **Ahlstrom Paper Group**, which is part of Ahlstrom Corporation, is also one of the world's top 50 largest papermakers. In 1997, following the full acquisition of two French concerns – Sibille Dalles and Sibille Tubes - the company became the world's leading manufacturers of speciality papers. In 1997, the group relocated its headquarters to the Netherlands in order to improve the organisation of its increasing international operations. In 1998, the company employed over 5000, and had a turnover of $905 million US.

The group now operates about 18 wholly-owned and two majority-owned mills, as well as two mills where it has minority stakes. The mills are widely distributed in locations such as Finland, Spain, France, Germany, Italy, the USA, Brazil, South Korea and Belgium. In Italy, the group has become more active. For example, in 1998, the Ahlstrom Paper Group's Italian subsidiary, Bosso Carte Speciali, acquired a 40% stake in the Cartiere Ascoli Marsoni, formerly part of the Binda group.

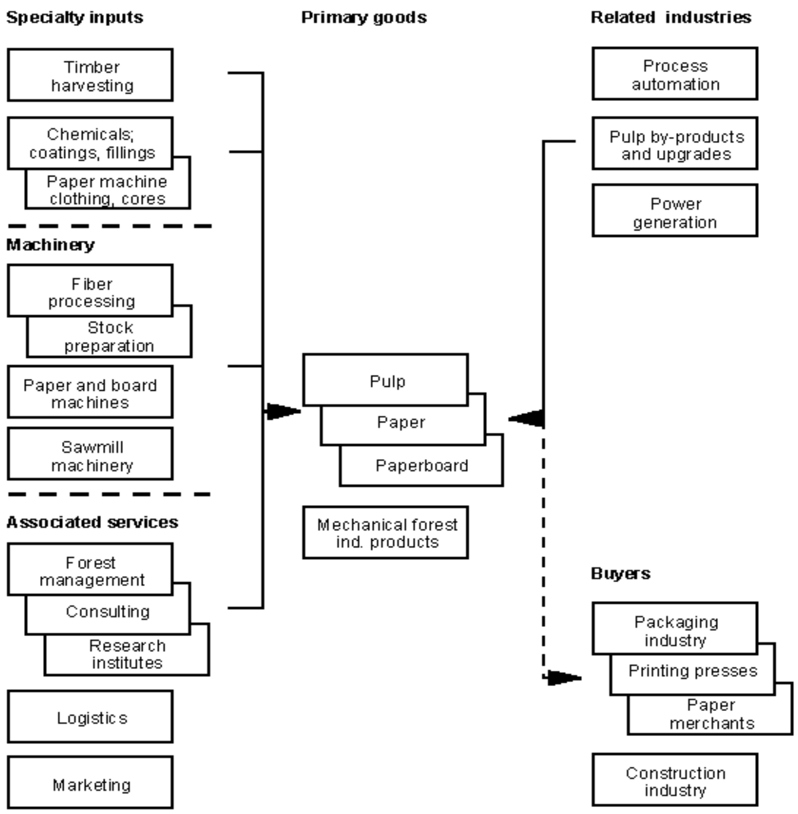
Box 6.2 The Finnish Forest Cluster - 500 and still swinging[25]

The Finnish forest cluster has developed around the key products of the forest industry: pulp, paper, paperboard, and sawn wood. The production of these has given rise to engineering workshops, speciality input producers, chemical firms, as well as service providers. Universities and research organisations are also an important part of the industrial network. Tight interplay among the participants has made the forest cluster a prosperous one.

[25] Follows mainly M. Lammi, 1994, The success story of paper, machines and know-how - the competitive advantage of the forest cluster, The Research Institute of the Finnish Economy, ETLA B 99 (in Finnish with English summary).

The flow of wood from a growing tree to a final product proceeds as follows: Forest machines collect timber. This wood raw material is transported to the road-side, where it is lifted onto a truck. At the mill the timber can be processed in many ways: e.g. by debarking, chipping, sawing, or boards can be made. Fibre processing machines make pulp either by mechanically grinding the wood or chemically, by 'cooking' it. Stock preparation machines wash and bleach the pulp in the next stage before it is fed to a paper machine. Finally paper is coated, calendered and/or cut to size in finishing machines.

Figure 6.9 The Finnish forest cluster



Nowadays all the machinery and equipment needed in the production of pulp, paper, paperboard, and sawnwood are largely made in Finland; for instance *Valmet* is currently the world's leading manufacturer of paper machines. The forest cluster is promoted by many supporting and related industries. Project management and engineering skills have been a considerable help along the way. An efficient energy system, world-class research, and forest management & harvesting abilities have also been sources of competitive strength.

The forest cluster has evolved from wood tar burning, over 500 years ago, to the current era of sophisticated printing papers. Development of forest industry machinery and equipment has been carried out near or within the parent branch; the links between metal and wood are therefore firm. The majority of forest industry chemicals were imported until the 1970s, but since then domestic companies have gained a foothold. Today they are also able to prosper independently in international competition.

The forest industry has brought about leading engineering workshops. At the same time Finland has remained competitive in the core products: sawnwood, paper, and paperboard.

At the turn of the century *Ahlstrom* was one of the leading forest companies. It acquired engineering workshops producing, among other things, saw mills, pulp, and paper machines. In the 1980s Ahlstrom gave up most of the traditional wood refining business and concentrated on achieving excellence in engineering.

Tampella had paper mills and engineering workshops already in the 19th century. For instance, grinding mills, soda boilers, and later paper machines were made. The production of paper machines was merged with Valmet Paper Machinery in 1992, while Tampella continues to manufacture recovery and power boilers.

In 1994 the export value of the forest cluster was FIM 61 billion. It has grown on average about 6% annually since 1980. Recently the Finnish share of OECD exports has somewhat decreased as the foreign production of Finnish companies has expanded.

Different types of high quality papers top the list of most important export products(top of table 6.9): these are rather sophisticated products compared to sawnwood, which is the second most important single product. Note the impressive export market share of plywood (in the middle of table). As the bottom of table illustrates (and taking into account the export orientation of the country) Finland is the most forest dependent country in the world.

The chemical forest industry (pulp, paper, paperboard, etc.) accounted for two thirds of the total exports. The share of the mechanical forest industry (sawnwood, plywood, etc.) was about 20%, and that of machinery 6%. The vigorous growth in the exports of printing and writing paper has magnified the role of the chemical forest industry over the years. Machines are a rather new addition to the range of products offered, and growth has been rapid - since the beginning of the 1980s it has remained steady at an annual rate of 12%.

Table 6.9 Main Exports of the Finnish forest cluster and its OECD export market share

Top 10 commodities in terms of export value	OECD export mkt share 1993,%	Export value 1994, MFIM	Share of national exports 1994,%	Annual growth 1990-94, %
1 Sawn soft wood	7.9	7690	4.99	15
2 Coated mechanical paper (e.g. LWC)	32.6	7683	4.98	11
3 Uncoated mechanical paper (e.g. SC)	30.2	5153	3.34	3
4 Newsprint	7.0	2899	1.88	0
5 Folding box board	25.8	2783	1.81	7
6 Uncoated fine paper, 40-150g/m^2	13.6	2650	1.72	2
7 Coated fine paper, less than 150g/m^2	12.2	2595	1.68	29
8 Bleached softwood pulp	5.0	1859	1.21	7
9 Birch plywood	41.1	1791	1.16	1
10 Bleached hardwood pulp	11.0	1600	1.04	-1
Top 10 commodities in terms of OECD export market share in 1993	**OECD export mkt share 1993,%**	**Export value 1994, MFIM**	**Share of national exports 1994,%**	**Annual growth 1990-94 %**
1 Machinery for making pulp	44.5	764	0.50	29
2 Wallpaper base	42.5	362	0.23	5
3 Birch plywood	41.1	1791	1.16	1
4 Pitch and similar rosin preparations	36.5	44	0.03	44
5 Coated mechanical paper (e.g. LWC)	32.6	7683	4.98	11
6 Uncoated kraft paperboard, >225g/m^2	31.8	825	0.54	16
7 Unbleached hardwood pulp	31.1	18	0.01	-13
8 Viscose fibre waste	30.8	39	0.03	9
9 Uncoated mechanical paper (e.g. SC)	30.2	5153	3.34	3
10 Bituminized paper	30.1	13	0.01	-6
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of exports in OECD**	
1 Finland	39.8		6.6	
2 Sweden	22.9		7.6	
3 Canada	16.9		15.7	
4 New Zealand	14.0		1.0	
5 Austria	13.8		3.9	
6 Denmark	8.0		1.9	
7 Portugal	7.8		0.9	
8 USA	5.7		16.7	
9 Italy	5.6		7.1	
10 Germany	4.9		12.6	

Source: OECD, Board of Customs, ETLA.

Table 6.10 Some companies in the Finnish forest cluster

Company	Products and services	Net Sales, MFIM	Person-nel	Foreign net sales,%
United Paper Mills (UPM)[1)]	Printing papers, packaging materials, sawn goods	19116	15029	77
Kymmene[1)]	Papers, panels and sawn timber	18883	17100	91
Enso-Gutzeit[2)]	Paper, board, sawn goods, pulp,	17711	14747	80
Metsäliitto Group* Metsä-Serla * Metsä-Botnia * Finnforest	Paper, board, tissue, pulp, wood procurement, sawn goods	14429	13331	75
Kemira	Chemicals and pigments	11698	11156	76
A.Ahlström	Processes and equipment for pulp and paper mills, speciality papers, boilers	10842	13479	84
Rauma *Sunds Defibrator *Neles-Jamesbury *Timberjack	Fibre processing systems and equipment, timber harvesting machines, industrial valves	8505	10111	77
Valmet	Paper and board machinery, pulp drying, stock preparation	8328	12146	81
Veitsiluoto[2)]	Fine paper, pulp	6062	4587	88
Myllykoski	Printing paper	4162	3018	100
Raisio Group	Paper chemicals	3518	1958	16
Jaakko Pöyry Group	Consulting services	1328	2548	74
Tampella Power	Chemical recovery boilers and evaporators	1156	1488	over 60
Sunila	Pulp	816	355	13
Kyro (Forest Division)[3)]	Board and paper, sawn goods	733	571	95
Nokian Paperi	Soft tissue paper and converted paper products	728	780	65
Isku	Furniture	696	1683	35
Paloheimo	Sawn goods, floorings	680	826	50
Finnish Chemicals	Pulp bleaching and paper chemicals	670	379	12
Asko Group *Asko Furniture	Furniture and interior decoration	621	1191	35
Vapo Timber	Timber products	568	432	81
Tamfelt	Paper machnine clothing	428	1147	53
Visko	Fibrous sausage casings	194	206	86

[1)] merger in 1996 [2)] merger in 1996 [3)] acquired by Metsäliitto

The geographical distribution of exports has stayed the same for over two decades. Only about one-fifth of the exports goes outside of Europe, mainly to the United States. Germany has passed England as the most important destination country as new Finnish production has been set up in England. Finland is one of the largest exporters of paper and paperboard in the world, second to only Canada. Even as a producer, Finland is the sixth largest in the world.

There are four clear volume leaders in the Finnish paper industry: *United Paper Mills (UPM), Kymmene*, *Enso-Gutzeit*, and *Metsä-Serla*. UPM is the world's largest manufacturer of super-calendered coated (SC) paper, and Kymmene is the dominant company in the lightweight coated (LWC) paper, both of which are used in magazines. Metsä-Serla is also an important provider of paperboard for some highly specialised industries, such as cosmetics and tobacco. There are also some somewhat smaller firms. UPM and Kymmene merged in 1996 and the new UPM-Kymmene became the largest forest firm in Europe and No 5 in the world. Enso-Gutzeit and a medium-sized Finnish forest firm *Veitsiluoto* also merged in 1996. The mechanical forest industry has largely been owned by the big paper companies. Paper production has been the principal line of business, and saw mills have been subordinates of pulp and paper factories, restricting the development of their own competitive advantages.

Valmet has gained market shares from its main competitors, the American firm *Beloit* and the German *Voith*. *Ahlstrom* and *Rauma Sunds Defibrator* are the leading companies in fibre technology in the world. *Tampella Power* produces soda and power boilers. *Timberjack*, *Sisu Logging* and *Ponsse* manufacture logging equipment. *Raisio*, *Kemira* and several others supply half of the forest chemicals used domestically. *Kone Wood,* among others, offers wood processing machinery. The main firms are listed in the table 6.10.

Selective disadvantages in the domestic factor markets have generated competitive strength

- *The value-added had to be increased due to expensive timber*

In the past, the growth of the forest industry was hindered by limited forest resources. During the last 10 years, however, the growth of the Finnish forests has speeded up, and is currently greater than the fellings. Since the majority of Finnish forests are privately owned, the supply is not controlled by the natural growth but rather by the owners' eagerness to sell. Thanks to the rather centralised bargaining process forest owners have managed to keep the prices of timber relatively high. Expensive raw material has forced the forest industry to invest in production methods that have used timber sparingly (e.g. mechanical rather than chemical pulping). Even though there have been pressures to increase the value added, most of the products are nevertheless bulk in their nature. The role of price competitiveness is still significant.

- *The usage of chemicals is increasing*

The Finnish forest industry uses FIM 4 billion worth of chemicals annually. Chemicals have become increasingly important as a result of the use of bigger paper machines, the growing popularity of coated papers, the usage of recycled fibre, and tighter environmental regulations. The production of forest industry chemicals is expected to grow steadily.

- *The price of electricity determines cost competitiveness*

The forest industry uses one-third of Finnish electricity. Over 30% of this is produced during the pulp process by taking advantage of back-pressure power. In the past, energy has been the only input promoting cost competitiveness of Finnish companies.

- *Human capital is clearly the main strength of the forest cluster*

Forest education in Finland is widely offered and of high quality. The educational system has supported the technological knowledge of the sector. The higher education, however, is too fragmented, and there is a great deal of overlapping. Each current unit should strive to find its strength and 'centres of excellence' in each sub-sector could be created. Also, greater co-operation between different units could increase productivity.

Labour costs have accounted for one-fourth of the expenses in the forest industry. Since the 1980s labour costs have almost tripled, whereas the price of timber has risen by only one half. In 20 years the employment in the forest cluster has decreased from 150,000 to 92,000. New techniques have been applied partly due to higher labour costs. This process has increased competitiveness indirectly.

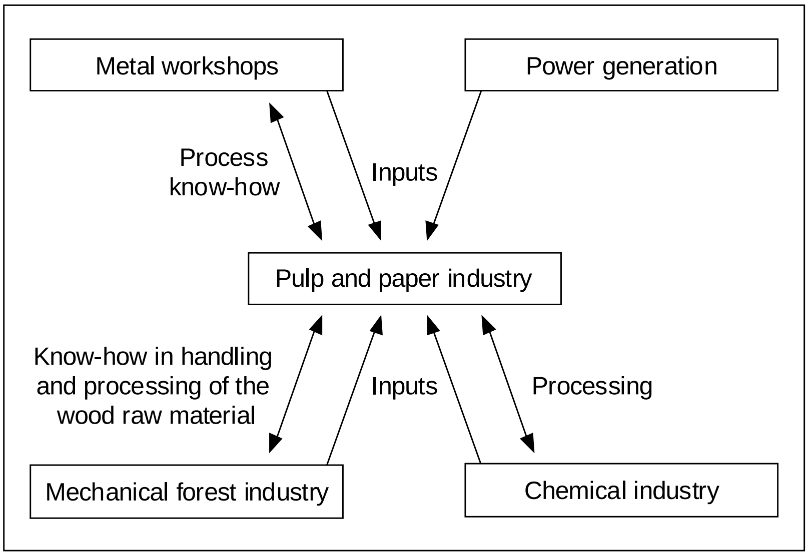
- *Efficient logistics could compensate for the unfavourable location of Finland*

Finland is distant from the main markets. Logistics costs are high in the forest industry; transportation costs alone are one-fifth of the expenses. This is a severe disadvantage, and serves as an incentive to bring production nearer to the customer.

Wood and iron: hand in hand

The forest cluster has strong related and supporting industries. In no other country has the forest industry given birth to such a range of equipment, chemicals, and services. The figure below shows the most important supporting industries.

Figure 6.10 Related and supporting industries: pulp and paper production



Metal workshops are the main source of competitive advantage as far as related and supporting industries are concerned. In co-operation, companies on both sides have acquired technological knowledge that is second-to-none in the world. This tight interaction has been a source of innovation for all parties involved. Nowadays, equipment providers are so competitive internationally, that they could undoubtedly succeed even without the support from the forest industry.

Chemical companies *Kemira* and *Raisio* have expanded their production of forest industry chemicals, and exports have picked up. Consulting has grown as well; so far *Jaakko Pöyry* has been the most successful. In addition to those mentioned, there are many other small companies in virtually all the sub-sectors of the forest cluster.

Refocusing on the customer rather than on the production

The competitive situation in the sawnwood market is intense. While the big sawmills dominate, smaller companies are numerous. Most of the products offered are rather standardised, emphasising the role of cost competitiveness.

Since there are only a few domestic producers in the forest chemical industry they have been able to co-operate in research and development. Internationally-oriented co-operation is active on other fronts as well, maybe the most concrete form being export co-operatives formed for the marketing of pulp, paper, paperboard, and their derivatives. During recent years this activity has gradually declined.

The production strategies of the forest industry have changed. While earlier the focus was on being an efficient volume producer, companies currently strive to serve their customers better by offering tailored speciality products.

The logistic chain of Finnish fine papers is long. Customers in central Europe demand fast and small shipments, which naturally increases costs. Therefore the production of certain paper grades could be more profitable outside Finland.

Finland as a home base for the forest cluster

The forest cluster has been export-oriented all along; early last century, 90% of production was exported. Compared to other Finnish industries, the history of internationalisation has been long. *Kymmene* bought the first foreign paper mill, the English *Star Paper*, in 1930. The 1960s and 1970s were decades of foreign direct investment, and in the 1980s many sizeable acquisitions were made. Already in 1980 some 10% of Finnish paper and paperboard were produced abroad - today the figure is over one-fourth. Foreign investments will continue. Finland, however, remains the favoured home base, mainly due to the vigorous cluster, allowing companies to stay on the cutting edge of their businesses.

The forest industry has permeated Finnish society. Thus, public decisions have shaped the structure of the forest cluster and vice-versa. A part of the forest industry is also publicly owned. Finland has a history of currency devaluations supporting the profitability of the forest industry. The government has influenced the field through taxation and energy policy. Some of the dynamism of the cluster has been lost due to this public risk-sharing.

Determinants of competitiveness in the Finnish forest cluster

The Finnish forest industry has continuously invested in state-of-the-art production facilities. The strategic product choices made by the leading producers have turned out to be the right ones. Ties to related industries have clearly supported competitiveness; this close interaction is most explicit between paper mills and engineering workshops. In the future the forest cluster will be able to build on the legacy of its achievements. The strength of the cluster is reinforced by the maturing chemical industry.

The greatest pressures within the cluster are faced by the pulp and paper industry: deciding the location of future production plants is problematic, and the usage of recycled fibre may reshape the competitive arena. Cost competitiveness of the Finnish SC and LWC paper producers can be enhanced by ensuring the supply of moderately priced energy.

Customers in the fine paper market require fast and small shipments of tailored products. This will add to the already high logistics costs of Finnish providers. One solution could be deliveries of domestically produced pulp to paper factories in central Europe.

The technological superiority of the Finnish forest cluster promotes production in Finland. Existing human capital could be further fine-tuned by investing in university education and by clarifying the missions of various education and research units.

The key question in the mechanical forest industry is the value-added content of the products. The share of price-sensitive bulk products should be decreased. Market and delivery channels should be trimmed.

Visions for the future: the Finnish forest cluster in an integrating Europe (As of 1996)

- With the advent of European Monetary Union (EMU), the exchange rate is out of the national control. The profitability of the forest industry can no longer be adjusted externally. Input prices (labour and timber) have to be more elastic. The efficient utilisation of existing capacity is one of the keys to profitability. Since the cyclical fluctuations in the European economy differ from that of the Finnish forest industry, domestic adaptation to business cycles is necessary.
- Recycled fibre and an increased supply of tropical pulp will put downward pressure to the domestic timber prices. Variations in the prices of the end products will also cause timber prices to fluctuate.
- Well-functioning timber markets should be able to provide the forest industry with sufficient raw material. Saw mills will continue to be subordinates of the chemical forest industry, and a

large share of the sawnwood will be basic products. Specialisation and customer-orientation, however, will increase.

- Domestic investments in the pulp and paper industry will be considerably smaller than in the 1980s. Finland is not as obvious an location of new factories as before, and capital markets are more competitive. Technological advantage is upgraded by small investments. As European energy prices are evened out, Finland becomes a less attractive home base for new production units.
- Customer-oriented production will become increasingly important. Eventually the production of fine paper will be done nearer to the final customer. Whereas an increasing share of paper will be produced outside Finland, machinery and equipment manufacturers continue to keep the majority of their activities in Finland. Exports of the forest cluster will grow steadily, and it will remain the most important Finnish cluster.

6.6.3 Sweden

With around 240,000 km² of commercial forests, covering 60% of the land area, Sweden has ample supplies of raw materials for woodpulp. With such a substantial forestry sector, it is no surprise that Sweden has an equally sizeable pulp industry. In 1997, Sweden had 46 pulp mills and a total annual production capacity of 11,4 million tonnes and an average capacity of around 250,000 tonnes per annum.

In 1997, the total pulp production reached 10,5 million tonnes, of which 3,4 million tonnes was market pulp. Sweden exports a substantial amount of pulp, averaging about 2,8 million tonnes per year, however exports have not risen since the early 1990s. The majority of Swedish pulp production (70%) is chemical pulp. In 1997, some 4,6 million t/a of bleached pulp was produced, mostly softwood pulp. About 80% of Sweden's pulp exports are supplied to the EU, with the biggest market being Germany. Over 2,3 million t/a of pulp exports were sulphate (nearly all bleached).

Even though Sweden has a substantial supply of wood materials for pulp manufacture, the country nevertheless also has a considerable recovered paper industry which has thrived throughout the

1990s. In 1997, some 1,3 million t/a of recovered paper was collected, achieving a recovery ratio of more than 60% (the European average was only 52%). The high national recovery rate in Sweden is quite an achievement given the shear size, sparsely populated areas and distances between major centres. Despite being a major exporter of paper and board, Sweden also consumes much of its production via recycling. In fact, the demand for recycled fibre in Sweden is such that it is a major importer of recovered paper, most of which comes from Germany.

Sweden's paper and board industry is also one of the largest in Europe. In 1997, Sweden produced almost 10,0 million tonnes of paper and board, making it the third largest in Europe. Exports of paper and board have traditionally been strong accounting for 80-90% of production. Sweden's industry is also highly international and in recent years the industry has become multinational in its manufacturing operations, via a large number of Swedish owned or controlled plants distributed across Europe and other parts of the world.

Of the 10,0 million tonnes of paper and board produced in Sweden in 1997, 2,5 million tonnes were printing and writing papers, 2,4 Mt were newsprint, 2,0 was corrugating materials, 1,7 paperboard, and almost 1,0 million wrapping paper. Newsprint and Kraftliner (accounting for three-quarters of corrugating materials) have traditionally been strong exports from Sweden. Within the printing and writing papers, mechanical and uncoated woodfree papers amount to almost 1,0 million t/a each.

In terms of exports, Sweden exported some 7,9 million tonnes of paper and board in 1997. Of this total, the biggest export was newsprint, followed by printing and writing papers (more than a third consisted of uncoated wood free). Case materials, folding boxboard and other packaging grades were also sizeable. Most of Sweden's exports are to the EU, 6,2 million t/a in 1997. Sweden's main markets are Gemany, the UK and France, however, Asia is also another major market.

Throughout the 1990s, the number of paper and board mills in Sweden has remained stable at 50, the production capacity has grown slightly to 10,5 million tonnes per year, whilst the average mill size has increased to 211,000 tonnes per annum. Like its neighbours in Finland, the sector is one of the most efficient in Europe, drawing on its abundance of natural resources.

The leading pulp, paper and paper converters in Sweden are Svenska Cellulosa, (SCA), Stora, MoDo, AssiDomän, Korsnäs, Munksjö, Södra, Trebruk and Rottneros Bruk. In 1997, Stora had an annual paper and board production output of 6,5 million tonnes, whilst SCA had about 5,4 million tonnes per annum. MoDo and AssiDomän also held substantial levels of capacity, both in excess of one million tonnes.

Stora and the Finnish Enso announced their merger in June 1998, creating one of the world's largest pulp and paper group **Stora-Enso**. The new group have three main product areas, publication papers, fine papers and packaging board. Based on pro-forma data for 1997, the new company had a combined annual turnover of $10.5 billion US and a total paper and board capacity of 13 million tonnes per year.

In 1998, Stora operated 4 market pulp mills in Sweden, Canada (which also produces newsprint) and Portugal, 8 publication paper mills in Sweden, Belgium, Germany, and France, 5 paperboard mills in Sweden, the UK and Germany and 5 fine paper mills in Sweden, Germany and Denmark. The company also has operations in some of the emerging markets, such as Brazil and China.

In recent years the company has made substantial investments in its mills. In 1997, the company installed a new 320,000 t/a liquid packaging board machine at its Skoghall mill, the same site also received additional capacity to its chemi-thermomechanical pulp line. At the company's Hylte mill, a further 15,000 t/a capacity was added to the newsprint line, whilst its de-inking line was rebuilt and its TMP line was upgraded. In addition the company was also installing a new recovery boiler at its Gruvön mill, which would add a further 15,000 t/a of capacity to its market pulp line.

SCA specialises in hygiene products (such as tissue papers), packaging and graphic papers. In 1998 the company had a turnover of $5.8 billion US and operated a 40 paper and board mills across Europe. SCA have adopted a growth strategy of selective acquisition of companies with complementary activities within product offerings and geographic presence, the development of new products and the increasing use of recycled fibre.

Within SCA's more important acquisitions in recent years, the company has purchased Mölnlycke in Sweden, Reedpack in the UK, Edet and Peaudouce in the hygiene products sector; Italcarta in Italy, Laakirchen in Austria, and the leading paper company in Germany, PWA. The company has also been active in other areas. In 1998, the company acquired the tissue operations of Svetogorsk in Russia. In the same year the company also acquired a 50% stake in the Brazilian group, Melhoramentos Papeis. It was also thought the company was interested in acquiring the packaging activities of the Portuguese company Portucel.

Modo specialises in fine paper, wood containing printing paper, and paperboard. In 1998, it had a turnover of $2.1 billion US, and operated 11 pulp, paper and board mills in Sweden, France and the UK. Modo is currently in a process of developing large scale cost effective production sites. International operations will be concentrated in a few large mill complexes which will focus resources through product specialisation. For example, a new 270,000 t/a newsprint machine at the company's Holmen paper mill at Braviken, was started up in 1996, with plans to add newsprint capacity to the site being implemented already in 1999. Other rebuilds include two uncoated woodfree paper machines adding 20,000 t/a to Modo's Husum mill.

AssiDomän was created in 1993, after a merger of the Assi and Domän groups. The company, with an annual turnover of $2.5 billion US in 1998, concentrates on the production of pulp, and packaging paper and board, and operate a number of mills in Sweden, France, Italy, Slovakia and the Czech Republic. The company has been active through a number of strategic acquisitions in Western Europe, one of which included the purchase of Modo packaging. In 1998, the company acquired the paper and packaging group, Esswell, which has plants in Italy, Spain, France, Germany and the Netherlands. In addition to acquisitions, the company has also made substantial investments into its mills, upgrading and adding capacity to its pulp, folding boxboard and liquid packaging board lines.

The company has also been expanding into Central and Eastern Europe via acquisitions. Some of which include purchasing a controlling interest in the largest Czech pulp and papermaker, Sepap, and also the acquisition of the Slovakian packaging materials producer, JCP Sturovo, both in 1997. One further acquisition of the Segezhabumprom pulp and paper mill in Russia, was later withdrawn after 'administrative' difficulties.

Korsnäs has one major pulp and packaging paper and board mill at Gävle, in Sweden. The company has implemented a major investment programme at the plant over recent years to substantially increase both capacity and quality of the production. The company added 80,000 t/a to its kraft pulp capacity, added 60,000 t/a paper and board capacity and was installing a further 60,000 t/a of additional capacity to its liquid packaging board line at the mill. Korsnäs expects to have an annual production capacity of around 400,000 tonnes for the production of liquid packaging board alone.

Munksjö has a total of 15 mills and in 1998 it had a turnover of $570 million US. Seven mills are located in Sweden, two in Italy and one in each of the following countries Norway, Denmark, Germany, Poland, Spain and the USA. The company has been undergoing restructuring to achieve its aim of becoming one of Europe's leading speciality paper companies. To facilitate this the company has withdrawn from lower-margin businesses within the forest products sector, and now concentrates on building its strength in niche markets were the potential returns are higher and possibilities exist for a medium sized company such as Munksjö. The company also has a strategy for expansion in Eastern Europe, with Poland a particular area of focus.

In 1997, **Södra** was the largest supplier of market pulp in Europe. The company operates three mills with a total capacity of 1,3 million tonnes per year. In 1998, Södra and the Finnish group Metsäliito entered into detailed negotiations with the Latvian government concerning the possible participation in a proposed five-six thousand tonne per year greenfield market pulp mill in Latvia. During 1999, the company was due to start up its newly expanded pulp machine at its Mönsterås mill, where an additional 200,000 t/a of capacity was being added.

Trebruk specialises in fine papers and operates through three companies, Munkedals and Hafreströms in Sweden and Kostrzynakie Zaklady Papiernicze in Poland.

Rottneros is a market pulp producer and in 1998 it operated three pulp mills in Sweden. The company's strategy is to strengthen its market position through product development, specialisation, the production of customised grades of pulp and to take advantage of the company's geographic proximity of its mills to the key European customers.

6.6.4 France

France has considerable forest resources, with over 138,600 km² of forest area covering about a quarter of the land area in France. In fact, France has substantial domestic supplies of pulpwood, with a great deal of this being located in the Landes area in South-West France. The French woodpulp industry is quite considerable. In 1997 the industry consisted of 20 pulp mills, of which 14 are integrated, with a combined annual capacity of 3,3 million tonnes and an average mill capacity of about 250,000 tonnes per year.

In 1997, over 2,8 million tonnes of pulp was produced in France. Of this total about 1,0 million tonnes was bleached and semi-bleached soda pulp (70% short fibre), and a further 0,7 million tonnes was thermomechanical pulp. However, throughout the 1990s pulp production has increased little.

In contrast, the recovered paper sector has grown quickly. Between 1992 and 1997, paper collection increased by 35% to 4,2 million tonnes, with consumption of recovered paper also increasing rapidly to 4,5 million tonnes. In fact, the consumption of recovered paper was higher than the consumption of pulpwood in 1997. During the 1990s paper recycling has become an area of national concern with the implementation of national recycling legislation.

In 1997, woodpulp imports amounted to over 2,0 million tonnes (most of which is bleached soda – long fibre). Of this figure only 36% were imported from the EU, whilst North America supplied more at 37% and Brazil provided about 9%. Notwithstanding the above, French pulp producers are nevertheless dependent on EU countries for more than 90% of their export sales, with Italy being the main customer absorbing 37% of French pulp exports.

Production in the French paper and board industry amounted to 9,1 million tonnes in 1997. During the period 1992 to 1997, production has grown by 19%. In addition, the export sector has enjoyed rapid growth throughout the 1990s, with exports growing by more than 40% between 1992 to 1997, the paper and board export ratio has also grown to nearly 50% of production.

Of the 9,1 million tonnes of paper and board production, printing and writing papers accounted for 3,4 million (over a third of which was uncoated woodfree), 2,9 million corrugating medium, 0,9 million was newsprint and about 0,7 million was speciality boards. Between 1992 and 1997, newsprint production has increased by 36%, benefiting from numerous startups and capacity expansions. Similarly tissue production has grown by the same magnitude. In addition, corrugated medium also experienced above average growth over the period.

The European Union is the main trading partner for France in both imports and exports of paper and board. In 1997, the EU accounted for 87% of imports and 82% of exports. Germany is the main supplier of imports to France, and also the main destination of French paper and board exports accounting for more than one-quarter in both cases. Finland, Sweden, Italy and the Netherlands are also key suppliers

In terms of exports, which totalled 4,3 million tonnes in 1997, printing and writing papers are the largest export accounting for about half. Corrugated medium was the next largest product export and along with newsprint has shown considerable growth in exports during the 1990s. After Germany, the main export markets for France are the UK, Italy, Spain and Belgium. In each export market, France has generally increased its share during the 1990s.

The French paper and board industry consists of about 111 paper mills, with an average mill capacity of just under 100,000 tonnes per annum. Since 1990, the number of mills has dropped from about 150 to 111, whilst the average mill capacity has doubled. However, the rapid reduction in the number of paper mills, has not been accompanied by a equally rapid reduction in employment, and indeed the pulp and paper industry now employs some 25,000 persons.

Over the past decade or so, a number of important foreign multinational pulp and paper companies have established or acquired manufacturing facilities in France. These include International Paper, Kimberly Clark, Fort James, David S. Smith, UPM-Kymmene, Norske Skogindusrier, Sonoco, Jefferson Smurfit, Stone Europa Carton, Modo, SCA, Ahlstrom Paper Group, and Stora Enso.

The fourth largest paper group in Europe, Arjo Wiggins Appleton, is an Anglo-French company which is actually controlled by French interests, but is headquartered in the UK. The largest French papermaker, by turnover, is La Rochette, followed by Otor, Exacompta Clairefontaine, Rossman, Papeteries Matussiére et Forest and Emin Leydier.

The La Rochette group operates in the packaging and pulp sectors. In 1998, it had a turnover of about 460 million Euros and employed some 2,300. The company's sales are generated 50/50 from pulp and packaging. La Rochette operates two pulp mills and a number of other mills for the production of corrugated medium and testliner plus several plants which manufacture cardboard, corrugated board packaging and wrapping paper. In addition, the company also operates a number of wood procurement, impregnation of wood plants. More than two-thirds of the company's sales are generated in France, however, Spain, Italy and Germany are also key areas.

During the 1990s, the **Otor Group** has become a major player within the European packaging materials business. The company has essentially expanded through acquisitions in France and Poland. In 1996, the company acquired a controlling interest in the former state-owned Polish board and tissue manufacturer, Silesienpap. In 1997, Otor acquired UPM-Kymmene's former Saint Etienne-du-Rouvray magazine paper mill, which was later converted to manufacture fluting and testliner and earmarked for capacity expansion of some 500,000 tonnes per year in the near future. In the same year the company also purchased the Papeteries de Riquet mill at Château-Landon, again this was also converted and now produces white-top liner.

The **Exacompta Clairefontaine** company concentrates mainly on communication papers and operates through a number of subsidiaries engaged in paper manufacturing and converting. The most significant subsidiary is Papeteries de Clairefontaine which produces communication papers such as copier and computer papers, exercise books, publishing, envelope, other stationery and cheque-book papers.

The **Rossman Group** specialises in the manufacture of corrugated cardboard and corrugating medium paper. The group has about 25 plants distributed around Europe and Africa. In Europe, operating units are located in France, Spain, Italy, Poland, Hungary and Romania, whilst in Africa, units are located in Cameroon, Ivory Coast, Burkina Faso and Ghana.

Papeteries Matussiére et Forest operates in the newsprint, printing and writing and packaging sectors and has six paper mills in France. The company's strategy aims to develop leading positions within niche markets of its principal sectors, newsprint/ book papers and non-carton packaging/envelope papers. These include markets for coloured newsprint, folded paper and card, coloured and other envelope paper, and paper for dictionaries and academic and guide books.

Emin Leydier is also a leading producer of paper-based packaging, specialising in the production of packaging paper and board. The company owns six mills, five in France and one in Italy. The main operation is centred at its 500,000 tonne per annum Papeteries Emin Leydier corrugated materials mill in France, with other operations being conducted at four smaller plants at Emin Leydier Emballages in France. In 1996, the company acquired a cardboard mill in Italy. It has been announced that the company is also considering the acquisition of other mills within the European corrugated packaging sector.

6.6.5 Italy

Although Italy has a sizeable amount of forest land, 68,000 km^2, which covers about one-quarter of its land area, it is not one of the major pulp producers in Europe. Even though pulp capacity is around 635,000 tonnes per annum, its 11 mills have generally produced much less, averaging about 425,000 tonnes per year during the 1990s. Moreover, in contrast to other EU countries, the average mill size in Italy has actually reduced during the 1990s.

Despite the relatively low levels of domestic pulp production, consumption is quite high at around 3,5 million tonnes in 1997, which is therefore satisfied by imports. In fact between 1992 and 1997, pulp consumption by paper and board producers in Italy grew by 20%, with imports rising by the same amount. Of the 3,0 million tonnes of pulp imported in 1997 nearly all was chemical and semi-chemical pulp. Only a third of pulp imports are from the EU. However, almost half of the pulp imported to Italy comes from North America, with Brazil and Chile also significant suppliers.

Over 50% of the fibre requirements of the Italian paper and board industry are satisfied by secondary fibre from recovered paper. Over the period 1992 to 1997, domestic recovery of paper has grown by a quarter to 2,3 million tonnes per year, while consumption has risen by a similar rate to approximately 3,7 million tonnes per year.

During the 1990s production levels in the Italian paper and board industry increased by 23%, and were particularly buoyant in 1997, growing by 84% from the year before. The rapid growth in the industry was assisted by export and demand growth during most of the 1990s. Production of paper and board in Italy amounted to 7,5 million tonnes in 1997.

Newsprint production experienced particularly strong growth during the mid-1990s, (almost doubling) but domestic output was well below domestic consumption. Printing and writing papers also experienced strong growth, rising by 10% in 1997 alone, due to the activity in the print media advertising sector. This has especially been the case within the coated mechanical and woodfree papers, which account for two thirds of printing and writing papers produced. Tissue papers have also performed quite well in recent years, growing by 36% over the period 1992-1997, and thanks to a push in exports, grew by 16% in 1997.

Imports of paper and board are substantial, at 3,8 million tonnes in 1997, however, the import penetration level has remained around 40% for most of the 1990s. EU countries supply most of Italy's imports of paper and board (75%). Germany are the biggest suppliers of paper and board to Italy, followed by Sweden, France and Finland. Both Austria and the USA are also significant suppliers. Of the total imports supplied to Italy in 1997, 1,4 million tonnes was printing and writing papers, 1,1 million tonnes was case materials and around 0,46 million tonnes newsprint.

In the case of exports, the Italian paper and board industry has enjoyed a boom during the 1990s. Between 1992 and 1997, exports rocketed by about 65%, growing by 12 in 1997 alone. This has been aided by the determined efforts of Italian papermakers who have attempted to develop foreign markets for their products. As a result of this push, the export ratio has gone from 17% to 24%, over the period 1992-1997.

In 1997, Italy had some 209 paper and board mills with a total capacity of 8.4 million tons per year. As in other European countries during the 1990s, Italy's total number of mills has contracted, while aggregate capacity and average mill size have both increased considerably over the decade. Similarly, employment has dropped and productivity levels have increased substantially. In Italy there are a number of substantial producers of paper and board, which include Cartiere Burgo, Reno de Medici, Binda, Cartoinvest, Cartiere del Garda, Gruppo Marconi, Cartiere Miliani Fabriano and Cartificio Ermolli who recently became more important in speciality grades.

Cartiere Burgo is the largest papermaking group in Italy. In 1998, it had a turnover of 1.5 billion Euro and employed about 5,700 persons. The company specialises in graphic papers, mostly coated. Paper accounts for about 95% of the company's sales, and although Italy is its main market where over half of sales are generated, sales in the rest of Europe have grown to 36%. The group also produces newsprint, paper for telephone directories, uncoated papers, speciality papers and packaging, which are mostly sold on the domestic market.

Burgo's manufacturing capacity is about 2.1 million tonnes of paper and about 0.7 million tonnes of pulp (chemical, wood, and de-inked pulp), largely for internal use. More than 1.6 million tonnes of capacity is devoted to the manufacture of coated graphic papers, where it is one of the leaders in Europe. It is ranked fourth in terms of production of both LWC and wood-free coated papers, whilst its share of the European market is around 10%. As part of the company's strategy to concentrate its resources on its core business, Burgo plans to install a new LWC line at its Verzuolo mill with an annual production capacity of 400,000 tonnes. The Finnish paper machinery builder, Valmet (Metso), will provide the new state-of-the-art technology line.

The group operates 11 mills, ten of which are in Italy. Burgo Ardennes SA is located in Belgium and was purchased in 1994 and comprises two plants. The Belgian plants were formerly known as La Cellulose des Ardennes, which produces woodfree coated paper and Cellardennes, which produces pulp. The group's mills are complemented by firms specialising in the various stages of the manufacturing cycle. Comecart SpA focuses on paper-mill engineering, design and construction, the Elettroburgo companies operate hydroelectric generating plants, while Italmaceri Srl collects and sorts waste paper for recycling as raw material.

Reno de Medici is the second largest Italian paper group, which was formed after the merger between Reno de Medici and the Saffa Group in 1997. Reno is Europe's second-largest carton board producer, with mills in Spain and Slovenia, as well as Italy. In 1997, the Austrian group, Mary-Melnhof acquired a 5.4% interest in Reno de Medici, and has since announced that it will take joint control of the Italian group.

Cartoinvest, which has recently been rapidly expanding, produces tissue paper and disposable paper products, as well as cardboard and corrugated paper. The group aslo produces tissue in Spain as well as Italy. Since the early 1990s, the company has continually increased its capacity and started-up a number of new tissue paper machines and converting lines. In 1997, the trend continued as the company announced plans to become the world's eighth largest tissue producer.

Cartificio Ermolli produces light weight speciality papers and tissues for many applications from food packaging to sanitary products. In 1998, the company had a turnover of about 50 million Euros. In recent years the company has been placed under new management and is now growing rapidly, through acquisitions of small speciality paper manufacturers (Monte Rosa and Denaeyer), with which it hopes to increase capacity and make considerable energy savings (energy costs are very high in Italy). Nowadays, the company employs over 650 people, and has gained considerable market shares in its speciality segments.

Ermolli's product development activities offer good insights into how companies maintain tight co-operation with their customers and suppliers. For example, within its light-weight printing papers, it conducts joint research with chemical suppliers, such as glue manufacturers where surface size characteristics are important. Within these speciality papers, technical characteristics are vital to the customers, who desire higher volumes, productivity and efficiency, yet strength is also a factor. In satisfying the customer's needs price levels have increased recently. (However, these price increases bring the threat of substitution, by plastic film products which have been developed and are now used by some customers). Hence, competition induces further product innovations. At the same time, in the area of paper backing for labelling, some labels are produced using silicon, and hence it is important that the paper backing must not absorb the very expensive silicon, whilst also being transparent to facilitate the machine eye operation. Again, this necessitates very tight co-operation between Ermolli, other suppliers and customers and further encourages innovation.

The history of Cartificio Ermolli stretches back to 1758 when the first paper mill was established in Moggio Udinese in the region of Friuli, northern Italy. Initially the paper industry thrived on the abundance of locally available raw materials such as cotton linters and rags from the textile industry. Also important was the incentive given by the Serenissima Republic of Venice to paper mills in the 18th century to constantly maintain quality and technology through the obligation of each papermaker to mark its own sheets with a watermark which was registered in Venice.

During the 19th century, hand made paper was abandoned as the first paper machine was established. The first paper mill was built adjacent to the Ermolli family timber factory, at the mouth of the Aupa and Fella rivers. Since then, despite difficult times of the second world war and earthquake damage in 1976, the company has continued to focus on technological modernisation, with regular investment in sophisticated process control equipment. Today the company is located at the confluence of the Fella and Tagliamento rivers from which it generates 60% of its 34 million KWh/year energy requirements, via its hydro-electric generator and thermo-electric power plant, which runs three paper machines.

Cartiere del Garda, which was bought in 1997 by CVC Capital Partners, is to be merged with Jefferson Smurfits's former Condat mill in France, which was also purchased by CVC in 1998. With a total capacity of 630,000 tonnes per year, the new group created has a pan-European share of coated woodfree paper segment of 9%.

6.6.6 United Kingdom

With only 10% of the land area in the UK occupied by commercial forests, the UK is one of the least forested areas of Europe. Consequently, pulp production in the UK is quite small in comparison with pulp consumption (2.26 million tonnes in 1997). To add to this, there is no capacity in the UK for chemical pulp and hence this is imported. About one-third comes from Finland and

Sweden, whilst a further 60% is imported from Canada, the USA, Brazil and Chile. However, the recovery of paper is quite substantial and growing thanks to public pressure, and thus consumption of recovered paper is as high as 4.6 million tonnes.

The UK has experienced record levels of paper and board production in recent years, and has grown by more than one-quarter between 1992 and 1997 to around 6.5 million tonnes. Consumption has been spurred on by domestic demand, which has continued to increase - so that the UK now has one of the highest levels of paper and board consumption per capita in Europe – and by increases of capacity coming on stream. Consumption of paper and board now stands at 12.2 million tonnes per year, and thus imports account for much of this. The main importers of paper and board are Finland and Sweden, who account for almost half of the total.

In 1997, there were nearly 100 mills in the UK paper and board industry, with a total capacity of 6.8 million tonnes per year. Since the early 1990s, the overall capacity has increased by over one-quarter, although the average mill size has increased a little. Nonetheless, the industry has seen much rationalisation and productivity increases, which have resulted in more than one-quarter of the work force being shed. At the same time, it has been forecast that production capacity could rise by 10% between 1997 and the end of the century.

During the 1980s and 1990s, a wave of takeovers of UK paper companies by foreign multi-nationals left only four major domestically owned paper and board producers, which are Arjo Wiggins Appleton, David S. Smith (Holdings), BPB Paper and Packaging, and Inveresk – all ranked in the world's top 150 paper and board groups. Foreign groups with interests in papermaking in the UK include Sappi, Jefferson Smurfit, SCA, Proctor & Gamble, Kimberly-Clark, International Paper, Fort James, Mondi, Fletcher Challenge, UPM-Kymmene, Stora-Enso, Sonoco, Stone Europe Carton and Abitibi-Consolidated.

Arjo Wiggins Appleton, is the largest UK paper and merchanting company, and although it is headquartered in the UK, it is an Anglo-French company. The company is the fourth largest in Europe, with an annual turnover of around $5.3 billion US and more than 18,000 employees – it is also the leading paper merchant supplying the printing and writing market in Europe. In 1997, it had a paper and board output of 1.92 million tonnes. The company was created in 1990 through the merger of the UK firm Wiggins Teape Appleton and the French firm Arjomari Prioux. In 1998, the group owned 25 mills, 21 in Europe, and four in the USA. In Europe, the company mills are mainly located in France and the UK, but it also has mills in Belgium, Germany and Spain. The company also has a 43% interest in Portugal's largest pulp and paper manufacturer, SOPORCEL. Arjo Wiggins has four main business groups in Europe: Carbonless and Thermal Papers, Coated Papers, Fine Papers and Speciality Papers.

Arjo Wiggins is Europe's leading carbonless paper manufacturer operating some of the most cost-efficient production facilities in the industry. Carbonless reels and sheets account for more than 80% of turnover in the carbonless and thermal papers business group. Coated paper is the largest single product category sold in Europe by the company, which concentrates on the top end of the market, with high-quality two-sided coated woodfree papers (which accounts for 75% of turnover in the coated paper group). The group's premium fine papers division specialises in top quality, high-value, uncoated papers, such as business stationery. The group's speciality papers division specialises in the high-value products, many of which are used outside the printing industry. These include, fine art papers, decorative papers for laminates, special tissues and recycled papers, banknote and security papers etc. It is also interesting to note that Arjo Wiggins co-operates closely with the French printing specialist Imprimerie Nationale as a key speciality paper supplier, mentioned in chapter 7.

David S. Smith (Holdings) is the holding company of a group, which has become a major European paper-based packaging materials company. In 1998, the company had a turnover of $ 988 million US and employed over 10,000 people. As of 1998, the group operated ten mills within the UK and two in France, plus a number of converting plants across Europe. Since the purchase of Kaysersberg Packaging, the company organised its operations into four main divisions: Kaysersberg Packaging, St. Regis Paper, David S. Smith Packaging, and Spicers.

The core activities of the group are fibre- and plastic-based packaging, recycled papermaking and the manufacture and distribution of other products. The company has rapidly developed via a mixture of bolt-on acquisitions and organic growth, aimed at extending the group's product range, geographical presence, and level of integration. Recently, it was outbid for the former Dutch Group KNP BT Packaging.

Inveresk Plc, turnover of $196 million in 1998, operates five mills in the UK, and employs over 1000 people. The company's activities are divided into two divisions Fine Papers and Coated and Speciality Papers. Since the mid-1990s, the company's core objective has been to become the leading speciality paper company in Europe. It has withdrawn from the commodity grade papers and has increasingly focused on higher value-added products.

The company is a global leader in specialist paper and works closely with its customers. The company runs customer focus groups in its graphic papers sector bringing together suppliers, merchants, distributors and converters. One example, of this tight co-operation is that with Europe's leading speciality printers Chiyoda Europe SA, based in Genk, Belgium, which teamed up with Inveresk, in 1993. Since then, the companies have built up a close working relationship. Chiyoda, now buys pre-impregnated papers from Inveresk. These papers are then printed using waterbased inks in chiyoda's specially designed rotogravure presses, which are then lacquered with various materials to the final customer's requirements. These decorative papers are used in over 900 different designs of decorative surfaces which are used in the furniture industry, interior decoration, panelling and flooring. Chiyoda exports about 95% of its products with Germany, France, the UK and Scandinavia accounting for the bulk of the exports.

6.6.7 Spain

Torraspapel Group is involved in the manufacture and distribution of paper and consumable goods for printing, publishing, label & flexible packaging, converting and office products. In 1998, the company had a turnover of $730 million US and employed over 3400 persons. The company is the leading manufacturer and distributor of products for the graphic industry in the Iberian Peninsula, and has a strong and growing presence in France, Germany, Italy, the UK, and the Mediterranean Basin and the Americas. In 1998, the company produced over 560,000 tonnes of paper (over 400,000 was coated papers), and distributed about 640,000.

Torraspapel was established about 300 years ago. Until the mid-1980s the company was family owned. However, the company is now under the ownership of the Kuwait Investment Office. The company's long-term aim is to become one of the world's top five coated woodfree paper producers, and hence it plans to build up its capacity to at least one million tonnes per year.

The company has nine mills, with five producing coated and uncoated woodfree paper, and indeed this segment has received substantial investment in modern equipment in 1998. In continuous forms and thermal paper (fax, labels, printing and CAD, and ticket papers), Torraspapel is focusing more on specialist and high added-value products such as security or water-mark paper. Within labelling and packaging, the company has made substantial investments in R&D to develop new products (leader in metallised papers) which are replacing traditional products. In the area of R&D the company invests about 5% of its turnover and employs 50 people. In addition, the company maintains tight co-operation with its customers and other suppliers, such as printers, particularly in labelling, to develop new technology.

In the area of distribution, Torraspapel markets products and services for the graphic industry, communication groups, corporations and final consumers, and has the most extensive sales network in south-east Europe. In fact, sales of the distribution network increased by 8% from 1997, whilst its position in France was also considerably strengthened. According to Torraspapel, 'despite globalisation, the printing and publishing industry remains highly fragmented. Printing companies employing less than ten people on average, undertake a great number of small orders, which necessitates the development of a very sophisticated logistical, computer and commercial system and which requires constant investment.' Indeed, with a distribution network of over 12,000 regular customers, which channel 6,000 references every day through its central warehouses in Spain and France, Torraspapel would appear to be an expert in this area.

Summary Conclusions

- The EU is the second largest producer and consumer of paper & board, accounting for one-quarter of the world's total paper and board.
- The pulp and paper industry is a very capital intensive industry.
- The EU produces one-fifth of the world's supply of woodpulp (which is mostly bleached sulphate pulp).
- Across the EU, pulp production varies greatly both in terms of grade and amount.
- The largest pulp producers are Finland, Sweden, Portugal and Spain, whilst the largest consumers of market pulp are Germany, France, the UK and Italy.
- Europe is a net exporter of paper and board.
- The main producers of paper and board are Germany, Finland, Sweden, France, Italy and the UK. The largest exporters are Finland, Germany, and Sweden.
- The largest consumers of paper and board are the five most populated countries in the EU.
- There are over 1000 paper and board mills distributed across the EU, with about two-thirds of these located in Italy, Germany, France, and Spain.
- Paper is used mostly for packaging, as graphic papers, newsprint and tissues.
- Paper and board capacity is widely distributed across the EU, and is not confined to any particular region or country.
- The increased use of recycled fibre has caused a shift in the industry closer to the larger consumer centres (nearer high density populated areas), this is particularly the case in newsprint production.
- Graphic papers (newsprint, magazine, catalogue papers etc) are still produced across Europe, by a small number of concentrated producers.
- Rapid changes in printing technology, continue to pose many new challenges for graphic paper producers, resulting in increasing co-operation between paper manufacturers and the printing industry.

- Continued technology developments may lead to higher product customisation but this may also result in a shift of production towards the main centres in Europe.

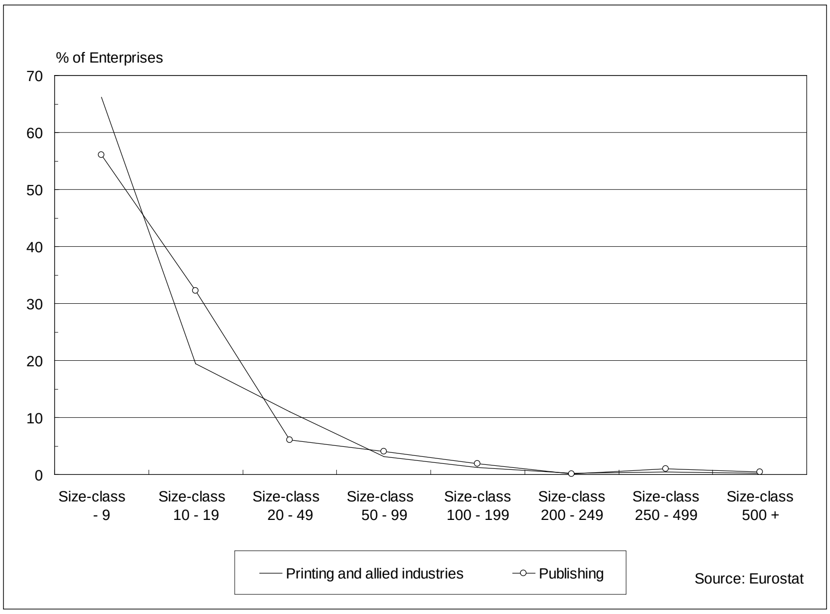
- Within packaging the use of recycled fibre is growing faster than virgin fibre. This may result in a shift in production, since access to recycled fibre will become more critical due to growing environmental awareness and other incentives.
- The pulp and paper industry within the EU is becoming more global.
- Of the world's top 150 pulp and paper companies, 60 of them are from the EU.
- The EU pulp and paper industry is less concentrated than its competitors in other continents, but it is likely that the industry will become more concentrated in the future.
- There is uncertainty as to whether increased size resulting from merger and acquisition is better for the industry.
- The pulp and paper industry has been affected by the growing environmental awareness of the consumer and by stricter environmental controls, but this has been a major source of innovation within the industry. Nowadays European producers have become leaders in many areas of environmental technology, which has provided a competitive edge.
- The sourcing of wood fibre should be better managed to maximise value-added of the raw material.
- Manufacturing companies are widely distributed across the European Union.
- Most of the major multinational companies have subsidiaries in many parts of Europe and further afield, and employ many people across Europe.
- Many companies are expanding into Eastern Europe.
- Most of the major companies have developed their expertise over long periods of time.
- Levels of investment in production machinery and equipment are very substantial.
- Many of the companies are inter-linked through complex ownership, and distribution networks.
- Paper manufacturers maintain tight co-operation with the printing and publishing industry to develop new products and processes.
- The Finnish pulp and paper cluster has been identified (other pulp and paper clusters include Sweden and Austria).
- Companies appear to be focusing more on core products.

Chapter 7. Printing and Publishing Industries

7.1 The European Printing Industry[1]

The European Union is the world's largest market for printing products. In the EU, the printing industry (including all branches of printing and allied trades) employs nearly 1 million people. There are about 60,000 firms, and about 85% of these employ less than 20 persons. There are very few large enterprises employing 500 persons or more (less than 0.5% of firms in the EU printing industry). See figure below.

Figure 7.1 Structure of the European Printing and Publishing Industries



1 Source: European Printing Industry and its Markets, by Richard Max-Lino and Camilla Kvam, published by Pira International, 1999.

During the recession in early 1990s, employment in the printing industry declined but the number of firms has remained fairly stable. Technological advances within the industry have made the printing process less labour intensive whilst employees have become even more highly skilled. The printing industry has traditionally always had strong labour unions, which have secured better working conditions for employees. However, the printing industry still remains sensitive to economic growth, and is adversely affected with increases in paper prices.

Within printing industry markets, smaller firms supply to a local client base, with products such as personal or commercial printed matter. Medium-sized firms tend to produce advertising material, books or continuous stationary for a regional market. In the case of larger firms, the client base is much wider in coverage, even international, with products such as gravure printing produce, catalogues, magazines, books and advertising material being supplied. At the same time, there are also some companies who specialise in prepress or print finishing services only, whilst at the other end of the scale, some larger enterprises run joint publishing and printing operations.

The printing industry is not a global industry as such. The main reason for this being, that, foreign trade is limited by several natural barriers. These limitations include, language barriers preventing wider distribution of products, the structure of the industry being composed mainly of SMEs who have limited resources to market themselves abroad, the need for a close client-customer relationship especially during the printing process and the high transportation costs. Despite the use of digital technology and the Internet, which smaller companies use more and more for marketing, exports remain less than 10% of turnover. However, Eastern Europe is expected to develop export potential in the future.

The main clients of the printing industry are publishers, who account for over 50% of production. The remaining orders come from companies, organisations, individuals, political parties and others. In terms of products, printing of newspapers accounts for about 20% of production, magazines and periodicals, 20%, and books another 10%. Advertising is another large product group, with a broad range of products including direct mail catalogues, prospectuses, posters, advertising inserts and leaflets.

Table 7.1 The EU Printing Industry and Trade in 1997

Country	Employ-ees	No. of Firms	Turnover (Mills ECUs)	Exports** (Mills ECUs)	Imports (Mills ECUs)	Trade Balance (Mills ECUs)
Austria	20212	396	1289	na	na	na
Belgium	21058*	1832*	4051	955	738	216
Denmark	18417**	2018*	3097	403	322	80
Finland	12161*	1391*	1603	284	95	188
France	96000	6200	**8525**	1450	1581	**-130**
Germany	219902	13775	**15122**	**3951**	1685	**2265**
Greece	na	na	153	na	na	na
Italy	46930*	na	**10196**	1548	511	**1036**
Ireland	na	na	na	na	na	na
Netherlands	29826*	2943	3503	1031	848	183
Portugal	na	na	492**	71	0	71
Spain	84150	6606	6572	695	353	341
Sweden	27061	2222	3862	183	292	-109
UK	167800**	18876**	**14205***	**2228**	1528	**699**

(Source: 'The Evolution of the European Graphic Industry 1996-1997', INTERGRAPH, 1998; 'The European Printing Industry and its Markets', Pira, 1999). Notes: *=1996, **=1995.

At the end of 1995, the printing industry started to recover from the recession. Although output increased, profit margins were squeezed by high paper prices - the main raw material used for printing. Major investments were made in order to update technology rather than to expand production capacity, and in fact these high levels of investment were expected to continue.

According to Pira, the industry faces competitive challenges, revolving around providing the appropriate range of products and services to help customers meet changing needs. Customers mainly want to lower their systems costs, reduce cycle times, and improve the targeting of their products. To address these customer needs, the industry may consider a range of measures:

- Offering a distributive platform that allows customers to print from multiple sites and to reduce time to market
- Implementing a digital process to reduce cycle time and processing costs, thus moving away from film and paper, towards a digital plate-making environment

- Investing in short-run printing, which enables customers to deliver highly targeted magazines and catalogues
- Purchasing strategically to lower overall costs, and
- Focusing on controlling costs, by restructuring the manufacturing platform (specifically rotogravure) and emphasising investments that improve productivity

The printing industry is sensitive to economic trends. Printing is demand based, and products are made to order, thus prohibiting firms from keeping stocks. Due to the reliance of the industry on the newspaper, magazine, book and advertising markets, changing consumer preferences and disposable income levels are also significant factors. At the same time, electricity and paper prices, seasonal demand, political developments and new legislation can also effect the industry just as much. Notwithstanding the above, the following issues are currently affecting the industry.

Environmental issues

During 1996, the European Commission issued a draft policy directive seeking to reduce emissions of volatile organic compounds (VOCs) by one third. Because European printing works are responsible for the discharge of some 187,000 tonnes of such VOCs, the commission targeted 20% of the printing works in the participating countries in an attempt to make them adopt new procedures.

As an alternative, vegetable oil-based printing inks contain very little VOCs, and are therefore more environmentally-friendly. Moreover, vegetable inks also have better performance characteristics, but there is one disadvantage, that is, there is a high cost associated with them. However, the changeover to vegetable inks in the newspaper industry – especially in the US and Belgium – demonstrates that price is not the only consideration for the printer.

New Technology

During the past decade, technological developments have shown great promise and at times threatened to rid the business community of the printed page. However, the printed page is still in favour as the majority of people still make use of paper documents to understand and make sense of things. Printed documents have several advantages such as portability, reliability and psychological appeal.

Nonetheless, digital technology is starting to reduce the dependence on paper, starting with print customisation and print-on-demand services. For example, the printed document will remain but the volume may be reduced, as the vendor will print only enough copies to cover the demand. On the other hand, the opposite may in fact be more the case. *See box 7.1 – Entitled: 'Bad News for Trees'.*

Box 7.1 Bad news for Trees

'Despite the advent of electronic books, ever more information will go on meaning ever more paper'

'The use of paper for writing and printing has soared in the past ten years – in Britain it is up by 65% per head. The fastest growth this century came in the 1980s, just as the personal computer was spreading. In the past five years, while the Internet has grown, the production of printing and writing paper in North America has grown by over 13%. Worldwide, it has more than doubled since 1982.

Junk mail, bloated newspapers and proliferating magazines have played a part, but so to have electronic devices in homes and offices. Hewlett-Packard estimates that around 860 billion pages were spewed out of copiers, fax machines and computer printers in America in 1996. The Internet is behind much of the growth; by distributing ever more information cheaply and easily, it provides more things to print.

Several hundred million emails are exchanged daily in America alone, with most recipients keeping hard copies of the more important ones. About 200 million pages of the main US daily newspapers are viewed on the web each month and although nobody knows exactly how many are printed, sites increasingly provide printer friendly versions. Books, too, have done well out of the Internet. The best-known retailer on the web, Amazon, has sold old-fashioned bound pages to over 4.5 million people.

In general, it seems that lots of people still prefer papers and books to liquid crystals and 'documents' There are good reasons for this. Firstly, desktop screens must be read sitting up in a fixed position. Even laptop displays are not nearly as portable as paper and their viewing angles are limited. Some other factors are less obvious, such as the contrast, brightness and resolution of text on a screen. Most people think that the text on a reasonable computer is clear enough to be perfectly readable, under good conditions. In fact it is not, which is partly why people often choose to read on paper instead.

Experiments, during the 1980s by IBM, showed that reading from paper was up to 30% faster than reading from screens, and that the lower resolution of the text on a screen is largely why. Expert opinions vary on how sharp a screen needs to be in order to make it easier to read from a screen than paper, but it seems that display resolutions of at least 150 pixels per inch are required. That is nearly double what they are today and 25% more than the very best. In fact, modern digital print engines have resolutions of about 600 dots per inch, and can print between 70 to 1300 pages per minute.[2] Hence, it is quite clear that screen technology is a long way behind printed paper technology.

Not only are today's computer screens too fuzzy, they are also the wrong shape. They are designed for watching, not reading, and are descendants of televisions not books. Hence, displays are landscape-shaped (wider than tall), whereas most printing and reading materials are portrait-shaped (taller than wider). For example, experiments at Kent State University, during 1997-98, showed a strong preference for portrait orientation and for two page spreads. Indeed, people have chosen to make their reading materials portrait-shaped for the past 3,000 years. Even Egyptian hieroglyphics were commonly organised in vertical columns.

Moreover, the immediate ancestor of today's book is the codex, a pile of pages stitched together, which replaced rolled up scrolls around the 4th century A:D: The fathers of the church were the early-adopters of codex technology. Codices had an advantage that they could be flipped through or opened to any point in the text without laborious unrolling, they were also more compact, and could contain much more information. Thus the upgrade from scroll to codex had advantages, which computers have largely thrown away, by demanding users to return to scrolling.

Tomorrow's digital reading devices, however, will be different. The first such 'ebook' went on sale in November 1998. It is, for all intents and purposes, and electronic codex. It is the size and weight of a largish paperback, with a portrait shaped screed and no scrolling text. The display is close to paper white and has a higher resolution than most computers (106 pixels per inch). It can be read from just about any angle, and readers can turn whole pages at a time at the press of a button. Although some of the hurdles to electronic

---

2 Source: 'Five year Technology Forecast of Printing and Publishing', by: John Berkenshaw, Roberto Minio and Sean Smyth, Pira International, 1999.

reading have been cleared, this is not the beginning of the end of paper.

With the ease of downloading via the Internet and recognition of the potential by publishers, there are many niches where ebooks could quite easily become established; abbreviated versions of 'broadsheet' newspapers, student textbooks, company manuals, fictional novel classics. However, some of the ebooks can not read in the format which electronic libraries are stored. At the same time, most of the ebooks are not compatible with one another.

Yet there are two reasons why even the most ambivalent champions of digital technology still do not think they can kill ordinary paper. One is the problem of durability. Atoms tend to persist, but electronic signals disappear unless recorded. Unfortunately, both the recording media and software used to retrieve digital data quickly becomes obsolete. Texts that people want to keep for a long time, or to give as durable gifts, are likely to remain in physical rather than digital form.

The other disadvantage of digital media is that people are not digital: they are physical objects who live and work in three spatial dimensions. This situation is not expected to change. People prefer to work and play with objects arranged around them, and their memories depend on cues provided by spatial location. Until homes can have dozens of digital displays and ebooks, paper is therefore likely to keep its place within them. Some technologies do their job perfectly and tend to stick around. The spoon is one example, the lawn roller another. Paper may well be a third.

According to Xplor International, a broad association of companies in the information business, the number of documents produced by organisations in any format is growing so fast that paper will continue to boom even as electronic documents grow. Xplor expects the proportion of documents that are printed to decline from 90% to 30% between 1995 and 2005, but the total number of documents printed to double over the same period. One reason for the thinking that the printed paper will continue to thrive is that the printing industry is itself going digital.

American print firms already receive about 60% of their jobs in electronic format. Some are starting to use digital presses, which print straight to plate without the need to make a film for each page. Fully digital presses can economically produce short runs of a handful of copies or even customise each copy. They can already match the quality of conventional lithographic machines for many jobs (though books and glossy magazines remain a problem). In general, most print runs of under 1,000 copies can currently be more cost effective on a digital press.

The implications for digital printing are twofold. First, digital presses promise to reduce the cost of publishing by distributing publications before rather than after they are printed. Text and illustrations can be broadcast cheaply in the form of electronic files and then printed at thousands of print shops close to where they will be sold. One company is already exploiting this idea as a way of selling newspapers. In 1998, PressPoint began publishing editions of Spanish and Austrian newspapers in Washington and New York. The papers are in colour on A3 broadsheets, printed in Xerox local print-centres and sold in hotels and colleges. Bloomberg, the London Times and the Miami Herald have all announced PressPoint editions. The company hopes to sell 500,000 copies a month in 12-15 cities by the end of 1999.

Digital printing could also let book publishers cut their stocks while keeping their whole 'backlist' permanently available, by printing books only when retailers – or even individual customers – ask for them. Lightening Print, a subsidiary of Ingram Book Group, America's largest book wholesaler, offers such a service to 180 publishers. Titles can be ordered by retailers one copy at a time. Les Editions, in France, also offers a similar service to individual shoppers from the its website.

Online publishers and digital-printing outfits are in many ways keen followers of Gutenburg; they rail against the effects of consolidation in the publishing industry and the tyranny of best sellers. By reducing the costs of making and distributing books, digital publishing could restore the world of reading to the state it enjoyed in the 15th century when print runs were small. Pessimists have tried to argue that the electronic revolution spells the end of literature (and therefore use of paper). On several counts, the reverse now seems to be the truth.

Source: Draws heavily from The Economist, pp 139-142, December 19th 1998.

At the same time, print on demand technology allows for last minute revisions and eliminates the need to warehouse mass quantities of documents, since clients can do smaller print runs at reasonable costs. In the past, the set-up costs associated with offset printing have been prohibitive for print quantities of less than 5000. With the aid of digital technology, however, the set-up only takes a few 'key strokes' of a keyboard. Moreover, due to the volume-based pricing nature of the offset printing last minute changes or customisation was an expensive proposition. Nowadays, on-demand printers can print from variable data streams, making customisation routine, whilst offering the potential for mass-customisation of brochures or catalogues to individual end users.

Multimedia and Internet

The multimedia concept is expected to have a wide impact on printing and publishing in the future, particularly as PC ownership spreads. Publishers, however, have been slow to adapt their products to the new technological environment. One major threat to publishers of encyclopaedias and reference books, is that of CD-ROMs, which may replace the printed version due to costs. However, many publishers see CD-ROMs as complementary to their current product range.

An increasing number of publishers, ranging from national newspapers to fashion and technical magazines, have been experimenting with the Internet. In most of the larger European countries, the number of Internet users has at least doubled between 1995-1997. However, some admit that they are following a trend, and are not convinced of the commercial potential but feel that they have to be seen at the forefront of technology. Within the industry, it is thought that the Internet will only really take off when it becomes more accessible, and that it will actually be complementary to, rather than a substitute for the printed word. Nevertheless, the Internet does pose a threat to one of the mainstays of newspapers i.e. classified advertising (especially recruitment), a profitable area of newspapers. Advertising is believed to be the main area, were Internet will generate revenues since subscriptions have been difficult to sell.

Newspapers

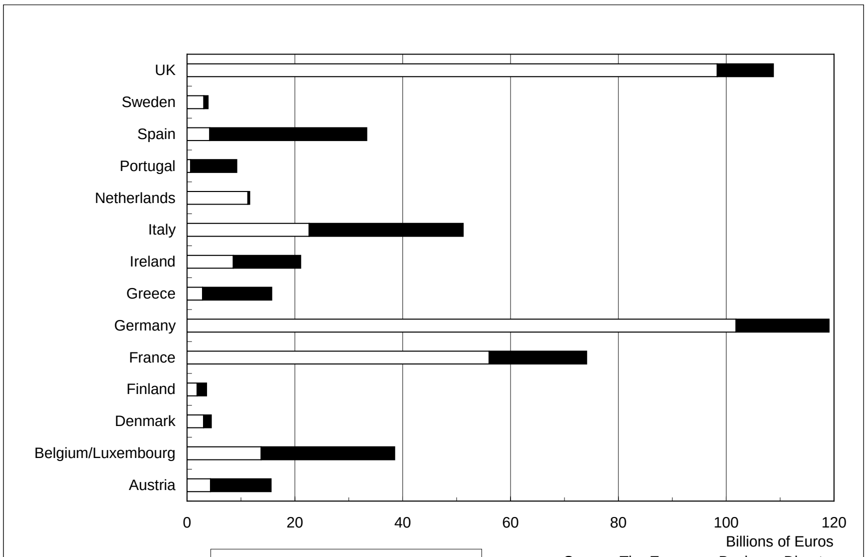
Over the last decade, newspaper publishers have witnessed a steady decline of circulation and the number of titles. Within Europe, the number of dailies has reduced from 1170 to 1128 between 1992 and 1996. In the UK daily newspaper sales have dropped 6% between 1992 and 1996. In parts of Europe there are exceptions to this trend with circulation figures rising, for example in Italy, Spain and Ireland. It has been suggested that newspapers are facing irreversible decline, with electronic information taking over as more people gain access to the Internet.

Notwithstanding the above, sources in the industry are hopeful that the decline has bottomed out. As the prospects for personalised newspapers come closer and are thus able to target market segments, they will become more attractive to advertisers. According to Pira, it is unlikely that the Internet will take over from newspapers as a major source of news, at least not in the short to medium term; rather it is likely that electronic information will complement newspapers. Readers with internet access are still the minority, and despite all the technological advances, newspapers remain the most portable source of news.

Magazines

There are over 50,000 magazines published in Europe and more than 30 billion copies circulated annually. As Europe has come out of the recession, the industry is thriving, and the number and range of titles are increasing. Life style, TV and other specialist magazines are some of the major growth areas. It is thought that Men's magazines, focusing on trends, money, health and racy cars, which have grown particularly quickly in the UK, may well emerge as a major market in Europe.

Figure 7.2 Trade in Newspapers and Periodicals in 1997



Source: The European Business Directory (originally adapted from Eurostat).

Table 7.2 Top European Newspapers by circulation, 1997

Title	Country	Publisher	Circulation (millions)
National Dailies			
Bild	Germany	Axel Springer Verlag	4,64
Sun	UK	News Group Newspapers Ltd	3,78
Mirror	UK	Mirror Group Newspapers Ltd	2,32
Daily Mail	UK	Associated Newspapers Ltd	2,24
Komsomolskaya Pravda	Russia	N/a	1,25
Express	UK	Express Newspapers Ltd	1,2
Trud	Russia	N/a	1,2
Daily Telegraph	UK	Telegraph Group Ltd	1,1
Neue Kronen-Zeitung	Austria	Krone Verlag	1,05
The Times	UK	Times Newspapers Ltd	0,8
Regional Dailies			
CAN, Dusseldorf	Germany	N/a	1,52
Westdeutsche Allgemeine Zeitung	Germany	N/a	1,16
Quest-France	France	François Régis Hutin	0,79
Daily Record (Scotland)	UK	Mirror Group Newspapers Ltd	0,69
Wirako	Germany	N/a	0,6
Hannoversche Allgemeine Zeitung	Germany	Verlagsgesellschaft Madsack	0,56
Stuttgarter Zeitung	Germany	Stuttgarter Zeitung Verlag	0,54
Thüringer Allgemeine	Germany	Zeitungsgruppe Thüringer Verwaltungs	0,53
Sächsiche Zeitung	Germany	Dresdner Druck & Verlagshaus	0,51
Evening Standard (London)	UK	Associated Newspapers Ltd	0,45

Source: Pira.

Contrary to the global interests of publishers, the European magazine industry continues to operate at the national level and by language grouping. German publishers benefit from German-language markets in Austria and Switzerland, while France benefits from French-speaking markets in Belgium, Luxembourg and to some extent Switzerland. In Scandinavia, the languages are not close enough to offer wider possibilities for a Scandinavian magazine market. Magazine publishers, increasingly are making investments at a pan-European level, were specialist titles are launched across several countries using local editions. For example, international titles such as Elle and Marie Claire are produced separately in each country but contain the same general themes yet cater for local tastes. Recently, German and UK companies have introduced some of their glossy magazines to the Eastern European markets.

In general, cover prices of magazines account for about 60% of publisher's sales in Western Europe, the remainder comprised of revenues generated via display and classified advertising. During the mid-1990s, increases in cover prices accounted for most of the revenue increases, due to the slow down in advertising revenues caused by the recession and the fact that TV advertising increased in importance. However, new technology could soon make personalised magazines a reality, thus providing greater interests to advertisers. Moreover, as the industry becomes more fragmented and specialised, advertisers will be able to target their products and services more specifically to their desired audience.

Over the last two decades, new production technology has revolutionised publishing by reducing the cost of market entry and making short print run titles economically viable. This has led to a dramatic increase in the range and specialisation of titles available, at the same time also increasing the overall number of publishers. Nowadays, publishers are more inclined to respond to fashions, launch new titles quickly, revamp, re-launch or even withdraw older ones much faster than before.

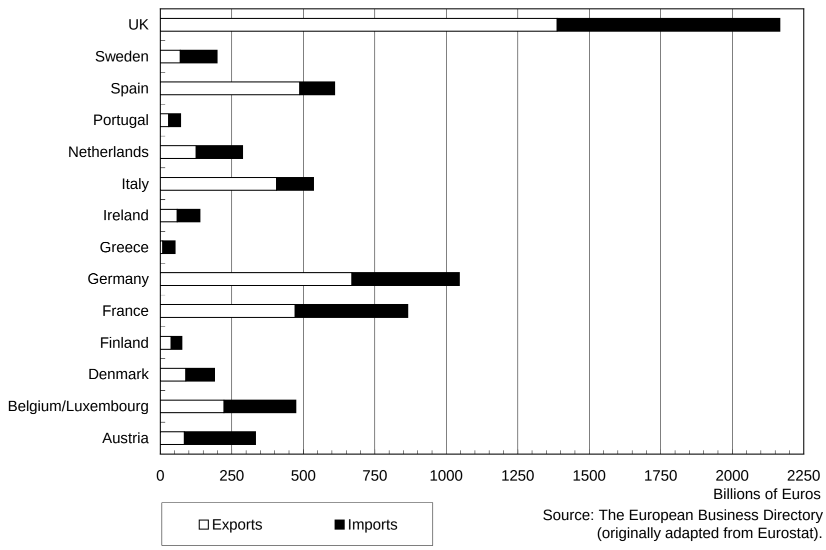
Recently, the number of newspaper supplements and target newspaper sections, combined with an increasing use of colour, has brought the newspaper industry increasingly into competition with magazines. Special interest sections now compete with niche magazines both for the readers and advertising. According to Pira, even though magazines are expected to experience continued growth over the next decades, particularly as consumers' demands diversify and Eastern European markets become more discerning, publishers will need to work to maintain their advertising market share.

Table 7.3 Top European Magazines by circulation, 1997

Title	Country	Publisher	Circulation (millions)
Womens's Magazines			
Bild der Frau	Germany	Axel Springer Verlag	1,93
Femme Actuelle	France	Prisma Presse	1,9
Poradnik Domowy	Poland	Pozarowka I SKA	1,65
Neue Post	Germany	H. Bauer Verlag	1,44
Take A Break	UK	H. Bauer Verlag	1,44
Tina	Germany	H. Bauer Verlag	1,35
Freizeit Revue	Germany	Burda Verlag	1,25
Prima	France	Prisma Presse	1,21
Das Neue Blatt	Germany	H. Bauer Verlag	1,1
Voici	France	Prisma Presse	0,8
TV Guides			
TV Magazine	France	Grope Hersant	4,03
Sky TV Guide	UK	Redwood	3,5
Télé 7 Jours	France	HFA	2,85
TV Spielfilm	Germany	TV Spielfilm Verlag	2,74
TV Movie	Germany	H. Bauer Verlag	2,73
Hörzu	Germany	Axel Springer Verlag	2,36
Tele Magazyn	Poland	N/a	2,26
Auf Einen Blick	Germany	H. Bauer Verlag	2,24
Télé Star	France	EMAP	2,04
Télé Z	France	EPM	1,98
General Interest Magazines			
Kampioen	Netherlands	Royal Dutch Touring Club ANWB	3,2
Pirkka	Finland	Kauppiaitten Kustannus	2,28
Reader's Digest	UK	Reader's Digest	1,5
Notre Temps	France	Bayard Presse International	1,06
Famiglia Cristiana	Italy	Periodici San Paulo	1,05
Vår Borstad	Sweden	Hyresgasternas Förlag	1,05
Gente	Italy	Rusconi	0,87
Reader's Digest	France	SRD	0,82
Messaggero S. Antonio	Italy	Messaggero S. Antonio	0,8
Oggi	Italy	RCS	0,73
Special Interest Magazines			
Das Haus	Germany	Burda Verlag	2,25
Auto Touring	Austria	ÖAMTC – Verlag	1,95
Idé Nyt	Denmark	Foriaget Idé Nyt A/S	1,62
Samvirke	Denmark	Samvirke	1,5
Briefing	Portugal	Briefing Publishing	1,5
Bravo	Germany	H. Bauer Verlag	1,3
L'Automobile	Italy	L'ed. Automobile	1,12
Auto Bild	Germany	Axel Springer Verlag	0,81
Irish Farmer's Journal	Ireland	The Agricultural Trust	0,73
Touring Magazine	Belgium	Touring Club of Belgium	0,72

Source: Pira.

Figure 7.3 Trade in Books and Brochures in 1997



Source: The European Business Directory (originally adapted from Eurostat).

Books

In recent years, book retailers have been consolidating, as the independents' share has dropped and supermarket chains have moved into the market. Book publishers increasingly find their profits being squeezed between the writer and retailer. Larger retailers are taking more of the profits, whilst agents are demanding larger advances.

Today, 60% of books never see the inside of a traditional bookstore. Technology has opened up new ways of selling, and pub- lishers endeavour to avoid the powerful retailers. Instead, books go through an increasing number of different outlets, from supermarkets, niche book clubs to online retailers. Rather than carrying a considerable amount of stock, the way to make money is to get books directly to the reader, therefore cutting out traditional bookstores.

Mail Order

Mail order product markets are well established in Germany, Switzerland and Austria, where products such as clothing, books, music and cosmetics have traditionally been sold in this way. The trend in the UK is for mail order to go up market into home decoration and lifestyle products. Mail order is marketed as a convenience for the career women who is otherwise too busy to shop. Many high street clothes shops and furniture retailers have started mail order businesses to cater for this group, which has a high spending capacity. In recent years, major mail order companies have expanded into Eastern Europe to take advantage of the emerging appetite for consumer goods.

Labels

Some five billion square metres of labels are produced in Europe each year. Although in recent years the growth rate has been between 3-7%, this is less than it used to be and hence over capacity in some key markets exerts pressure on margins. Labelling represents one of the most innovative parts of the printing industry. In particular, this is especially the case with roll label presses, which have reached new levels of combination printing since it is recognised that no single process is capable of reproducing the array of graphics nor the wide variety of substrates demanded.

Packaging

According to Pira, 'packaging printers predict favourable business conditions in the near future. Industry sources expect to see continued growth in both commercial printing and packaging in the next year, with the trend in vendor consolidation programmes and long-term agreements and contracts remaining strong.'

7.2 Printing

In Western Europe, the value of the graphics industry is about £ 38 billion, with Germany (£9.5 billion), France (£7.5), and the UK (£4 billion) being the main markets (1994). Of the total figure, newspapers account for 21%, magazines, 14%, books, 8%, promotional, 23%, security/business, 11% and other 23%. However, in terms of product function, the picture may appear somewhat different. For example, promotional products account for 40% of the print products, informational products, about 27%, entertainment, 27%, educational, 4%, and transactional, 2%.

Germany has been at the forefront of the printing industry since the 1800s, and even before that, with the invention of the Guttenburg Press in Germany during the 15th Century. In addition, the German printing industry was the focus of much research in Michael E. Porter's: The Competitive Advantage of Nations. In fact, this study revealed the existence of a very strong 'Printing Cluster' in Germany, which has helped the Germany printing press industry to dominate the printing industry for most of this century. The following section describes in some detail the German Printing Cluster, how it developed, and how it has managed to attain and maintain its position as a leader in printing technology, for many decades. This section shows why the printing industry is strongly related to the pulp and paper industrial cluster.

7.2.1 The printing press industry[3]

In the late 1980s there were three principal printing techniques. 'Letterpress' used a negative to transfer an image to paper, 'Gravure' employed a recessed negative, and 'Offset' was a chemical process. In 1985, offset presses accounted for about 80% of printing press demand. Both letterpress and offset presses could be divided into two basic types. Sheet-fed presses are smaller, standardised units, in which single sheets are fed into the press at high speed. In the late 1980s, a black & white sheet-fed press cost about $85,000, whilst a six-colour, high speed machine cost around $550,000.

However, web-fed presses (developed in the late 19th century) are much larger and more complex machines costing as much as $70 million. Web-fed presses as the name implies are fed by a continuous roll of paper, they are designed for extremely high printing speed and are used primarily for printing newspapers and magazines. Web-fed presses are highly customised to the individual buyer and require two to three years between order and delivery.

The printing press is the single largest capital investment for its users. In the late 1980s, the most important buyer purchase criteria were machine throughput, reliability, service, printing quality, versatility, degree of customisation, ease of maintenance, ability to

---

3 This section draws heavily from 'The Competitive Advantage of Nations – with new introduction'; pp 179-195, by Michael E. Porter. The Free Press, 1998.

control, and delivery time. Reliability is particularly important because downtime is unacceptable in many applications. For example, a newspaper must be printed on time, the machine must be capable of running 24 hours per day 365 days a year, and is expected to have a life-span of about 20 years.

After world war II, technology shifted from letterpress to offset, the latter offering greater control, higher speed and lower cost than letterpress. By the 1960s sheet-fed offset machines dominated the markets. In the late 1960s, however, the technology began to move to web-fed offset presses. By the late 1980s, the strongest demand was for web-offset machines for newspaper printing. During this period the industry also saw many technological developments such as the ability to print in multiple colours, the introduction of electronic controls facilitating the control of inking units to automate the inking process, the computerisation of scanners to automate inking under different printing conditions and the use of electronics in the pre-print preparation for different photo-typeset techniques.

7.2.2 The German Printing Cluster

The printing press industry had long-standing links with a number of other strong German industries besides printing. Paper-making machinery was an important related industry, because the properties of paper were important to the operation of a printing press. J.M. Voith Gmbh Maschinenfabrik, together with its subsidiary O. Dörries, was the world's leading paper press maker. Another world renown paper machine producer was Sulzer-Escher-Wyss, Swiss-owned but with its home base in Germany. The close proximity of internationally successful German paper machine and printing press companies facilitated active interaction between the designers of both products.

German printing press companies also benefited from the presence of strong paper producers like Feldmühle AG, E. Holtzmann & Cie. AG, M.D. Paperfabriken Heinrich Nicolaus, and Zanders AG. The rapid increases in paper throughput would have been impossible without the co-operation of paper makers who had developed paper that could withstand speeds of up to thirty-five feet per second as well as the paper machine providers who developed the necessary machinery to produce it.

Internationally prominent German printing ink producers also benefited the German press industry. Printing ink became especially important to the development of multicolour web-fed presses in the early 1900s. Machine improvements required improved inks that led to further machine improvements.

The success of German printing ink producers was closely related to the pre-eminent German chemical industry. An early breakthrough was the development in 1880 of a laboratory process to produce synthetic indigo by the German Adolf von Baeyer, and its commercialisation around the turn of the century by the German chemical firms Hoechst and BASF. Synthetic inks were an offshoot of dyes. Prior to the development of synthetic inks, printing ink had been produced primarily in-house by the printshops. World famous German printing ink producers were BASF's Printing Systems division, Michael Huber Farbenfabriken, Hartmann Druckfarben, and Siegwerk Farbenfabrik Keller.

Another important product related to printing presses was typesetting systems. The two world leaders were Linotype and Monotype, both founded in the US over 100 years ago. Even though the two leading firms were American, both had major German sub-

Table 7.4 German Competitors in Related Industries

Company	Location	Date founded
Paper		
Feldmühle	Düsseldorf	1885
E. Holtzmann & Cie	Weisenbach	1883
Paperfabriken Heinrich Nicolaus	Dachau	1862
Zanders	Bergisch Gladbach	1829
Paper Machines		
J.M. Voith/ Dörries	Heidenheim/Düren	1867/1885
Sulzer-Escher-Wyss	Ravensburg	1856
Printing Ink		
BASF	Ludwigshafen	1865
Michael Huber Farbenfabriken	Munich	1765
Hartmann Druckfarben	Frankfurt	1905
Siegwerk Farbenfabrik Keller	Siegburg	1905

Source: M.E. Porter, 1998.

sidiaries. The base for new product development had long been in Germany, pointing to the existence of the German printing cluster. During the 1980s, Linotype moved its headquarters to Eschborn, Germany, indicating the importance of the German printing cluster.

Shifting Competitive Positions

Switzerland had maintained a position as an exporter of printing presses. The principal Swiss producer was Maschinenfabrik Wifag AG, based in Berne. It was the third-leading European producer of web-offset presses for newspaper printing. Wifag, located not far from the German border, was effectively part of the German cluster. Like its German competitors, Wifag presses were differentiated by high quality and technical innovation. Wifag viewed Germany as its key market. It was especially proud of having sold a press in Augsburg, MAN's home town.

Two other printing press exporting nations, the US and Britain, were steadily losing position. Britain's world export share fell from 9.2% in 1975 to 5.9% in 1985, and Baker-Perkins was the only significant producer remaining. It produced web-offset presses for newspapers, where the British home market was substantial. The US was the second-largest exporter of printing presses, holding 19.7% of the world printing press exports in 1975. By 1985, the US share of world exports had dropped to 3.9%, and the US ran the world's largest printing press trade deficit of $330 million. American technology was simpler to operate but also less sophisticated than that of European machines. American-built machines were also said to suffer more breakdowns and to rank lower in quality than German or Swiss machines.

Meanwhile, Japan was enjoying a growing position in the industry. The nation was a relative newcomer to international printing press competition. The Japanese industry was established in the twentieth century. Japanese home demand for offset printing was substantial because typing was impractical and thus all formal documents had to be printed. From the late 1970s, Japanese home demand became aligned with international demand that also moved to offset printing. This marked the beginning of inroads by Japanese press makers into foreign markets. By 1985, Japan had become the world's second-largest printing press exporter. Its world share in exports increased to 19.1% from 2.9% in 1975. During the same period, Japan's trade balance in presses rose from negative to $296 million, the world's second highest after Germany.

Danger signals

Flexographic printing (flexo) was the newest printing technology under development and achieved some market penetration in the 1980s, especially for newspaper printing. Flexo, also called 'aniline printing' was a variation of the old letterpress technique but made use of aniline (water-based) inks and flexible rubber plates instead of cast metal letters. It was developed first for the food packaging industry, because aniline inks could be used on non-absorbent surfaces and were safe for the use on food wrappers. Its quality for paper printing was not as high as offset, but the investment and operating costs were lower.

Flexo was first applied to newspaper printing by the American firms in the late 1970s and early 1980s. By 1988, however, German firms were the pre-eminent suppliers. The leading producer of flexo presses in Germany was K&B, which had built them in co-operation with Windmöller & Hölscher, a prominent German packaging machinery producer that supplied the basic flexo printing unit. Germany's strong international packaging machinery industry had been drawn by evolving technology to the printing cluster.

In 1988, the German printing press industry was enjoying growth and worldwide success despite high labour costs and rising currency exchange rates. Most producers were recording record profits. Printing press companies ranked among the most profitable in Germany.

Record profits carried danger signals for the future. Since the 1970s, the number of German competitors had decreased substantially through consolidation. K&B acquired a 49% interest in Albert Frankenthal in 1979, which was increased to a majority interest in 1988. The two firms agreed to co-ordinate their production programmes. In 1979, MAN and Roland merged to become MAN-Roland. At this point in time, consolidation in the German printing press industry had virtually removed any price competition and domestic rivalry was no longer assured. A group of more vigorous Japanese competitors represented a growing threat, especially in sheet fed-presses.

The German printing press industry is a remarkable story of competitive advantage sustained for more than 160 years. The early history of the industry shows how the international mobility of technology and skilled personnel is far from a new phenomenon.

The initial seed for the industry was planted by a remarkable German, Friedrich Koenig, who became interested in presses because of his training and work as a printer. To pursue development, he was forced to go to England, the Nation with the most favourable national 'diamond' for industry at that time. Driven out of England by attempts by his buyers/investors to limit industry growth to protect their interests, he was drawn back to Germany. The location he chose was influenced by an early example of government efforts to attract investments.

Notably, K&B's presence soon started a process which made Germany a more favourable environment for competitive advantage in the industry. A large group of German rivals emerged directly or indirectly out of the industry pioneer. Specialised factor-creation mechanisms were established and widened over time. As demand for presses developed in Germany, the high standards and sophistication of German printers and end users spurred innovation, reinforced by pressures from selective factor disadvantages. German demand anticipated needs for quality and productivity that would spread worldwide. All the related and supporting industries essential to innovation (paper, paper machinery, ink, typesetting systems) grew up with the printing press industry and achieved world-class status in their own right.

The uniquely large group of domestic competitors, located in southern Germany, were each others' most important rivals. Domestic rivalry not only stimulated innovation directly but had beneficial effects on German factor creation and on related industries. The successful Swiss firm, Wifag, was a 'de facto' part of the German cluster. Firms from other nations did not challenge Germany because they lacked essential elements of the 'diamond'. Japan was a late entrant into the industry because of home demand that diverged sharply from most world demand. German firms, in contrast, enjoyed early mover advantages from having established worldwide brand reputations and service networks in an industry where buyers are conservative and loyal.

The printing press industry illustrates not only the 'diamond' at work but the phenomenon of clustering. Germany is the world leader, or among the leaders, not only in printing presses but in printing, fine paper, paper machines, typesetting systems, printing inks, and packaging machinery. The last related industry became important more recently with the emergence of flexo presses. The German printing cluster is mutually reinforcing, and the industries have developed together. Relationships among companies are close and in some cases formal.

Even though the German printing press industry was enjoying record profits in the late 1980s, however, there were signs that German dominance of world printing press markets might wane. Japanese home demand, which strongly favoured offset printing, had moved from out of step to perhaps ahead of demand in the rest of the world. Flexo printing was not developed in Germany. An indication that German demand is becoming less anticipatory of future world demand is that demand for this new technology is taking off first abroad.

Most significant, however, is that domestic rivalry in Germany may be eroded to the point where it is no longer sufficient to motivate constant innovation. Current profitability and market position can be misleading in an industry. The printing press industry is one where early mover advantages are particularly strong, especially in large web-fed presses. Without aggressive domestic rivalry, German firms may think they are holding market position when in fact the underpinnings of future competitive advantage are already lost.

The German printing cluster demonstrates how machinery and technology are important to the competitive development of an industry. However, this also shows that people are equally as important in the development process. In addition, it should also be clear why the printing industry is seen as part of the pulp and paper industrial cluster, being an important source of innovation and key customer. Nonetheless, technology developments will remain a key catalyst for change within the industry. In the following sections we will therefore examine how technology is likely to affect the printing and publishing industries, and thus the demand for paper and board products.

As of the 1980s, Germany was the leader in printing press technology, whilst offset web fed printing was the most dominant. However, already by then the emergence of electronic and computerised controls had been well established, as indicated below.

Table 7.5 Emergence of Printing Press Technology

	Offset Sheet/Web-Fed	Flexo-graphic	Gravure	Letter-press	Screen	Electronic/ Computer add-ons
First Appearance	1920/1970	Late 1970s		15th cent.		Late 1970s
First Applications	Germany	US/ Germ		Germany		Japan

Table 7.6 Estimated World Printing Press Sales by Press Technology

	Offset Sheet/Web-Fed	Flexo-graphic	Gravure	Letter-press	Screen	Digital
1985	80%			20%		0

Now almost 15 years later how is digital technology affecting the printing and publishing industry.

7.2.3 Developments in Printing Technology[4]

Printing products tend to be produced by one main type of printing technology. For example, newspapers and magazines are mostly printed via offset techniques (in fact, this has been the case since the late 1980s, as shown above), whereas, packaging tends to be printed via flexographic processes. See figure below.

At present, offset-lithography is the dominant printing technology and this is thought to remain the most dominant in the near future. However, this position is already being eroded by flexography and the rapidly growing digital technologies. Indeed, over the next five years, it is forecast that digital printing will become the second largest printing process in use after offset-litho. Moreover, it is also anticipated that flexo will replace gravure and litho in some areas.

---

4 This section draws heavily on 'Five year Technology Forecast of Printing and Publishing', by: John Berkenshaw, Roberto Minio and Sean Smyth, Pira International, 1999.

Table 7.7 Printing Process Categories - Approximate Shares (%)

	Offset-lithography	Flexo-graphic	Gravure	Letter-press	Screen	Digital
Magazines	**66**	0	32	2	0	0
Catalogues	**57**	0	42	1	0	0
Books	**61**	1	26	2	1	10
Newspapers	**89**	1	5	5	0	0
Direct Mail	**82**	0	10	0	0	10
Envelopes/Labels	24	**53**	5	8	0	10
Business/Legal	27	**51**	8	4	0	10
Packaging	10	**64**	19	1	1	5
Total	**41**	**27**	**18**	**3**	**0**	**11**

Source: Pira.

Table 7.8 Forecast Development of Printing Process Market Shares (%)

	Offset-lithography	Gravure	Flexo-graphic	Letter-press	Screen	Digital
1995	46	18	18	7	3	8
2000	42	17	19	6	3	13
2005	**30**	15	22	5	3	**25**

Source: Pira.

Gravure will continue to decline as better targeting of con-sumers by publishers leads to reduced run lengths, and thus erodes gravure's competitive advantage.

In addition, according to Pira, on-press digital platemaking (Heidelberg DI) and non-plate (electrophotography, ink-jet) are expected to grow substantially in mono applications, short run colour, on-demand and variable information printing. Digital techniques will also develop to aid litho, flexo and gravure printing.

Digital technology is seen as the main factor which will affect change across the industry. Digitisation has revolutionised pre-press, replacing the craft-based approach with a more controlled production-based one. Desktop publishing has enabled publishers to handle graphic design and preparation themselves, at lower costs. The boundaries between design and production are gradually disappearing, as have those between commercial print and quick print which are nowadays completely blurred.

At present, the printing industry is not focused on environmental issues. However, legislation concerning packaging waste and the market for recycled paper is expected to have an increasing economic impact. The major concerns revolve around emissions of VOCs (Volatile Organic Compounds) from cleaning materials and solvent emissions from inks during drying processes. Waste control and energy consumption are anticipated to become more important in the future.

Table 7.9 Summary of Environmental issues in Printing

Process	VOCs	Waste Materials	Fluid Effluent	Energy Consumption
Prepress	Flexo plate developing	Used plates	Photographic chemicals Plate processing chemicals	
Litho-heatset	Solvents from heatset inks IPA from fount solution Wash-up solvents	Waste generated during make-ready and on the run		Dryer
Litho-coldset	Wash-up solvents	Waste generated during make-ready and on the run		
Litho-sheet	IPA from fount solution	Waste generated during make-ready and on the run		IR/UV dryers
Gravure	Solvent inks			Dryers and solvent recovery system
Flexo	Solvent inks		Presses using water-based inks create large quantities of contaminated water when washed up	Heat for UV dryers
Digital	Solvent evaporation (some systems)	Waste toner and press components		

Source: Pira.

Nowadays, life-cycle-analysis is used to assess environmental impacts of a production process from raw material to final product. By itself, printing is not thought to cause a significant environmental impact. But this is a simplistic perspective. The utilisation of paper and ink does have other energy, waste and forestry resource implications, which if ignored could present environmental problems. However, to say that the subject is a complex one is an understatement, indeed, the matter deserves much more attention than can be presented here. Needless to say, detailed discussion regarding environmental analysis will be left to the environmental experts.

7.2.4 Developments in the Publishing Industry

Publishing markets are derived from products or services, which add value to informational content of various media. In many cases, markets overlap, relate to, or compete with traditional publishing, such as advertising. For example, many consumer magazines and newspapers rely on revenues generated from classified or display advertising. Adjacent industries may include libraries, cinema, television, telecommunications, IT, music and video-based publishing. In fact, many of these industries are expected to converge over the next ten years as advertisers and publishers attempt to obtain revenues from consumers rather than products.

Within the publishing industry the range of product offerings are wide and varied. Products include; books, periodicals, newspapers, corporate publishing, directories, games, database publishing, internet publishing, direct marketing, multimedia products etc. Although the limited availability of publishing statistics make it difficult to assess the exact market sizes, most experts tend to agree that the share of electronic media market is really tiny, at between 3-5%. Moreover, despite the recent attention the growth in market share is forecast to remain quite small over the next 5 years.

In Europe, the main publishing markets are the UK and Germany. Within newspaper titles (dailies, weeklies and Sunday papers), France, Switzerland and Finland publish the most titles after the UK and Germany. In terms of business and professional magazine titles, Italy publishes more than Germany and the UK, whilst the Netherlands also has a considerable magazine market. The largest book markets are found in the UK and Germany, with France, Spain and Italy having the next largest.

Table 7.10 Products of the Publishing Industry

Product	Market Segment
Books	Fiction; Non-fiction; Educational; STM (Scientific, Technical and Medical)
Periodicals	Consumer, business to business, hobbyist /specialist, learned
Newspapers	International, national, regional/local, free-sheets
Corporate Publishing	Service industries eg financial services, holiday, manufacturing sectors (aerospace, automotive) government (local, national, international), charities and non-profit organisations
Directories	Consumer, trade
Games	Paper-based, PC-based, proprietary electronic platform, hand held
Database Publishing	Financial and business, professional and academic, STM, consumer
Internet Publishing	Consumer, business-to-business, social and one-to-one
Direct Marketing	Catalogues, direct mail, discount coupons
Multimedia products	Point-of-sale, educational, industrial and commercial training, promotional, product support, software

In terms of a publishing market there is no single market. Books, periodicals and newspapers compete with corporate publishing, directories, electronic games, databases and Internet published material for their revenues. Nonetheless, the vast majority of value-added information products in publishing are still paper-based. In 1998, the book, periodical and newspaper markets earned in excess of 95% of their revenues from paper-based products. Even in directory publishing and direct marketing paper-based products are still being used extensively. In just about every area of publishing, either substitute or new electronic products are being developed as a market of digital media. Again this shows that the use of paper is likely to remain the main source of communicating the written word for the foreseeable future.

According to Pira, in 1993, it was thought that electronic products would account for as much as 40% of the publishing industry's revenue by the year 2000.[5] But as shown above, this estimate has proven to be a gross over-estimation, with the real figure likely to be less than 5% of publishers' revenues by 2004 being more realistic. In general, there are a large amount of technology and products on the market, but very little publishers are making sufficient profits from their experiments. Despite the current trend, it is still thought that digital media will become increasingly more important, as Internet develops and new business models emerge.

In the new 'information age', where information becomes the key to success in commerce, the context of the publisher's market is expanding. This change may result in a fundamental shift, which may push the publisher away from the concept of product delivery, to a more service-based delivery. To this end, it is thought that innovative content-related products will need to offer:

- Enhanced functionality of the product
- Improved fitness-for-purpose for the end user
- Reduction in the cost of manufacturing and/or distribution
- Motivation for substitution of an existing consumer income stream
- Reuse of existing content to open new revenue streams
- Personalisation of products offering significant purchaser benefits
- Enhanced conformity to perceived or actual environmental legislative factors

In the years to come, market developments will likely be governed by end user demands, indeed this is an area often ignored in printing and publishing. For example, printing and publishing companies have traditionally tended to focus more on the technology as the key consideration in the market. However, as mentioned earlier, the key market developments will encompass mass customisation, the enabling ability of IT and the modifying effect of environmental concerns. With this in mind, market forecasts for the printing and publishing industry vary greatly. Nonetheless, the table below, which has been compiled by Pira, provides several such estimates:

---

[5] Based on forecasts made at the Frankfurt bookfair in 1993.

Table 7.11 Market Forecasts for year 2000

Market	Revenue 1995 (US $)	Revenue 2000 (US $)	Annual Growth (%)
US Print Market	235 bn	260 bn	2
US Online Market	30 bn	47 bn	11
EU Publishing Market	65 bn	87 bn	6
EU Online Market	183 mill	1,3 bn	45
Electronic Print	96,2 bn (1996)	150 bn (2001)	
World Newsprint	36 mill tonnes (1997)	41 mill tonnes (2007)	1,2
World Printing & Writing Paper	92 mill tonnes (1997)	150 mill tonnes (2007)	3,6
World GDP			3,3

Source: Pira.

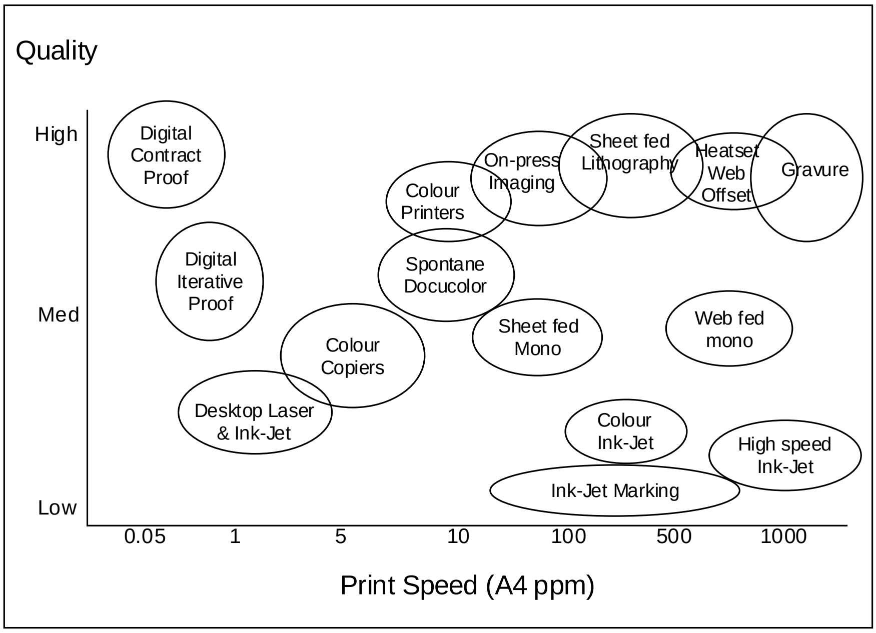
It is evident that the above estimates show fairly healthy predictions for growth in the traditional printed products, and rapid growth in online services and digital printing. In fact, Pira predicts that the digital printing will increase its share of the overall print market, to between 20-25% of the total, by 2005. However, it is worth pointing out that both newsprint and printing and writing papers are forecast to grow.

Printing technology processes are wide and varied. In the figure below, the comparative productivity and quality of the available print processes are indicated. Press manufacturers are positioning themselves within specific market segments, hence consolidation of press manufacturers will enable them to serve markets better.

In the past, the move from sheetfed to web, then faster paper travel and multi-web formats, increased press productivity, markedly. Since the 1960s, productivity of typical presses has increased by a factor of 2000, whilst productivity per person has increased even higher since web presses deliver six-colour dried, folded sections ready for binding. In fact, today's trends are towards larger, faster presses being developed in flexo, offset and gravure. By comparing this figure with that showing the various grades of paper according to quality, shown in chapter 6, it should be evident that different grades of paper are engineered to obtain the desired properties according to the printing technology to be utilised.

Although, bigger and faster presses imply a reduction in the unit cost of production plus time-savings (both of which benefit the

Figure 7.4 Productivity & Quality of Printing Technologies (Source: Pira)



print buyers), limits are being approached in the use of paper. For example, 'paper engineering' problems are limiting top speeds and preventing consistently high speeds being achieved. Nonetheless, there are many examples where paper manufacturers and printing firms have and continue to collaborate with one another to solve these and similar problems.

One recent example, is that involving three companies whose industries stretch from pulp and paper manufacturing to publishing, whose objective is to intensify co-operation and to improve the certification of pulp and paper products. Norske Skog (Norway's biggest pulp and paper group), Otto Versand (Germany's biggest mail order group) and Axel Springer Verlag (a leading German publishing group) are collaborating to produce a magazine and a mail order catalogue which will be controlled in terms of environmental friendliness. The result is that the groups expect the project to lead to a 10% reduction in the pulp used per tonne of paper.[6]

---

6 Dow Jones Online News –USA, 13/4/1999.

Indeed, this is typically how company's innovate within the forest-based and related industries and achieve competitive advantage over their rivals. Moreover, this also provides another reason why we should use a broad definition of an industry to capture the real industry in its entirety. This is the essence of cluster-type behaviour between firms. However, continued rapid developments does still require more co-operation.

7.3 Printing and Publishing Industry Companies

Within the printing industry in Europe, levels of productivity (measured by value-added per employee) have been rising since the recession in the early 1990s. Although, Italy, the Netherlands, and Austria have fairly high levels of productivity, they are nevertheless below those of Japan. Similarly, productivity levels in publishing have also been rising since the early 1990s. Italy, France, the UK, and the Netherlands have the highest levels of productivity.

It is interesting to note that the Netherlands has one of the highest levels of investment in machinery and equipment in this

Figure 7.5 Productivity within Printing and Related Service Activities

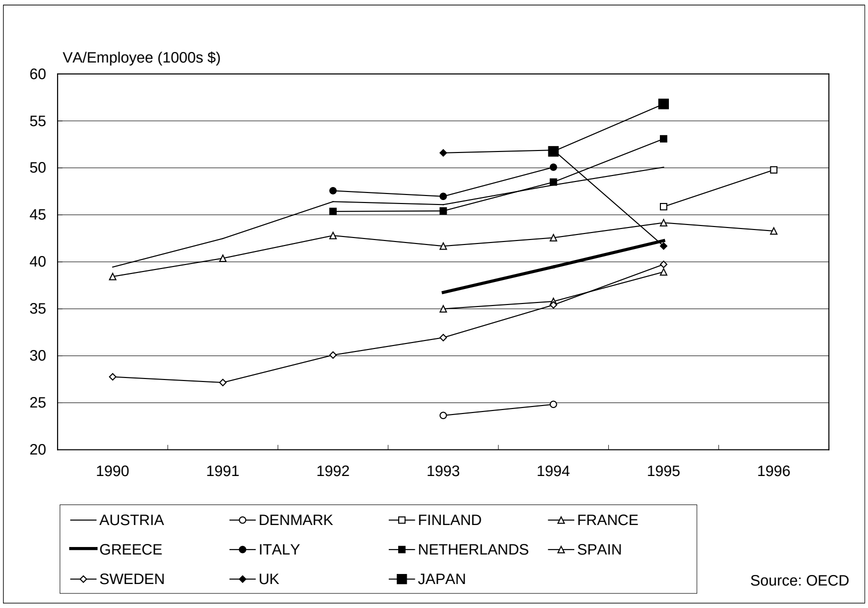
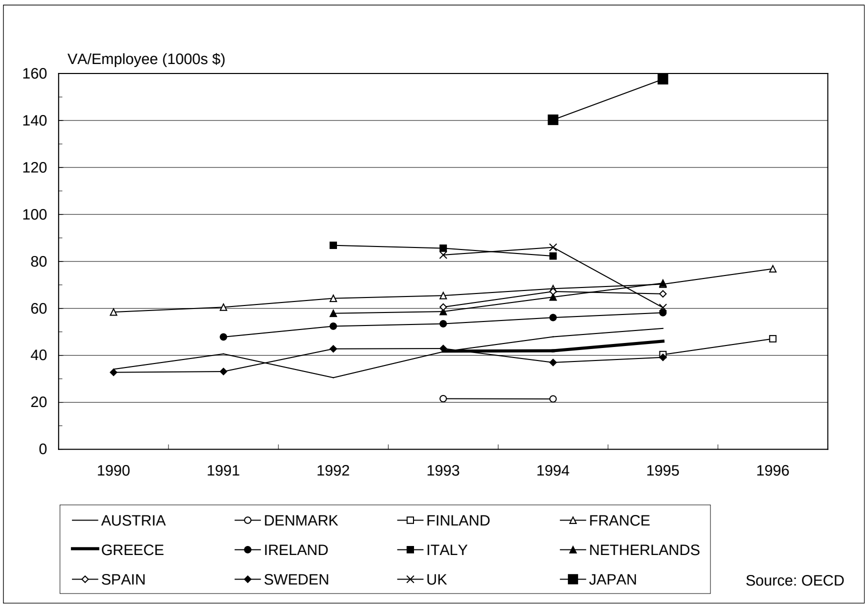


Figure 7.6 Productivity within Publishing



sector with over 20% of value added being invested, whilst other countries invest between 10-15% of value added.

Co-operation between the printing and publishing industries and their suppliers, is mainly initiated from the supplier end. For example, a great majority of the innovations are derived from the machinery manufacturers, followed by the software organisations. This, in turn, is followed by paper, chemical, ink and dye suppliers. In fact, although technology development is currently very rapid, suppliers are the most active in R&D as most printers conduct very little (most being outsourced altogether).

Traditionally, the printing industry has always necessitated close co-operation between printer and publisher to ensure the final product is produced as required, often to enable last minute changes as well. As a consequence, regional influences are more important than global influences. The printing industry is therefore not a global industry as such. To add to this, each European country's printing industry appears to have developed differently, with regional variations also being discernible.

The following section provides details of the activities of some major printing and publishing companies from a selection of the main printing and publishing markets across the EU. In general, most of the companies listed are involved in the printing and publishing of newspapers, magazines, books, brochures, directories, security and speciality papers. Besides many having a national and international presence, many operate on a regional basis, both within national borders or across them. What is clear, however, is that most of the companies have moved towards digital technology in one way or another, with some having committed themselves substantially to multimedia publishing, owning several broadcast and news media companies. Another discernible characteristic is that multimedia companies have expanded into printing and publishing. Combined the trends suggest a convergence of communication industries. In addition, several larger companies have began to expand into Eastern Europe: Axel Springer; VNU; Bonnier Group; Egmont Group etc.

Germany

Axel Springer Verlag is one of Germany's largest publishers, with a turnover of DM 4,600 million, and over 12,000 employees, in 1997. It produces several national newspapers (*Die Welt, Bild*) and a number of regional ones (Berliner Morgenpost, Hamburger Abendblatt). Axel Springer was founded in 1945 in Hamburg. The company moved from tabloid publishing into newspapers, and also moved its headquarters to Berlin in 1967. The company, part owned by the family of Axel Springer and partly by the German film group Kirch, is now in the process of transforming itself into a global media company.

Although the majority of its activities are in Germany, non-German sales account for about 13% of its sales, via ventures in France, Poland, Austria and Switzerland. The company has plans to duplicate *Computer Bild*, the largest computer magazine in Europe, in France and Poland. Eastern Europe is a key investment area, for example, *Bild der Frau* a version of the German magazine, is already the most read women's magazine in Poland. Car magazines, based on *Auto Bild*, are sold in 11 countries.

Newspapers and Magazines account for about 85% of Axel Springer's sales. During the 1970s the company expanded from newspapers into the regional newsletter and magazine market, acquiring magazine publisher Gilde-Verlag, and later Novel publisher Cora Verlag. Springer also launched women's magazines Journal fur die Frau, in 1978, and Bild der Frau in 1983. Other publishing operations include books and special interest trade magazines published throughout Europe. In 1996, the company entered the Czech and Slovak newspaper markets purchasing a 49% stake in the Dutch firm Ringer-Taurus.

Springer also owns 40% of German TV station SAT 1, and a 10% stake of in AOL Germany. In 1998, the company also formed a joint venture with Deutsche Telekom, German publishing group Holtzbrick and Infoseek, a US provider of Internet search services, to create an Internet site for Germany's growing online market. Springer has also acquired 95% of German book publisher Econ & List

Verlagsgesellschaft and announced plans to launch a weekly business publication covering the Euro. The company also has partial stakes in more than 30 publishing companies around Europe.

Bertelsmann is the world's third-largest media company, after Time Warner and Disney. The company employs some 57,000 people and has annual sales of about US$ 13,000 million and is active in television, music and publishing.

The company's book business accounts for 31% of its sales. In 1998, Bertlesmann acquired Random House, the number one trade book publisher in the USA, creating the world's largest English language book publisher. In addition, Bertelsmann's book club is also the world's largest, with 35 million members. The company publishes more than ten newspapers and 70 magazines. Recent developments on the printing side include the construction of Gruner & Jahr's two new printing plants in Dresden and Berlin. Gruner & Jahr account for as much as 21% of Bertelsmann's turnover.

Music accounts for the biggest proportion of of Bertlesmann's sales. However, during 1997, the merger of Bertelsmann subsidiary UFA and CLT of Luxembourg created CLT-UFA making it one of the largest broadcasting and entertainment companies in Europe. In the same year, the company purchased a 50% stake in book seller Barnes and Noble's online retail subsidiary barnesnoble.com. In 1998, Bertelsmann also acquired Springer Verlag as part of its strategy to compete with professional book publishers such as Wolters Kluwer. Whilst Europe accounts for about 65% of the company's sales, the US still accounts for about 25%.

Heinrich Bauer Verlag is the leading publisher of German consumer magazines. The Bauer Group is privately owned by the Bauer family, initially originating out of a printing shop founded by Julius Bauer. The company entered into the publishing business in 1903 via the publication of the regional advertiser Polenburgsorter Zeitung. Later in 1926, it published its first magazine.

The company's annual turnover is approximately DM 3000 million, with publishing accounting for 98% of its sales. Its key strengths are its mass market magazines such as Neue Post, Tina, Das Neue Blatt and Bella, but it also publishes a number of television programme listings, and also owns one newspaper. Germany, remains its main market accounting for some 80% of sales. However, it also expanded into France in 1985.

Burda Holdings GmbH & Co is the third largest publishing company in Germany with a readership of 25 million, the main weekly magazine, Focus, has about 6 million alone. The company was established in 1908, when the present chairman's grandfather, Franz Burda, opened a printing shop in Offensburg. Magazine publishing and printing are the core businesses of Burda, but it also has a number of regional newspapers in Germany and has interests in radio and television.

Burda has an annual turnover of about DM 2.2 billion, with most of its revenues being generated in Germany. However, the company also has activities outside Germany. In 1963, it started its first foreign venture in Austria, and in 1971 it co-opened a printing plant in the USA. Printing operations are conducted in Offenburg, Darmstadt and Vieux Thann. At the same time, the company did not move into newspapers until 1991 when it acquired several new titles.

Suddeutscher Verlag GmbH is a privately owned company with some 39 subsidiaries. It is one of Germany' leading newspaper publishers, employing more than 2000 people and having an annual turnover in excess of DM 1110 million. The company's core business is newspapers. The company has both national and regional titles. Its regional newspaper Suddeutsche Zeitung has a readership of 1.2 million.

The company has now also started to move into magazines, and it is now planning titles in Eastern Germany, with other companies. Suddeutscher has other activities, which include printing, supplements, books and other media. At the same time, the company has also invested in new presses to increase colour capacity and pagination.

Dumont Schauberg is comprised of a group of printing and publishing companies. The company, initially established in 1956 by Ernst Brucker, publishes books, newspapers and magazines, and has an annual turnover of about DM 950 million.

UK

The Daily Mail had a turnover of about £1200 million in 1997. Newspapers are the group's core activity, accounting for about 75% of its operations, which despite some international acquisitions, remain predominantly focused on the UK where 90% of its revenues are generated. The **Daily Mail and General Trust Plc** is the holding company for the group which consists of; Associated Newspapers, Northcliffe Newspapers, Euromoney Publications, Harmsworth Media, and Harmsworth Publishing.

The company's main printing plant, located at Harmsworth Quays, has just been expanded to increase capacity. Existing print sites are located at sites all over the UK such as in Plymouth, Bristol (South west of England), Manchester, Newcastle (north of England), Glasgow (in Scotland) and in Belfast (N. Ireland). However, it has recently opened new printing plants in Southampton (southern England) and in Orlanda, Florida.

Associated Newspapers publishes the company's three main newspapers, the Daily Mail, the Mail on Sunday and the Evening Standard. All three of the above papers are printed by Harmsworth Quays in Associated Newspapers' London Docklands plant. Northcliff Newspapers, the regional publishing division of the group, publishes 17 daily titles, 14 weekly titles together with some 1.7 million copies of free titles each week. This division also undertakes more than 100 external printing contracts for newspapers, magazines and other publications, during downtimes of the group's presses.

Euromoney publishes more than 50 business and financial titles. Harmsworth Media is responsible for the group's television, exhibitions and radio operations. Whilst Harmsworth publishing is responsible for the Group's information publishing activities which include educational businesses, publishing and academic, vocational and language training.

Polestar Plc (Formerly, Webinvest, comprising BPC and Watmoughs) was formed in 1998, after the merger of The British Printing Company (BPC) and Watmoughs Holdings and is Europe's largest privately held printing company. It employs over 6000 staff and had a sales turnover of some £ 550 million, in 1998. The company has operations in the UK, Hungary and Spain, with sales offices in France and the US.

Polestar has printing assets, which comprise more than 90 presses and 60 binding lines in some 37 sites. Manufacturing and distribution services on offer include: 16 Gravure Presses, 47 Heatset Web Offset Presses, 29 Sheetfed Presses, 7 Digital printing facilities, 12 Digital studios, 5 Data Manipulation Facilities, 19 Personalisation Lines and 60 Binding Lines.

The company is divided into six business units; Polestar Web Offset, Polestar Consumer Magazines, Polestar Gravure, Polestar Digital Information, Polestar Packaging and Polestar International. Magazines account for 27% of the company's sales turnover, Catalogues and brochures, 20%, Newspaper supplements, 18%, Direct marketing, 14%, Packaging, 13%, and Corporate & Academic a further 8%.

Polestar is reported to control over 90% of the UK's gravure production capacity, and Investcorp, the Bahrain-based company which formed Polestar via its acquisition of BPC and Watmoughs, has announced plans to invest £ 100 million to improve the company's competitive position in Europe.

News International Corporation is a multinational media group with a broad spectrum of interests in television, newspapers, magazines, books, film and technology, which is run by Rupert Murdock. In the UK, the company is one of the leaders in printing and publishing of newspapers, with in-house printing activities that include colour supplements. In 1998, the company's turnover was in excess of US $12,800 million, with newspapers, magazines/inserts and books accounting for about 50% of its sales.

Newspapers are the main business area of News Corporation. Titles such as; The Times, The Sunday Times, (which has 48% of the Sunday broadsheet newspaper market), the Sun (50% of the daily tabloid market) and the News of the World (the largest selling English language newspaper in the world with sales of 4.3 million). Other main titles include the Daily Telegraph and Herald Sun both in Sydney, Australia, and also the New York Post.

Magazines and Inserts are another major area, but these are mostly distributed within the USA, where the company has the number one selling weekly magazine, TV Guide, and over 180 separate weekly editions with a paid circulation of 13 million copies.

EMAP is the second largest consumer magazine publisher and commercial radio group in the UK, having leading positions in several business publishing sectors. In 1998, EMAP had a turnover of around £ 770 million, 68% of which was generated in the UK. The company is divided into four divisions; Consumer Magazines, Business Communications, Newspapers and Printing and Radio.

Consumer Magazines is EMAP's largest business area, accounting for almost two-thirds of the company's turnover. It publishes 90 consumer magazines in the UK and 40 in France, while the Business Communications division publishes 96 magazines and accounts for about 25% of the turnover. According to Pira, EMAP aims to obtain a dominant position within the UK magazine market, business communications and radio, from which it can move into continental Europe.

Indeed, expansion has already began through new product development and acquisitions. For example, it has acquired three magazines from CLT in France; Telestar, the second largest television listings magazine in France and Belgium, Top Santé, a woman's health magazine, and Télé Star Jeux. In fact, 38 other titles have been purchased in 1994, and in total this has provided EMAP with about 16% of the French consumer magazine industry, similar to the share of Hachette and Gruner & Jahr's Prisma Presse. More recently, plans for greater international expansion within the US and Australian markets, have been announced.

The **Gaurdian Media Group** is one of the main UK media businesses with a wide range of interests in national, regional and local newspapers, magazines, television and radio. In 1998, the company had a turnover of about £ 370 million. The company is divided into six divisions; National Newspaper, Manchester, Surrey, Auto Trader, Broadcast Communications and other interests.

Within the National Newspapers division, the Gaurdian has been quite successful lately in terms of circulation figures with its main titles, the Gaurdian and the Observer. In fact the Gaurdian has also been launched in Latin America and South Africa. In the Manchester division, regional presses have also gained strongly and in total has 36 weekly newspapers in Greater Manchester. The Auto Trader division has continued to increase its turnover and profits for the 15th year, and indeed its Auto Trader magazines continue to dominate motor advertising publication in the market.

Pearson Plc is the UK's largest media and entertainment company, with a turnover of US $ 3770 million in 1997 (UK and Europe accounting for some 50% of this). The company owns the publisher Penguin USA, the Financial Times and production company Pearson Television, maker of Baywatch. Other concerns include textbook publisher Addison Wesley Longman, newspaper and magazine publishing groups Les Echos (France) and Recoletos (Spain), and the UK consumer magazines, Pearson New Entertainment. In addition, the company also has a 50% interest in The Economist magazine and London investment bank Lazard Brothers.

In recent years, Pearson has been streamlining its operations. In 1995, it closed its East India Dock printing plant in London but expanded its five existing printing plants abroad whilst also adding new printing operations in Sweden and the USA. As part of its strategy to focus on core businesses, Pearson has also acquired Simon & Schuster's book publishing operations and is investing heavily in promoting the Financial Times worldwide. In fact, it has earmarked investments of some US $ 160 million to erode the share of its main rival, the Wall Street Journal.

Rexam is the largest paper and packaging product group in the UK, with over 100 businesses. The company operates worldwide in six continents and has a annual turnover of about US $ 3.3 billion, employing more than 21000 people. The company produces packaging for food, health and beauty products, medical supplies and industrial uses. It also manufactures coated products such as decorative papers and silicon-coated film, speciality and security printing (greeting cards and cheque-books), and engineered building products.

According to Pira, 'the company is currently considering several substantial acquisitions to build up its core specialist packaging and coated film and paper divisions'. Coated film and paper, healthcare and beauty packaging are expected to be the target of the company's future acquisitions. At the same time, it is believed that Rexam will sell off its industrial packaging and printing and building materials divisions. For example, the company has already acquired the medical products division of Lawson Maraan as well as that of Tritek Cardboard Packaging Ltd, whilst selling its controlling interest in the UK's Smith & McLaurin (label stock producer).

United News & Media is a large international information and media group, with a turnover of US $ 3420 million. The company's business services division includes Miller Freeman (publisher of Pulp and Paper International), PR Newswire and Mediamark multimedia research. Its consumer publishing division runs the Express newspapers. In 1996, the TV and Financial Group, MAI, merged with United News & Media. The new media enterprise now comprises the national newspapers Daily Express, Daily Star, and Sunday Express, plus substantial interests in the UK commercial TV broadcasters.

With a turnover of nearly US $ 600 million, **St Ives Plc** is one of the UK's leading commercial printers. It prints hardback and paperback books, magazines, (Top Gear and Vogue), financial documents (annual reports etc), and corporate information. The company also produces packaging for CDs and CD-ROMs. However, in the area of direct response printing, promotional items such as mail order catalogues and direct mail items represent one of the fastest growing areas for the company, it now has 10% of the UK market. International operations outside the UK account for about 25% of sales, and this is seen as another area of expansion for the company.

France

Imprimerie Nationale was initially established in 1640 under Cardinal de Richelieu. Since then the company has passed through imperial, royal and national status. More recently, under the authority of the ministry of justice, it has become a limited company, thus gaining its autonomy and complete management and operational independence. It operates in many fields including printing, graphics, publishing and communications. In the past it has worked exclusively for the Government, but has since entered the competitive market and has made substantial investments in new technology to improve performance, whilst offering services to public and private sectors.

The company operates three industrial sites, in Paris, Douai and Évry, and is the leading general printer in France. It has a workforce of about 2000, whilst its printing assets include 9 rotary machines, offset rotary machines, lithographic presses, scanners, CAP, flashing, UV coating, binding and making-up.

The company has developed a modern, evolutive and powerful system for printing and finishing, extending from reproducing plates on a range of specially adapted rotary presses, through to manufacturing on an assembly and palletisation line that is unique in continental Europe. In fact, today Imprimerie is the leader in the field of high volume work and it is today the world leader in telephone directory printing. In the production of telephone directories Imprimerie produces 43 million volumes, involving 60,000 tonnes of paper, 40 billion pages, 380 tonnes of printing ink and 200 tonnes of adhesives. The company is also a leading art publisher, selling copyrights on the international art books market.

Besides general printing services its also offers consultancy in communication and graphic design, a comprehensive magazine production service (from creation through to production, and dispatch) and continuous printing of administrative and commercial forms (zoned listings, systems for controlling registered mail, pads, notebooks, tickets and receipt slips – separate or fanfold etc). The company also prints confidential documents such as examination papers, architectural designs, through its confidential unit which leads the sector in France by keeping abreast of the latest technological developments in printing.

Imprimerie also prints security papers and is the sole supplier to the government. The company utilises the latest technologies available such as dichroic ink, iridescent panels, micro printing, photo-luminescent inks, security strips, watermarks, holograms etc. In fact the company has developed technical innovations to assist these techniques further by maintaining links with the world's security specialists. Some examples of these innovations are a new very high security toner (developed with Nipson of the Bull Group), an new optically variable printing technique, and an anti-photocopy background. In 1970, the company created the Europe's first computerised composition system on an industrial scale. In 1994, the company created Integrane, paving the way to a veritable multimedia publishing system.

In France, **Bayard Presse International** is the leading publisher specialising in children's educational press, senior-interest magazines, outdoor interest magazines and religious publications. The company employs some 1500 people plus around 2000 freelancers, and has an annual turnover of around FFr 1500 million. It publishes some 97 newspapers and magazines worldwide, with a total circulation of 7.4 million in France and 34 other countries.

Bayard published the first magazine for retired people back in the late 1960s. It also publishes, Pomme d'Api, for pre-literate children, Eureka, a monthly science magazine and Capital Sante, a health magazine for the mass-markets. However, in addition to its traditional printing and publishing operations, the company also produces TV programmes, CDs and cassettes.

With over 23,000 employees, and a turnover of some US $9000 million, **Havas SA** is one of the world's largest media companies. In 1997, Havas merged with Générale des Eaux, forming Vivendi. Havas publishes business, reference, educational, and trade books in France, Italy, Spain and the UK. Havas advertising is one of Europe's largest agencies, with affiliates in 65 countries and over 100,000 billboards and airport posters in 8 European countries.

Printing operations account for about 40% of the company's revenues and includes printing of directory advertising, free sheets, newspapers, outdoor and transport advertisements. The Havas Media Communication division is the leading French publisher of directories and circulars and France's leader in ad sales for regional publications and is the top home delivery press distributor. Its CEP subsidiary is also the leading trade publisher in France, with some 50 book imprints and ownership of over 50 French periodicals.

In 1998, the company moved into the Spanish literary and educational markets following the acquisition of the Spanish publisher Grupo Anaya. The group also has strong ties with Bertlesmann, through strategic alliances across French-German-Spanish markets. The company also produces and distributes CD-ROMs and other software and publishes online, and has operations in the audiovisual sector with radio, TV, film and advertising. The company also has interests in CANAL+, the world's largest pay-TV group, and CLT-UFA, Europe's biggest commercial TV and Radio venture.

The main activities of **Lagardére SCA (Hachette)** are publishing and the media, however, the company also operates in technology and transportation sectors. In 1997, the company had a turnover of FFr11000 million, with about 60% being derived from communications and media. Most of the company's sales are in Europe, about 43% in France and about 30% in other European countries.

Hachette, responsible for distribution, print media and book publishing, publishes more than 130 magazines and newspapers in over 30 countries, and financed the start-up of the late J.F. Kennedy Junior's political magazine, George. It also owns the world's leading encyclopaedia publisher, Grolier. Magazine titles include; Car and Driver, Elle, George, Metropolitan Home, Mirabella, Paris Match, Premiere and Woman's Day.

Italy

Gruppo Arnoldo Mondadori Editore is one of the foremost publishing houses in Italy and is the leader in Italian consumer magazines. The company employs over 5000 persons and in 1996, had a turnover of some L 2240 billion. Magazines account for about 45% of the company's revenues, books, 24%, and printing, 20%. Mondadori publishes some of the most popular and well established magazines in Italy; Panorama, Grazia, Sorrisi & Canzoni, Chi and Marie Claire to name a few, in addition to books aimed at both mass markets and scholarly niches.

Rusconi Editore SpA is one of the largest media groups in Italy, having a turnover of about L 440 billion and employing some 500 people. It is family owned and has some 14 companies. Its main activity is book and magazine publishing, although it is also involved in distribution, advertising and printing. Rusconi has 20 magazines, such as Gioia, Eva Express, Gente Money, and the 800,000 circulation Gente. The company is also active on many segments of book publishing.

Spain

The Spanish company **Grupo Zeta** publishes some 40 titles, including El Periódico de Catalunya. It has an annual turnover of about Pta 50 billion. In addition to newspaper and magazine publishing, the group also has interests in one of Spain's commercial television channels, Antena 3 TV. One of its subsidiaries Ediciones Primera Palma, plans to invest Pta 10 billion in a new printing plant in Spain.

Netherlands

VNU, annual turnover of FL 3920 million, is one of the leading publishers of regional newspapers and mass-circulation magazines. The company also produces educational publications, business and professional magazines and databases. The company was formed in the early 1960s following the merger of two of Holland's largest mass-market consumer publishing companies. In the late 1960s, VNU acquired magazine publisher NRM and Smeets, one of the largest offset printers in Europe. Since then it has invested in Dutch and Belgian TV stations.

However, in the past decade, the company has entered the Eastern European market with the launch of Moscow Magazine. Recently, 1997, it acquired Kwety Ceske, the largest consumer magazine publisher in the Czech Republic. Consumer magazines and newspapers account for about 50% of the company's sales revenues.

Roto Smeets de Boer NV is the largest independent printer in the Netherlands. It has an annual turnover of around FL 1300 million and its core activities are printing, processing and reproduction of information supplied by third parties. Roto produces monthly and weekly magazines, mail order catalogues, directories and advertising material. The company is divided into three areas; Rotogravure, which accounts for 42% of sales revenues, Web-offset, 29%, and Sheet-fed offset, 26%. Subsequent to the acquisition of Senefelder in 1998, it now has over two-thirds of the rotary offset market in the Netherlands, at the same time it has also gained a stronger position in the northern European market.

Sweden

Bonnier Group is the leading media group in Scandinavia with interests in all areas of printing and publishing. The group has recently completed their acquisition of all shares in Marieberg, the largest media investment company in Scandinavia, with newspaper and commercial TV interests in 7 countries including Sweden, Finland, Norway and Germany. This acquisition strengthens Bonnier's position as the largest Nordic newspaper publisher and commercial TV operator. The company, has a turnover of some SKr 9400 million, and is comprised of several subsidiaries such as Bonnier Media, Marieberg, Dagens Industri, Bonnier Business and Frili Industrial Group.

Marieberg, the second largest part of the group, has supplemented its traditional daily newspapers with free door-to-door newspapers, and electronic services. Its main newspapers are Dagens Nyheter, Sydsvenska Dagbladet and Expressen. Marieberg has gained a strong presence in Finland and Norway and is also active in the Baltic Sea region.

Bonnier media, the largest part of the Group, has operations in books, magazines, film and radio. Dagens Industri has expanded into the Baltic Sea region and also Austria. Its main operation is Sweden's most profitable newspaper, Dagens Industri, however it also oversees the century old business newspaper Borsen, in Denmark. The group also owns Bonnier Business Publishing (magazines and books), Bonnier Interactive (multimedia online), Publications Bonnier (special interests magazines), amongst others.

Denmark

The Egmont Group is one of the largest media companies in Scandinavia, with a turnover of around DKr 6790 million. The group, comprising 106 companies, started to expand outside Scandinavia, in the late 1980s, and now has operations in 28 countries including in Hungary, Latvia, Australia and China. It is divided into five divisions; Egmont Magazines, Egmont Juvenile, Egmont Books, TV2 Norway and Nordisk Film.

Egmont's core markets were traditionally in magazines, books and children's publications, but recently this has been changing towards broadcast and multimedia with the acquisition of Nordisk Film, and video distributor Metronome Vision.

The company is also investing to become the largest Internet provider in Scandinavia, entering an alliance with Telia of Sweden. However, Internet developments have not proved so successful for the company. For example, a children's subscription service, Fun Online, was launched by Egmont Interactive of Germany, but was discontinued in 1998 and its contents placed on the Internet free, because it only obtained 3000 subscribers out of its targeted 120,000.

Egmont Magazine has a total weekly circulation of around 800,000 copies in Scandinavia. In 1994, the company made the single largest investment in Norwegian magazine printing by investment DKr 120 million in new printing and prepress technology. In Germany, the print sector has been performing very well, with 90% of the German comics market, at the same time increasing its presence in pre-school and beyond the children's segments. In the UK, the company has acquired Reed Children's Books, further strengthening its position in Europe in this sector.

Summary Conclusions

- Printing and Publishing industries are mainly comprised of SMEs, with about 85% having less than 20 employees.
- Printing and Publishing industries are found at local, regional, and national levels
- Although some firms are international and multinational the printing industry itself is not a global industry
- The main clients of the printing industry are publishers
- The vast majority of printing industry products are paper or board based
- Environmental concerns are becoming more of an influence within the industry (particularly VOCs)
- New technology has increased the use of paper, not reduced it
- Internet is not likely to replace books or newspapers but is more likely to find niche markets which may be complementary to paper products.
- The magazine segment appears to be an area of continued growth, with further potential (especially with customised printing with the aid of digital printing)
- The German printing industry has been at the forefront of technology for many years and indeed a strong printing cluster has previously been identified
- Printing technology is changing fast:
  - Offset printing will remain the main type of printing, however, flexographic and digital printing will erode its share
  - Gravure printing will continue to decline as run lengths are reduced
  - Digital printing will become the second largest type of printing in the near future.
- Publishing industries and multimedia markets will likely converge in the future

- The vast majority of value-added information products are paper-based (books, periodicals and newspapers earn bout 95% of their revenues from paper products)
- World newsprint and printing and writing papers are forecast to grow in the future
- Rapid changes in printing technology will necessitate more co-operation throughout the value chain (from raw material and equipment suppliers to publishers)
- Many companies conduct both printing and publishing operations, were paper products are the main source of revenue. However, many companies are moving more into multimedia products.
- Expansion into Eastern Europe is very evident.

Chapter 8. Related and Supporting Industries

Within the Forest-based industries of the EU, there are many industries, which can be classified as related, supporting, or as speciality-input providers. Some related and supporting industries such as machine building have fairly obvious connections (sawmilling machinery, woodworking machinery, pulp and paper machinery, furniture manufacturing machinery etc) but other types of industries are less obvious but do have clear relationships once pointed out. For example, speciality inputs include, bleaching chemicals for the pulp and paper industry, wood adhesives for the wood panel industry, and printing inks to the printing industry.

Each of the latter inputs are generally recorded as belonging to the chemical sector, but one can see that they are manufactured purely to serve the needs of another industry. Thus these are included as belonging to the forest-based and related industries as part of a cluster. In addition, related and supporting industries may also include R&D and consulting services however in this study we have not attempted to identify or to include these. Therefore, this chapter attempts to give examples of some related and supporting industries by describing a selection of 'machine building' and 'speciality input' companies and their activities in relation to the forest-based industries of the EU.

8.1 Machine Building Industries

In 1995, about $10.3 billion US was invested in machinery and equipment within the forest-based and related industries of the EU. Of this figure, sawmilling & planning of wood accounted for $ 0.5 million US, wood products about $ 1.5 billion US, paper & paper products around $6.3 billion US, and furniture manufacturing a further $ 2 billion US. The table below gives details of the estimated investments in machinery and equipment at the national level. Clearly, the production of pulp and paper products accounts for the vast majority of investments, confirming the capital-intensive nature of the industry. In fact, in terms of forest-based and related industries, this sector represents the single most important investment in each country.

Table 8.1 Investments in Machinery and Equipment by Industry, in 1995 (millions of $US)

Country	Sawmilling & Planning of Wood	Wood Products	Paper & Paper Products	Furniture Manu-facturing	Total Investments by Country
Austria	85	122	185	88	480
Belgium/Lux	Na	24	308	132	464
Denmark*	2	23	44	34	103
Finland	110	77	495	23	705
France	2	203	726	236	1167
Germany#	59	358	1335	550	2302
Greece	1	8	41	10	60
Italy*	22	193	615	314	1144
Ireland	6	8	24	8	46
Netherlands	4	41	226	56	327
Portugal	Na	24	319	11	354
Spain	33	237	506	286	1062
Sweden#	157	73	402	48	680
UK	18	105	1091	204	1418
Total EU15	**499**	**1496**	**6315**	**1999**	**10309**
% of Total	**4,8**	**14,5**	**61,2**	**19,4**	**100**

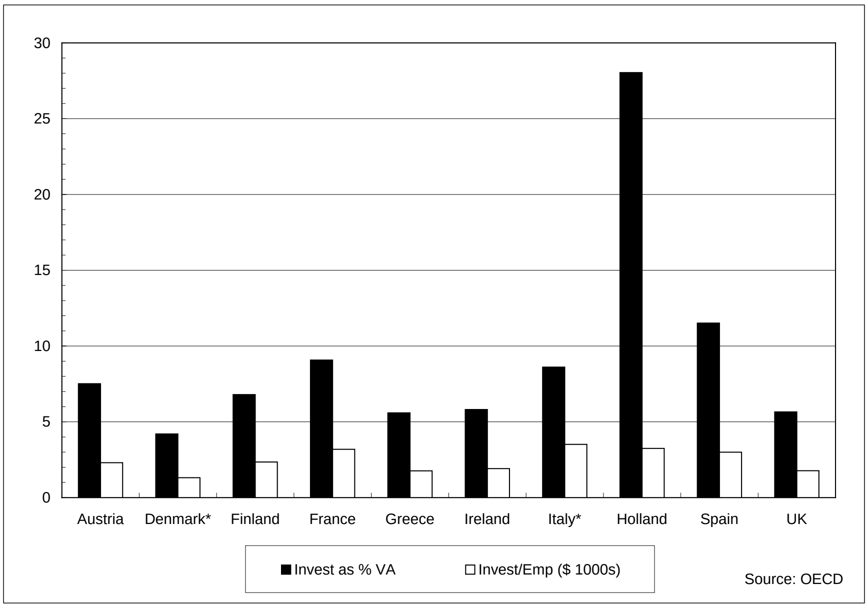
Source: Industrial Structure Statistics – Volume 1, 1998, OECD.
Notes*=1994; #=ETLA estimates.

While the printing and publishing industries are an essential element of the forest-based and related industries, being the key customers and users of paper products, their associated machine building industries are not considered part of the industrial cluster. This is despite the fact that at individual national levels, it may be that the pulp and paper industry has developed around the printing industry – i.e. the German printing cluster, as identified by Porter et al[1]. The main reason for this is that the technology is developed to facilitate printing were paper is merely an input, where as, machinery in the other areas listed above utilises and enhances the basic wood or paper product, adding to the competitiveness of that industry. Nevertheless, it is clear that the printing technology itself is an important factor, directly influencing the characteristics of the paper product being supplied.

1 The Competitive Advantage of Nations, M.E. Porter, 1990.

Generally speaking, the levels of investment are connected to the size of the industry in each respective country. However, one should not necessarily equate level of investment with competitiveness. Take for example, the furniture industry in Denmark, which has very low levels of investment in machinery in terms of value added, yet the country has the highest export ratio in the EU (75% of its production being exported). In fact, the same can be said for Italy, which again has relatively low levels of investment but is one of the biggest exporters of furniture in the world. The figure below shows typical levels of investment across the EU.

Figure 8.1 Investment in Machinery & Equipment – Furniture Industry - 1995



In addition, within industry sectors, countries tend to have different strategies and for different reasons. For instance, investments in the sawmilling industry tend to have a higher capital intensity in Austria and Finland, both of which have an abundance of natural resources. In Finland's case, a mass production strategy is required to overcome disadvantages of distance to the main markets in central Europe. Whereas in Austria, the high levels of investment could reflect its strategy of producing higher value added products, since distance to markets is less of a factor, when compared to Finland. Typical investment levels are shown below.

Figure 8.2 Investment in Machinery & Equipment – Sawmilling Industry – 1995

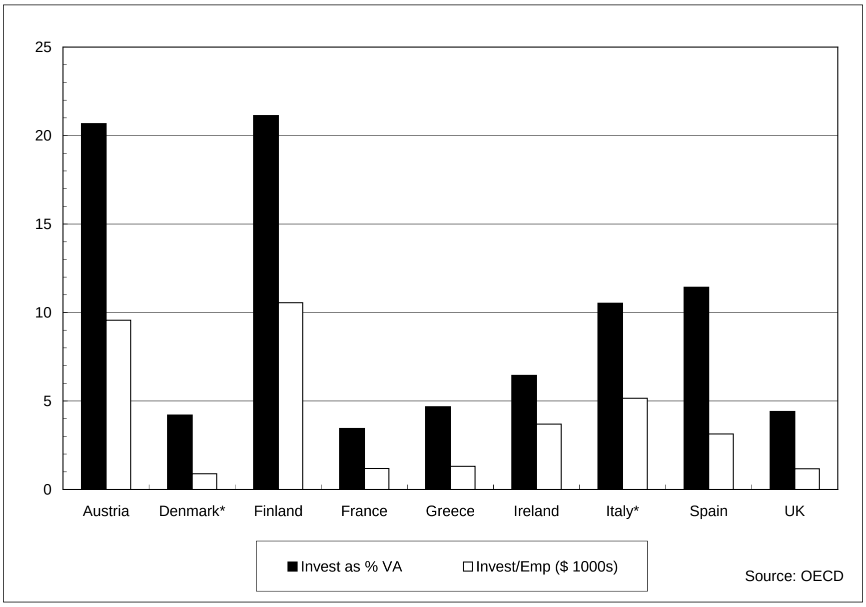
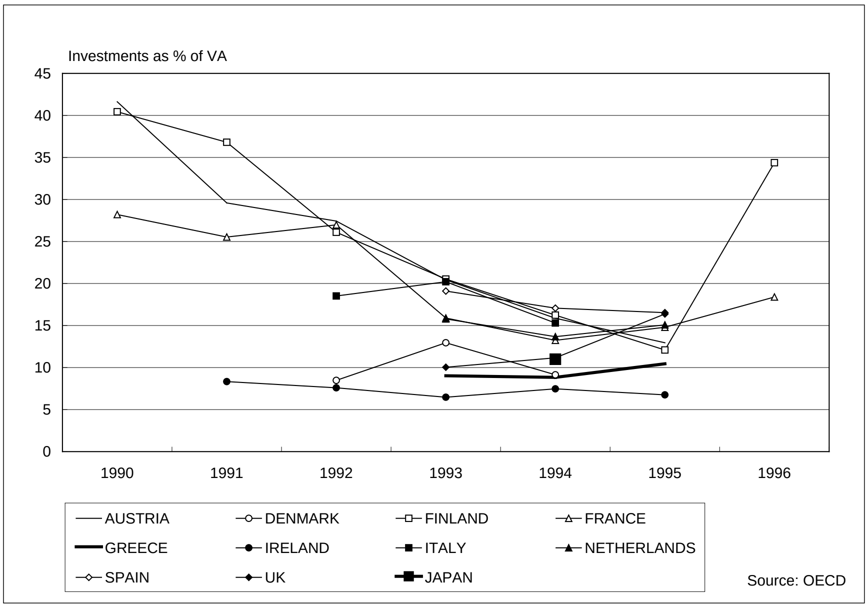


Figure 8.3 Pulp and Paper industry Investments in Machinery & Equipment



At the country level, each country tends to have a bias towards certain industries in terms of capital expenditures. In Italy, Spain and Belgium, up to one-third or more is invested into furniture manufacturing. Whereas in Finland and Portugal more than 70% of the country's investments within the forest-based industries is channelled into the pulp and paper industry.

Some countries appear to constantly maintain high levels of investment. If we take for example, Finland, it is quite evident that they are striving to remain at the forefront of technology, by continually investing in machinery. In a highly capital intensive industry continuous investments are necessary to upgrade, rebuild or improve production plants.

In describing the related and supporting industries we have utilised monographic descriptions to demonstrate how these companies – and many more - are connected to the industry and are important sources of innovation, technology, and R&D which is embodied within the machinery itself. For example, some of the largest and most competitive producers of LWC paper are located in Finland. In addition, the paper machine manufacturer Valmet (Metso) is also located in Finland were it develops its machinery to satisfy the high demands of Finnish producers, via tight co-operation. However, Valmet also supplies machinery to competitors of the Finnish paper producers. In 1999, Valmet and Cartiere Burgo (the Italian LWC producer) entered into an agreement for the supply of state-of-the-art LWC machinery. Therefore, R&D and technology which is embodied in machinery is thus transferred internationally.

The final point to note is that this machinery and equipment quite often provides the basis from which some companies, and sectors of industry, derive their competitive edge, but rarely does the machinery alone provide the advantage, it is a combination of factors that converge to form the basis of success. Indeed, this is the concept of the cluster, and this is why traditional economical analysis does not always capture the true competitiveness of a particular industry. One should also bear in mind that machinery used within the forest-based and related industries is often very specialised in nature and developed by both customer and end user in co-operation.

As such, the development of this type of specialised machinery represents a considerable investment in R&D, which often does not show up as R&D expenditure in forest industry companies' balance sheets. See later discussion on R&D.

Box 8.1 Technology Developments in the Forest-Based Industries[2]

The development of new technologies has helped to shape the face of the forest-based and related industries. Today, rapid developments in the high-tech sector, particularly in the area of processing technology and management systems and methods, are being adapted for use in the forest-based and related industries. In general, the main driving forces over the recent decade or so have been: 1) Growing concern for the environment and demand for sustainability, material and energy conservation; 2) Increasing consumer demand for higher product quality, performance and safety; and 3) Increasing competition in markets through globalisation.

However, many developments have occurred some time ago. One of the most significant technological developments occurred as a result of the industrial revolution, with the advent of the steam engine. Not only did sawmills adopt this technology to increase productivity, but also the rapid expansion of railway networks opened-up vast areas of untouched forest resources. Indeed, this led to a rapid increase in the production of wood products beginning in the mid 1800s.

Notwithstanding, until the 19th century wood was still used primarily as fuel and as a raw material in construction, with as much as 95% of harvested wood being used as fuel, and even today as much as 50% of wood harvested globally is used as fuel. However, since the 1950's, numerous wood products have been developed, thanks to technology developments.

Until the 1950s, construction timber and timber manufacture was the most important sector of the forest industry. However, pulp and paper was and still remains an important sector also. Fibreboards were invented at the beginning of the century, but didn't become significant product lines until 1960.

---

2 Source: 'Technology Developments in the Forest Industry: Past, Present and Future', J. Philippou, in Analysing Structural Changes in Roundwood and Forest Products Markets in Europe, pp 41-54, EFI Proceedings No. 26, 1998.

The softwood plywood industry flourished after the second World War, (particularly in North America) providing a versatile panel product used in house construction and other applications. However, during this period, the availability of low-cost sawmill and plywood residues coupled with the development of synthetic adhesives saw the development and introduction of particleboard, a product with wide application potential. The dominant species used in plywood and particleboard were conifers, whilst broad-leaved species were mostly utilised in the production of timber and veneer for the manufacture of high-quality furniture.

Up to the 1960s, the rapid expansion of the sawmill and plywood industries put pressure on the forest resources. At the same time, competitive substitutes, such as aluminium and plastic products also rapidly developed. These developments made it clear that better and more efficient use of the forest resources was necessary. This led to extensive research and development of wood characteristics and its potential applications, and to development of machining, slicing, drying, impregnation, adhesives, pulping and bleaching processing techniques and new products.

The sawmill industry developed thin and precise saws, introduced automation, computers, log scanners and on-line camera defect detection grading, and flexible control systems. These increased production, quality, efficiency in processing and reduced residues.

Plywood manufacturing techniques were also improved, increasing veneer recovery and enabling more efficient use of smaller logs and peeling of new, mainly hardwood species. In addition, improvements in the drying of veneer and polymerisation of adhesives facilitated faster production rates and lower production costs. Nowadays, very thin veneer is manufactured from nearly all wood species and they are used extensively as an overlay to enhance particleboard and other wood based panels.

The invention of particleboard was a significant breakthrough in the use of residues and low grade small dimension logs and logging residues. Research into adhesion and co-polymerisation of synthetic adhesives and the adaptation of high-technology, led to a better understanding and development of fully automated and computer controlled production lines, and spawned a new growth segment in the wood industry. For example, acceptance of particleboard on the market was soon followed by a stream of higher quality wood-based panel products. These products include multi-layered boards with veneer or plastic laminates, cement and gypsum bonded boards, veneer and plywood overlaid boards, waferboards, oriented strand boards (OSB), medium density fibreboard (MDF), and a number of molded wood-plastic composites. All the above boards are produced from wood manufacturing residues or low quality small dimension wood materials.

Manufacturing of both MDF and OSB has been growing rapidly since the 1980s. The properties of MDF have permitted the substitution of timber and plywood in many non-structural uses whilst helping to extend the use of wood to many new applications. Furthermore, shortages in large diameter logs and the availability of logs of smaller diameters, at much lower prices, led to the development of the so-called 'engineered wood products' such as laminated veneer lumber (LVL), and oriented strand lumber (OSL). These latter two products are made from low grade small dimension timber, long strands, low grade veneer strips, and crush trees etc, glued together in structural timber dimensions.

The latest developments in the field of wood composites are Molded fibre products. Technology is available to combine wood fibres with plastics or synthetic fibres to make a variety of new composite products, utilising the best characteristics of each type of fibre. Chemical modification of wood fibre and grafting of polymering chemicals have opened up new avenues in producing composites with enhanced properties. New composite products under development are based on the utilisation of waste paper, recycled wood and other biomass and recycled plastics.

The pulp and paper industry has grown rapidly during this century, with technology developing at a much quicker pace than in other forest-based industries. Developments and improvements in pulping methods enabled the production of mechanical, chemical, semi-chemical and thermomechanical pulps, to name but a few, using all types of wood species and residues.

Developments in drying technology and equipment (press-drying) have led to significant reductions in energy consumption, while development of effective incinerators of the pulping material in the black liquor have enabled the generation of almost all thermal energy needed in chemical pulping methods, and recovery of pulping chemicals.

Although the pulp industry was previously one of the most polluting industries of water and air, active research to eliminate the pollutant substances started very early. In fact new pulping chemicals and methods were developed to eliminate or reduce sulphur from the pulping liquor, mercaptans, chlorine and dioxins generated during pulp bleaching. Development of effective de-inking technologies facilitated the recycling of used paper and paperboard fibres. In recent years the pulp and paper industry has managed via technology development to solve most of its previous environmental problems, to reduce energy consumption, to utilise fibres from just about any wood species and solid residues. Today, innovations stem from tight co-operation between, pulp and paper producers, machinery builders and speciality suppliers such as chemical manufacturers (chemicals, fillers, pigments, additives etc).

In sum, the adaptation of high-technology and engineering monitoring systems have permitted effective control of the quality and production costs of an increasingly large number of end products, ranging from newsprint and printing and writing papers to speciality papers.

In the area of wood preservation the toxicity of the preserving chemicals and the environmental effects are the focus of much attention. Very active research is currently underway to develop more ecological methods to enhance the durability of wood without the use of antibiotics, antagonists and treatments to modify the chemical structure of the wood cell walls to prevent degradation.

Development of Adhesives technology have played a vital role in the progress of the wood industry. Wood panels, engineered wood and the application of wood in many areas would not have been possible without the existence of adhesives. It is claimed that any development that occurred in the wood panel industry was closely associated with the development of polymers and synthetic adhesives.

Urea-, melamine- and phenol-formaldehyde prepolymers are some of the most commonly used adhesives on wood products. However, their use has been associated with formaldehyde release during production and use of the wood composites. Despite the minimisation of these problems, a great deal of research is currently underway in the development of formaldehyde free adhesives. Tannins, foliage and residue lignin, and other chemicals from renewable materials also offer potential as wood adhesives.

In the future it seems likely that 'there will be more technological and managerial efforts to improve the effectiveness of sawmills and plywood mills to use smaller diameter logs and to improve quality and reduce costs'. 'Developments in wood panels, such as particleboard, MDF and OSB, will focus on improving the properties of the panels, particularly dimensional stability, durability and resistance to fire.' 'New improvements in the adhesive formulation and application will improve product quality and reduce or eliminate volatile organic compounds (VOCs).' 'Continuous improvements in wood panels would substitute timber and plywood in many ways and promote their use instead of non-wood substitutes.’ ‘The technology of producing composite products by combining wood, plastic, synthetic fibre, metals and organic materials will become highly developed.’

Adaptation of modern processing and management systems technologies developed in high-technology sectors are being applied to forest-based and related industries. A selection of these technologies include, automation, computer and electronically controlled systems, laser, ultrasonic, microwaves, radio frequency waves, scanners, biotechnology, polymers, systems engineering, total quality management, telematics etc.

These technologies will influence forest-based and related industries and strengthen their competitive position by ‘producing clean and well engineered wood-based products that meet requirements of sustainability development, environmental protection, safety and customer satisfaction.’

8.1.1 Woodworking Machinery Industry[3]

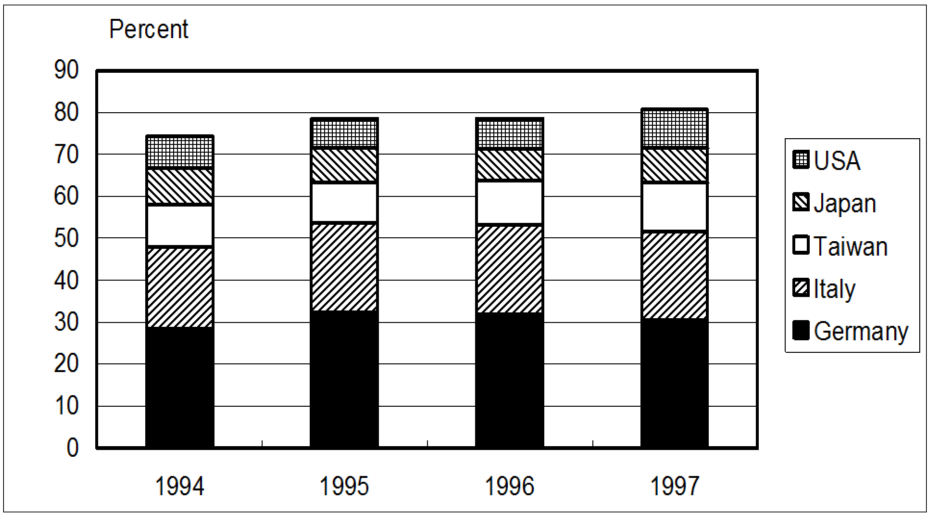
The German woodworking machinery industry is the one of largest in the world. In 1998, it had a turnover of approximately Euro 3 billion, employed around 25,000 persons and comprised 250 companies. The German industry is also a global leader in woodworking technology with the most registered machinery patents. Moreover, it is one of the most competitive in terms of exports, with a market share of the world markets of about 30%. Italy is also a considerable exporter of wood working machinery with a market share of 21%. Taiwan, Japan and the USA are also key producers with sizeable market shares, as shown below. In recent years other European countries, such as Spain, have gained market shares in woodworking machinery manufacture.

Exports of German woodworking machinery have grown since 1993 along with increased production, whilst imports have remained at constantly low levels. In 1998, the value of production was just under Euro 3 billion, exports were worth approximately

---

[3] Source: VDMA Fachverband Holzbearbeitungsmaschinen (The German Woodworking Machinery Manufacturers Association).

Figure 8.4 World Trade of Woodworking Machinery



Euro 2 billion, and imports were around Euro 0.4 billion. The majority of German woodworking machinery exports (over two-thirds) are absorbed within Europe, however, the USA is also a substantial market, as is Asia.

8.1.2 Woodworking machinery and equipment manufacturers

The German company, **Weinig Group**, is one of the largest in solid wood machinery field who manufactures specialist machinery for wood and wood furniture manufacturers. The Group produces a range of woodworking machinery, which includes planers, moulders, window machining centres, band re-saws, tooling, tool washing mechanical handling equipment, tool grinders and other special machines. In 1998, the Group had an annual turnover of DM 529 million, and employed almost 2000 persons, with more than 130 apprentices. Over 80% of the company's production is exported. Weinig products are installed in more than 100 countries around the world (it is also claimed that there are 50,000 machines in operation worldwide), and in moulders it the global leader with more than 40% of the world market.

The company is a keen investor in research & development and education and training. Weinig has state of the art training facility, and an annual expenditure on training and education for its employees of more than DM 6,2 million. In fact, it invests 5% of its sales revenues on R&D.

Weinig's main production facilities are located in Tauberbischofsheim, in Germany. However, the Weinig group is also located in most of the main woodworking industry markets in Europe, the USA, Asia and Australia. For example, Weinig is located in Chambray les Tours, in France; Bruneck and Manzano (Udine) in Italy; Halmstad in Sweden; Abingdon in the UK; and North Carolina in the USA. Udine is located in North east Italy in the heart of one of Italy's furniture districts. Halmstad is located in south west Sweden, in close proximity to Copenhagen, is near the wood and furniture districts of Sweden and Denmark. North Carolina, is the home to one of America's furniture clusters.

Barberan S.A.,[4] established in 1929, is one of the largest woodworking machinery companies in Spain. It is one of the world leaders in wood finishing technology and manufactures three main types of machinery: profile wrapping, board laminating, and lacquering machines. Barberan, located in Castelldefels, in Barcelona, began to manufacture lacquering equipment in the early 1960s and soon after expanded with profile wrapping and board laminating technology. Its main customers are the wood products and furniture industries.

The company strives to develop state-of-the-art machines and systems to ensure demands of surface finishing are achieved, more efficiently, and by adopting environmentally friendly solutions. Barberan, maintains very close co-operation with the most important glue suppliers. As a consequence, it has built up expertise in a wide variety of wrapping machines employing any kind of material (wood veneers, paper, PVC foil, as well as low pressure laminates and other flexible materials) over a wide variety of substrates (solid wood, particle board, MDF, plastic, and aluminium extrusions), using either conventional, hot melt or cold glues, including the latest generation of PUR glues.

In recent years, Barberan has increased its share of exports to the EU and also South America. Barberan's main competitors are located in Germany and Italy, where there are 2 to 3 main producers of profile wrapping and lacquering machines, in each country. However, according to Barberan, Italian and Spanish manufacturers are more innovative today, and indeed, previous poor quality perceptions have been overcome, so that today, there is very little difference in quality/price ratios between competitors. In fact, Barberan sells many machines, especially profile wrapping were it is a world leader, to German customers.

Nearly all of Barberan's machines are custom built for very experienced and demanding customers. Nonetheless, a great deal of Barberan's customers are previous clients, seeking new machines. In general, these machines can cost anything from $30,000 to $1 million US and as such they represent a major investment for the client. As a result customers tend to be more technically sophisticated these days and sometimes request machine testing to compare results against competitor's machines. Today the specialised nature of machines demanded by customers is resulting in many new smaller machine builders entering the industry to niche markets.

There is mutual co-operation between Barberan (as with other machine manufacturers) and the major glue manufacturers. Glue is a constant factor as

---

4 Based on Interview with Barberan, August 1999 and on company reports.

one of the biggest inputs within wood finishing hence tight co-operation is essential. Adhesive manufacturers are highly concentrated and are thus very powerful suppliers. The main glue suppliers are located in Germany, Sweden, the UK and the Netherlands. At the same time, systems for the application of glues is also a major input, many of which are also supplied by the large multinationals. Other important inputs tend to be lacquers, and paint finishes.

In Scandinavia, were regulations are more rigid, the industry is more environmentally aware and already manufacturers have switched to water-based adhesive products. Barberan have responded to this trend. Today a large proportion of its wrapping machines are built to wrap wood with paper and veneer, and whilst these methods utilise both hot melt or PVA glues, the latter adhesives are waterborne and contain less contaminants. However, within the EU, there are differences. Solvent borne glues are still used in many EU countries such as Belgium, the UK and Germany.

Glues are also important from the point of view of productivity. For example, hot melt adhesives increase productivity of lamination or wrapping (e.g. 120m/min), whereas water-based glues are much slower (20m/min). Differences in machinery and glue application system are also a factor, but the difference in cost and productivity is still the deciding factor. Therefore, environmental trends, are likely to effect both machine building and wood product industries.

Dieffenbacher designs and manufactures hydraulic presses and complete production lines, including gluing, forming and material handling for the production of particleboard, MDF, OSB and other wood based panels. The product range of products also includes manufacturing systems for decorative and technical laminates, and plants for the production of LVL. The company's main customers are the wood-based panel and furniture industries.

In 1997, Dieffenbacher had an annual turnover of DM 310 million and employed over 800 people. About one third of the worldwide production of wood-based panels is carried out on Dieffenbacher presses and press systems. The company was established in 1873 and began manufacturing hydraulic presses for fruit, wine and oil. In 1954, it built its first particleboard and veneering presses, and since then, nearly 1000 presses and press lines have been put into operation. In 1990, the first continuous particleboard press started production. During the 1990s, the company expanded to Eastern Europe, USA, and Asia, having previously moved into Canada in the 1980s.

The company produces machinery for most segments of the panel industry, high or low volume, specialised or flexible machinery. For example, the Conti-Panel-System is an all round press which is equally suitable for particleboard, MDF, OSB and LVL and large volume capacities. The single-opening presses are designed for small and medium capacities for countries where difficult production situations prevail, such as adverse climatic conditions. At the other end, the company's multi-opening press is designed for high levels of production and a high format of flexibility for particleboard, MDF, OSB and Waferboard. Furthermore, the company's short-cycle press system is especially designed for laminating every substrate known to date i.e. particleboard, fibreboard and plywood, with various laminating materials such as decorative paper impregnated with melamine resin; paper impregnated with phenolic resin, and real wood veneer.

Dieffenbacher has also been expanding in Europe. In 1997, it acquired Karle & Jung Gmbh in Karlsruhe, Germany and Dieffenbacher UTW in Vienna, Austria. In 1998, the company also acquired Schenck Panel Production Systems in Darmstadt, Germany. Through this latest acquisition, Dieffenbacher Schenck Panel will continue to specialise in design, supply, installation and start up of turnkey process equipment lines for the production of particleboard, MDF, OSB and LVL.

Pagnoni Impianti SpA is based in Monza, near Milan in Italy, and produces presses primarily for the wood-based panel and panel processing industries. In 1998, the company had an annual turnover of 15 million Euros, and employed 55 people. The company's main products are Wood-based panel (particleboard, MDF, HB, Plywood, CBPB) press lines, Short-cycle lamination (LPM) press lines, Decorative Laminates (High Pressure Laminates) press lines, and special presses of different types. Short-cycle lamination press lines - used in the furniture industry - account for about 50% of products sold, whilst wood based panel press lines account for a further 20%.

Pagnoni's main markets are in Italy and southern European and Mediterranean countries, Eastern European countries and South America. The company maintains close co-operation with its customers and suppliers. The general design of the press line (in which design and construction is the company's core activity) is almost always developed together with the customer, whilst the design of the single machines included in the production line are studied together with the sub-suppliers. Moreover, key customers may also suggest modifications and/or improvements in the design of both press and other machines, therefore helping to develop machinery technology with the company.

Pagnoni is an old and well-established company with more than 150 years of history. Its history of development is both interesting and instructive of how company's innovate, survive through hardships, shape their environment and ultimately to maintain their competitive position. It also shows why competitive companies do not just appear overnight, development is dependent on many factors, some of which become evident through Pagnoni's history as described below, but competitiveness requires continuous innovation and development, all of which takes time and effort:

Box 8.2 Pagnoni Presses[5]

In the 1700s the Pagnoni's were millers, and operated a small enterprise in Monza on the river Lambro, grinding grains into flour. At that time, northern Lombardy was an important host to flour

[5] Source: Extracts from: A history of presses – 'From the Fratelli Pagnoni company of 1848 to Pagnoni Impianti of 1998', by Francesco Mandressi, and Barbara Pagnoni, Pagnoni Impianti s.p.a 1998.

mills producing what was the main staple diet across Europe. Water was the main source of power used to drive mill machinery in the production of textiles, flour, oil, etc. This necessitated the understanding and application of the most advanced mechanics during that time.

Essentially, the real mechanics of a water-powered wheel were the ingenious arrangement of cogs, pulleys, belts and transmission shafts that convert the energy of the moving water to turn the grindstones, oil mills, or presses. In addition to running the production of the mill, the miller was also responsible for looking after all the machinery and in order to do this well, he had to develop a good knowledge of the engineering complexities and mechanics well above the average person at that time.

With the advent of the industrial revolution, the traditional technology used in mills was replaced by more efficient and practical systems driven by combustible fuels, and later by electricity. As a consequence, the people running the mills developed skills, which they soon applied to new areas of manufacturing. In 1848, after several generations of experience had accumulated, the Pagnoni brothers, Stafano and Martino, transformed the family mill into an engineering workshop. This has since been recognised as the foundation of the Pagnoni factory.

During the early 1800s, the industrial revolution, which originated in Britain, was transforming the lifestyles of people all over Europe – economically and socially. However, this progress was not even. While in France, Belgium and Germany industrial development was growing well, Italy appeared to remain outside this development.

One example of industrial expansion is that of the spread of railway networks. In Italy, the railway system dates only from the 1860s, whereas in other countries such as Britain, Belgium, France and the United States, the railway networks already extended throughout each country for thousands of miles.

Despite Italy's apparent insignificance as a contributor to the economic progress sweeping across Europe, the Pagnoni brothers saw a unique opportunity. Hence, drawing on their spirit of commitment, resources, and capacity for invention, they successfully transformed their small engineering workshop into a full-scale industry, which was capable of undertaking all types of mechanical engineering, by taking advantage of the lack of such production facilities in the area around them.

The Lombardy region - and the district of Monza in particular - were fairly representative of the industrial backwardness prevalent in Italy at that time. Only the textile industry had begun to evolve, but their pull was not enough to catalyse industrialisation. Lacking the critical mass to structure itself as a business supplying services to industry, the Pagnoni company kept all of its options open, whilst focusing the bulk of its activities on the production of machinery for mills.

The firm's first headquarters had been in Monza, located on the island in the middle of the Lambro river - the site of the Pagnoni's water mill. However, in the wake of Italian Unification, a great surge in industrialisation occurred. The prime mover behind the local transformation of Pagnoni, came through Giuseppe Pagnoni, who is remembered as the pioneer of the company's industrialisation. By 1892, the company had relocated to a factory in Via Magenta in Monza, The new plant included a new foundry, large sheds covering an area of 15,000 square metres and a further 10,000 for storage of raw material.

Despite the large-scale expansion, it soon became clear that the foundry was too small, and in 1903, it was completely rebuilt incorporating the latest standards of technology and state of the art machinery. The investment in the new foundry meant that the firm could take on production contracts for third parties, as well as serving as an engineering workshop, whose production turnover had meanwhile escalated dramatically. By 1911, the Pagnoni factory had 299 employees and ranked as the twelfth largest firm operating within the Monza district, which had become an important area for industry.

The company had kept its options open, by diversifying activities and taking advantage of its experience and technical prowess. In fact, the company was able to produce all types of machinery and to address the needs of a broad portfolio of customers. In addition to building machinery and entire plants for flour mills, sawmills, oil mills, pasta manufacturers and rice producers, Pagnoni also built the add-on parts and additional machinery to automate related operations according to customer desires, whilst also installing the machinery as well.

The creative input, which went into the design of these machines and often employed highly innovative solutions, was well matched by the ability of the workshop technicians, who actually built the new machines. What is stunning is that besides the sheer magnitude of the machine shop's production turnover, is how it not only built the main body of the machinery ordered, but also manufactured all the necessary components of which it was constituted. These assembly items included pulleys, packings, brackets, transmission shafts, rings of all diameters and materials, rods, hand wheels, bushings, valves, and even bolts.

Apart from energetic leadership, Giuseppe Pagnoni was blessed with considerable foresight. One example, was when he decided to begin producing machines for pasta and olive oil, in the 1880s. Giuseppe, realised how industrialisation was affecting the way people lived, particularly in the city. The traditional model of consumption – were food requirements were met primarily by the countryside, was being replaced by a new regime, in which the mediation of the food industry was becoming the key. At this point, Pagnoni decided to concentrate in two fields. Pasta-mixer and heading machines, pumps and dryers, and presses became the company's core products.

Until this time, the design and manufacture of mechanical presses had not been part of the company's traditional production activity. The transition required a huge shift in scale for many areas of the company. Machinery produced had taken on very large dimensions - weighing several tons and standing six or seven metres high. These machines were very powerful, required a huge investment of effort, but ultimately led to the company's complete mastery of hydraulic technology.

From this point on, presses of all kinds became the most important item of Pagnoni's machine production. Soon their use spread to other applications. In addition to the heavy demand from the pasta and oil production sectors, Pagnoni began production of presses for: tobacco casking; bending rails and metal sections; grinding wheels; drying and baling raw cotton; and for the production of plywood panels. While demand was not high for plywood panel presses, the introduction of this type of press (in production as early as the 1890s) constituted a technological watershed for the innovation involved, and the large dimensions that were achieved.

While the growth of turnover at Pagnoni in the early 1900s can be seen in the growing number of employees, the reputation of its products is revealed from the awards the company received. However, Pagnoni received a more important endorsement of its products by an ever-increasing list of impressive clients. These included: pasta producers, Buitoni, Barilla, De Cecco; olive oil producers, Sasso and Carli; and a vast number of clients in many sectors of industry such as Pirelli, Breda, Campari, Falk, Fiat, Dalmine, Isotta Fraschini, Frette, Ansaldo, Singer, Cinzano and even Alfa Romeo.

Before the First World War, Pagnoni had made a name for itself abroad. Initially, contractors were based in the Mediterranean basin, but these were gradually complemented by an increasing number of companies from countries more industrially developed than Italy. These included Switzerland, Germany, France - and between the war years - the United States, and enabled the company to compete with the world's top producers in the most advanced markets. In the 1920s the firm mounted an export drive, aimed at countries further afield, such as Brazil, Uruguay, Chile, Argentina, South Africa, Nigeria, Algeria and Sweden.

By the 1920s, Pagnoni was still looking for new applications for its machinery. The company's products soon included hot-presses for producing plywood panels, a field of research in which it was a pioneer. Owing to its weight, ease of modelling, and resistance, plywood was being used in advanced industries in the construction of aeroplanes, and was also being increasingly used by architects for interior design. However, production of plywood was still in its early stages, and not yet widespread.

Pagnoni's foray into this sector was particularly important to the company. The manufacture of plywood presses was not merely the conversion of existing machinery, it involved the complete creation of one-off devices of great power that incorporated leading-edge technologies. The first series of presses were multi-opening – capable of pressing several panels at once – were equipped with a sophisticated system for heating the pressure plates (until then unheated), thereby greatly reducing the time involved in each cycle. The trials and tests made on these machines gave Pagnoni the opportunity to develop new technologies and experience, and soon led to plywood becoming the vanguard of the company.

The years that led up to the First World War saw the company in a whirlwind of activity. The only setback emerged on the eve of the outbreak of war, when Giovanni Battista Pagnoni withdrew his participation in the company in 1914 due to health reasons, leaving Giuseppe Pagnoni to run the business alone. The war brought hard times on the company and profound changes. Engineering industries were channelled away from normal activities – its primary source of customers – and hence Pagnoni was diverted away from the evolving expansion programme.

Even after the end of the war, the company suffered a further set back with the death of Giuseppe Pagnoni, and the subsequent break-up of the business, which became a joint stock company. However, the majority shareholder and chairman of the company, Nicola Pagnoni, son of Giuseppe, bought back shares from his relatives to enable him to run the company more efficiently. Fortunately, the technical prowess that Pagnoni had accumulated over the years was unaffected by the difficulties at management level. Soon the company had renewed its earlier activities, led by the main sectors serving pasta and olive oil industries.

Meanwhile, the number of employees at the plant had reached one thousand and the surge in projects and designs for presses for plywood production reflected the increasing importance of the woodworking department. However, after the revaluation of the Lira, a period of economic hardship began in 1927, and orders gradually dwindled. At one point, this difficult combination of factors forced the company to take on orders at less than the real cost of production to avoid closure. The economic crises of 1929 triggered by the Wall Street crash further compounded the ongoing stagnation of the markets, which was soon followed by a full-scale recession.

By 1931, Pagnoni was forced to go into liquidation, but by 1933 this was revoked and production resumed along with trade activities. Although hard-times had been forced upon the company, the way in which Pagnoni managed to haul itself out of its difficulties was largely due to the ingenuity of Nicola Pagnoni, who gambled on a completely new design cage for the oil press. The new design was a low-cost apparatus, which was designed to be compatible with other presses. The sale of the new presses was not easy, and in order to sell them, Nicola personally travelled throughout the country by train in third class. However, his determination soon paid off, as many oil producers readily adopted the innovative Pagnoni cage.

After the economic crisis was over, Pagnoni was once again in a position to pursue its expansion. In 1933, the company was transformed into a limited partnership as Fratelli Pagnoni. The partners were Nicola Pagnoni, as the majority shareholder, his son Pino, Nicola's second son Franco joined later.

The outbreak of the Second World War brought an abrupt end to Pagnoni's new phase of development. However, work resumed after the war, gaining new momentum following the construction of a new plant in Via Sempione, in Monza, in 1948. The plant was centred on a large industrial shed, the tallest in Monza at that time, housing all the production machinery. The huge capacity and unusual height of the building enabled the construction of machines, which were much larger than anything before.

At this point, the company decided to phase out the production of machinery for the food industry and instead to concentrate on the production of wood board presses, a sector in constant expansion. And because of the outsize systems that such machinery required, Pagnoni was ideally positioned to test their new production potential.

Between the 1950s and 1960s, the business was revamped under the guidance of Pino Pagnoni, who introduced a new, more modern company set-up, fitting out the new premises with completely new equipment, some of which he designed and built himself. In addition, he radically altered the way in which the presses were built with the introduction of parts made from welded plates, rather than from cast iron and steel.

The surge of development that followed was astonishing and enabled the company to climb into a dominant position in the field of presses for wood panels. In this period, over 300 presses for plywood were built, most of which are still in operation today. But the great technical ingenuity of Pino Pagnoni prompted the company to branch out into other areas of activity, such as metal engineering, with presses for extrusion, stamping and forming steel plates; presses for conveyor belts and V-belts (rubber production); plastic laminates; PVC plates; paperboard and regenerated leather.

Pino Pagnoni, also introduced a mobile pre-press for the production of chipboard panels, a radical idea at that time, which anticipated the modern use of continuous pre-presses. The patent on the mobile pre-press was one of the company's flagships for years and earned Pagnoni worldwide admiration from manufacturers of recycled wood-chip products (chipboard and fibreboard), a field that was continually growing in importance.

After the premature death of Pino Pagnoni, in 1965, Franco Pagnoni assumed control of the company maintaining the course of development throughout the 1970s. During this time, the company began producing complete turn-key plants, particularly for the field of chipboard production. However, the economic downtown and the galloping inflation triggered by the second oil crisis, brought about a drastic decline in reinvestment in capital goods such as plants manufactured by Pagnoni. This crisis hit the company hard, and culminated in its liquidation in 1983.

Notwithstanding the deep crisis in the market, Pagnoni's production activity was never forced to halt. Fratelli Pagnoni was taken over by Pagnoni Impianti S.P.A., and run by the brothers Aldo and Giorgio Pagnoni. Even though family resources were quite modest, this was more than compensated for by the widespread loyalty of Pagnoni's clients, who accepted to finance the large-scale plants commissioned to the new company.

By 1986, Pagnoni was able to set up the largest European production line for MDF (Medium Density Fibreboard), the wood fibre panelboard that was in great demand at that time. Since then, the business has rapidly expanded. Nowadays, as with other manufacturing industries, Pagnoni only manufactures the main parts of the plants internally, and outsources the production of less technological equipment. However, the design and engineering is provided exclusively by the Pagnoni technical department, which makes use of state-of-the-art computer aided design systems.

Today, Pagnoni is rated as one of the world's leading suppliers of machinery for the production of plants for the melamine lamination of wood-based panels, together with small and mid-size lines for the production of plastic laminates, chipboard, fibreboard and other products for the wood industry.

Over 150 years of Pagnoni history testify to the company's quest for innovation, technical expertise, and ingenuity to remain competitive. The continuous leadership by five generations of the Pagnoni family show great enterpreneurship, tenacity and commitment, even in the face of extreme hardship.

8.1.3 Pulp and Papermaking Machinery and Equipment

The pulp and paper industry is more capital intensive than other forest-based industries. The machinery utilised by the pulp and paper industry is very wide and diverse, with the majority of it specialised in nature. For example, at last year's pulp and paper exhibition - PULPAPER 1998 – for suppliers to the pulp and paper industry, there were over several hundred companies represented, the vast majority of which were from Europe. See table 8.3 below.

The machinery and equipment listed in the table generally pertains to the pulp and paper industry. However, sawmilling and planning of wood and the production of wood products, and wood furniture, also necessitates a considerable amount of specialised machinery and equipment.

Within the manufacturing of pulp and paper machinery there are many products which are produced to suit particular methods of pulping and grades of paper and board production. A selection of some of the main categories and the companies competing within them, are listed in table 8.4, along with several forestry machinery companies.

Table 8.3 Pulp and Paper Industry Suppliers exhibiting at the PULPAPER exhibition in 1998

Supplier	Number of companies	Supplier	Number of companies
Maintenance technology	167	Paper and board machines	76
Steam, heat and power technology	77	Paper and board machines – Auxiliary equipment	168
Fuel handling and supply	65	Calendering and finishing	70
Heating, ventilation and air conditioning	41	Converting	55
Water purification technology	116	Process & quality control and measurements	171
Wood handling and chipping	53	Machines drives	44
Mechanical pulp production	50	Electrical equipment	42
Chemical pulping	50	Pumps, valves and piping systems	217
Screening and cleaning	58	Environmental protection technology	77
Pulp drying and baling	30	Waste paper handling	44
Chemical recovery	40	Particle board and fibreboard production	19
Fibre supply	5	Materials and consumables	85
Stock preparation	74	Coating	116
Bleaching and bleaching chemicals	64	Chemicals and additives	67
Transport and material handling	80	Laboratory equipment	64

Although the table does not comprehensively list all competitors, it does list most of the main ones. In most areas it is clear that machine-building industries of the pulp and paper industry are dominated by the European companies. The main competitors are located in the USA.

One of the main competitors in the USA, Beloit, has recently been put up for sale by it owners. Beloit's parent company 'Harnischfeger Industries Inc, filed for Chapter 11 bankruptcy protection in June 1999. Beloit sales have fallen to $830 million last year from nearly $1.3 billion in 1997. Harnischfeger's losses reached $90.7 million in the first six months of 1999, just before the company filed for bankruptcy protection'.[6]

[6] Nashau Telegraph on the web: http://www.nashuatelegraph.com/Business/10x/1009x-beloit.html

Table 8.4 Selection of pulp and papermaking machinery manufacturers

Machinery	Company	Country
Fibre technology: - Chemical pulping systems - Mechanical pulping systems	Ahlström Beloit-Impco Kvaerner Pulping Metso Andritz Spraut-Bauer Metso	Finland USA Norway Finland Austria Finland
Fibreboard technology	Dieffenbachen Schenck Siempelkamp Washington Ironworks Metso	Germany Germany Germany USA Finland
Stock preparation and pulping with recycled fibre	Andritz Spraut-Bauer Beloit Black Clawson Voith-Sulzer Papertec Metso	Austria USA USA Germany Finland
Paper technology	Beloit Voith-Sulzer Metso	USA Germany Finland
Automation and Control Technology	ABB Fisher-Rosemount Honeywell Invensys Keystone Siemens Automation Metso	Switzerland USA USA UK UK Germany Finland
Forest machines	Blount Caterpillar John Deere Partek/Sisu Logging Metso	USA USA USA Finland Finland

Source: Metso.

8.1.4 Pulp, Paper and Board Machinery Manufacturers

Andritz AG is an Austrian-based company with worldwide activities producing technically sophisticated and custom-tailored machinery and plants. It has over 3,000 employees and in 1998 had annual sales of about $725 million US. – About 51% of which were made in Europe. North America accounted for a further 24%

and Asia another 19%. The company is a leading supplier of woodyards, refiner systems, of pulp bleaching, dewatering, and drying plants and of tissue machines.

Andritz produces a wide range of machinery, plants and services for woodyards for the pulp, paper and fiberboard industries, such as wood processing equipment; chip and bark processing plants and equipment; groundwood processing plants and equipment, automation systems for woodyards, refiner Systems for mechanical pulp plants and systems for the pulp and fiberboard industries. Complete mechanical pulping systems from chip washer to final bleached pulp, including refining, screening, cleaning, dewatering and heat recovery systems.

In the area of pulp technology it manufactures: machines and systems for dewatering, washing and bleaching of pulp and fibrous sludges in the pulp and paper industry. Whilst in the paper technology area it produces: tissue machines, stock preparation equipment for paper and board mills, and air engineering equipment. Tissue machines and stock preparation equipment are of Voith-Sulzer design.

The company also produces a wide variety of refiners: refiners for high-consistency systems, complete panelboard (fiberboard, MDF) refining systems. In addition, Andritz also undertake studies and provide services such as: consultation on energy conservation, maintenance and repair work, process optimization for tissue machines, stock preparation and air engineering and rebuilds.

Andritz has operations in Austria, Finland, Sweden, USA, Canada and Brazil. In Austria it provides the full range of its products through its business units specialising in wood processing, pulp technology, paper technology, hydraulic machines, environment and process technologies. In Finland, its business units cover wood processing, and pulp technology, in Sweden wood processing, pulp technology, environment and process technologies, whilst in the USA, Canada and Brazil, business units mainly concentrate on wood processing.

Andritz and Voith Sulzer co-operate in various joint ventures to develop new products and technology. For example, Voith Sulzer and Andritz have developed a design that gives quality features similar to through-air drying - but with a more simple system and lower investment and operating costs. This new concept is the TissueFlex - a shoe press used in mechanical dewatering, ahead of drying. Though successfully used a hundred times over for other paper grades, its application in tissue production is a real novelty.

Andritz AG and Hadwaco Ltd. Oy have signed a co-operation agreement to jointly market and further develop new, highly efficient systems for water loop closure and internal process water purification in the pulp, paper, and fibreboard industry. The Finnish evaporator manufacturer, Hadwaco, is part of the Hackman Group.

In September 1999, AGIV signed a agreement on the sale of its shares in Andritz AG to a group of investors, comprising: The Carlyle Group from the USA, represented by its European affiliate in Munich (at 47.5%), UIAG Unternehmens Invest AG, Austria, (25%), and Andritz AG CEO Dr. Wolfgang

Leitner, the Custos private foundation, and members of Andritz AG Executive Board, jointly at 27.5%.

Metso was formed in 1999 after a merger between the two Finnish companies **Valmet** (a paper machinery manufacturing company) and **Rauma** (a metal and engineering subsidiary of UPM-Kymmene). In 1998, Metso had net sales of EUR 3,695 million and employed some 23,000 persons. Metso is a global market leader in all areas of wood fiber processing, from forest machinery to paper converting machinery. The Corporation also holds strong positions in process automation, flow control and crushing systems. According to Metso, its future focus will be expert services and solutions in the maintenance and development of equipment and processes.

Metso has its own production in 12 countries and offices in approximately 40 countries. In 1998, about half of the Corporation's net sales originated from Europe (mostly in Finland and Scandinavia) with just under one-quarter each from North America, Asia-Pacific.

Metso's operations are divided into three business areas:

1) *Fiber and Paper Technology (Valmet)*
2) *Automation and Control Technology*
3) *Machinery*

In 1998, the *Fiber and Paper Technology* business area accounted for over half of the Corporation's net sales, *Automation and Control Technology* accounted for 16% and *Machinery* for 32%. Metso's largest customer group is the pulp and paper industry.

Metso's fibre and paper technology business area, i.e. Valmet, designs and manufactures pulp and paper industry processes, machinery and equipment. It also provides expert services for developing customers' production processes. It is strongly focused on research and development, which is carried out in ten research centres around the world. In 1998, 31 percent of the business area's net sales were from new machines, 41 percent from rebuilds, and 28 percent from service and maintenance.

Metso's *automation and control technology* business area, i.e. Neles Automation, develops and supplies automation and field equipment solutions for the process industry. The most significant customers of automation and control technology are the pulp and paper industry, other process industry and the energy industry.

According to Metso, its automation and control technology business is growing through its technological competence and development of new products and systems for the process industry. Automation and control technology co-operates with Metso's fiber and paper technology business area.

In 1998, sales within the automation and control technology area were predominantly generated in North America (over a third), however, Finland was also a key market accounting for a fifth with Europe also important at one-quarter. Asia was also a substantial market.

Metso's *Machinery* business area is divided into four business groups: forest machines (Timberjack), crushing systems (Nordberg), gears and components and car manufacturing (Valmet Automotive). As much as 52% of Timberjacks sales were made in North America. Europe is also a large market for Timberjack, at 43%.

The European and North American markets are already quite stable. Asia-Pacific and South America are potential growth areas for Metso's business. The main markets of both the fiber and paper technology business area and the automation and control technology business area are Europe, North America and Asia. In the machinery business area, the main markets of forest machines and crushing systems are North America and Europe.

Metso Corporation's production is focused on Europe and North America, where all business areas have production units of their own. China is also developing as a significant country of production for Metso Corporation. About three quarters of Metso's staff are employed in Europe. Finland employs almost half, with Scandinavia and other Europe around a tenth, each. North America is also home to about one-fifth of Metso's employees.

All of the products of Metso's business areas and business groups hold leading positions in the global markets:

- Valmet is the leading supplier of paper machines in the world and one of world's largest producers of equipment and processes for wood fiber processing.
- Neles Automation is one of the leading suppliers in its own speciality areas and a market leader in supplying systems and solutions for the pulp and paper industry.
- Timberjack is the world's leading manufacturer of forest machines.
- Nordberg is the world's leading supplier of crushing systems.

Metso has a long list of machinery projects to its name. However, one recent example of the latest state-of-the-art machinery to be supplied is the LWC line for Cartiere Burgo.

In August 1999, Valmet signed a letter of intent for the supply on a turnkey basis of an LWC production line at the Verzuolo mill, for the Italian paper company Cartiere Burgo. The new line will have an annual capacity of 400,000 tonnes, and will elevate the plant to world class status, in terms of size and the application of state-of-the-art technology. Total investment is estimated at around 500 million Euros and includes, a wood-pulp production plant; a paper machine with a wire width of 10.45m and a design speed of 2,000m/min, equiped with an on-machine film coater, stock preparation plant and ancillary equipment; and off-machine multinip calenders.[7]

---

7 Cartiere Burgo Interim Report, six months ended 30th June 1999. – September 1999.

Box 8.3 The History of Metso (Valmet-Rauma)

At least four of the companies forming part of the present Metso Corporation date back to the 19th century. The Karlstad foundry in Sweden was founded in 1865, while Sunds Bruk, the predecessor of Sunds Defibrator Industries Ab, was established in Sweden in 1868, and the Nordberg Manufacturing Company started in the United States in 1886. In addition, the French company Ateliers Bergeaud was established in1895, but it wasn't until 1987 that did it come into the ownership of Rauma-Repola, which is itself now part of Metso.

However, the history of Metso Corporation dates back to the 1750s, when a small shipyard was established on the island fortress of Viapori outside Helsinki. By the early 20th century the company was in the ownership of the Finnish state and became part of what later became known as Valmet.

In the 1940s: Rauma-Raahe Oy and the Valtion Metallitehtaat were founded, from the amalgamation of a number of sawmills and timber companies that had grown out of steam sawmills.

In 1946, several metal workshops owned by the Finnish state were merged to form the Valtion Metallitehtaat (the State Metal Works). At the beginning of 1951, the Valtion Metallitehtaat group was renamed Valmet Oy, and the product range expanded over the years to include ships, aircraft, weapons, locomotives, tractors, marine engines, elevators and, of course, paper machines.

Valmet began the manufacture of paper machines at the former Rautpohja artillery works in Jyväskylä in Finland in the early 1950s and delivered its first paper machine in 1953. Valmet became an internationally significant paper machine supplier in the mid-1960s, when it delivered several machines to the some of world's leading paper industry countries.

In 1951 two of the most important sawmilling and timber companies, Repola-Viipuri Oy and Lahti Oy were merged with Rauma-Raahe Oy. Initially the new company, Rauma-Repola, was officially a timber processing company, with a focus on the sawmill industry and pulp production. However, the management of Rauma-Repola made a determined effort to expand the basis of the company to include mechanical engineering. Already in the 1950s, the company's product range included pulp industry and metallurgical machinery, as well as shipbuilding. Indeed, shipbuilding remained central to Rauma-Repola's operations up to the end of the 1980s, but by the early 1990s this area was abandoned.

In 1968, Valmet and the Swedish company, Saab-Scania AB, established a car plant in Uusikaupunki, Finland, where production started in 1969. The first model made at the plant was the Saab 96. Later, other makes and models, including the Chrysler Talbot, Opel Calibra and Porsche Boxster were introduced. In 1992, the Uusikaupunki plant was transferred to Valmet's sole ownership, which became known as Valmet Automotive in 1995.

In 1970 Rauma-Repola took over Lokomo Oy, a company operating in Tampere, Finland which was established in 1915. The acquisition brought with it series-produced machinery, including crushers, excavators, road graders, cranes and forest machines.

During the 1980's, most of Finland's exports went to the Soviet Union and the CMEA countries. In fact, even at the end of the 80s a third of Rauma-Repola's exports went to this area. However, in the early 1990s, when the Soviet Union broke-up, Finnish exports lost a major market, whilst at the same time markets for the shipbuilding industry also dried up. This meant that Rauma-Repola's metal and engineering industry faced the need for radical change. The company responded by determinedly developing those businesses that had proven to be competitive.

Valmet had already streamlined and renewed its operations in the 1980s, beginning to focus more on paper machines and related technology. In 1996, Valmet sold its shipbuilding industry to Wärtsilä, buying in return Wärtsilä's paper finishing machinery unit with facilities in Järvenpää, just outside Helsinki. This was combined with Valmet's existing paper machine division to form Valmet Paper Machinery Inc.. For Valmet, the 1980s were characterised by rapid internationalisation.

For Rauma-Repola, the 1980s were a period of major corporate acquisitions. The company purchased Neles in Finland and Jamesbury in the USA, merging them in 1988 to form Neles-Jamesbury, which later became Neles Controls in 1997.

In 1987, Rauma-Repola bought the leading European crusher manufacturer, Bergaud and its subsidiaries, as well as Nordberg UK, followed in 1989 by two other large companies, Nordberg Inc and Timberjack Corporation, both in the USA. The Swedish company Sunds Defibrator Industries AB came under Rauma-Repola's ownership in stages during 1988-1991.

Valmet was still under state ownership until it became the first such company to be listed on the Helsinki Stock Exchange in 1988, when a share issue implemented by Valmet cut Finnish state ownership from 100% to 80%. Further issues were made during 1994 and 1996 reducing the state's shares to 58.6%, and 20% (the current level), respectively.

In 1991, Rauma-Repola and the major Finnish forest industry corporation, United Paper Mills Inc., merged. The new company, Repola Corporation, was a privately-owned company, with operations divided between the forest industry and the metal and engineering industry. The new company's metal and engineering side was concentrated in Repola's new subsidiary, called Rauma Corporation.

In 1995, Rauma was listed on the Helsinki and New York stock exchanges. However, after Kymmene Corporation and Repola merged in 1996 to form UPM-Kymmene Corporation, Rauma became a subsidiary of UPM-Kymmene. UPM-Kymmene gradually reduced its holding in Rauma to 34.5% by 1998.

Valmet was listed on the New York Stock Exchange in 1996. And in late 1998, Rauma and Valmet proposed a merger which was later approved at the beginning of 1999. The new company was renamed as Metso Corporation.

Agnati Group SpA[8] is a family run business headquartered in Vimercate, near Milan in Italy and employs some 350 people wordwide. The company designs and manufactures corrugating machinery (including automation controls) for corrugated board manufacturers. It operates via several subsidiary companies in France, Germany, the UK, the US and also Singapore. The company was established in 1932 to supply equipment and services to the corrugating industry, but has since become one of the largest manufacturers of corrugated machinery and a world leader in the supply of advanced technology corrugators.

Since the 1960s the company's strategy has been to concentrate all its resources on a single product, the corrugator. Indeed, this approach has led to more and more specialised knowledge of technology, product, and market needs. Non-stop product research and product innovation have placed Agnati at the forefront of the industry leading to pioneering inventions from the 1980s to the present day, which have contributed to the technological evolution of the industry.

Success in technology development have also spawned Agnati's worldwide expansion on the international markets. From the 1980s Agnati's market share has increased continually. Since 1992, total sales have increased by more than 50%, but the company has continued to invest in operational and human resources. During the past ten years the company has maintained a level of in-

8 Based on Interview with Agnati, in August 1999 and on company reports.

vestment of over 4 to 5% of turnover per annum, in leading edge production equipment.

Agnati maintains close co-operation with its customers to study every problem or requirement, which it believes has provided strong incentives to invent new solutions and to create successful products. In fact, the company invented the positive pressure single facer in 1982, (known as ACS – air cushion system), which was developed to overcome limitations of other systems and to provide, in advance, other capabilities for the future. Today, this is still recognised as the industry standard (over 430 are in use today).

The company was also one of the first to introduce a helical blade direct drive knife and an automatic electronic slitter scorer. More recently, in 1989, it also introduced an exclusive automatic system for paper roll change (super 90 multipleflute), an innovative new multi-module slitter scorer, and a new corrugator control and automation system with exclusive features. Today, there are only three main producers of corrugating machinery in Europe, BHS and Peters, from Germany and Agnati. Mitsubishi, from Japan are also a key producer, whilst there are three others in the US.

Client requirements are constantly changing. Paper is the largest cost factor and an expensive input for corrugated board producers. As such clients desire stronger boards utilising less paper. Hence, machines must be developed to produce stronger boards but with lighter material. The situation is also complicated by the fact that cardboard manufacturers are differentiated, with some producing on fast running/high capacity machines whilst others manufacture smaller quantities for niche markets.

Another factor in machine building is the trends towards recycling. Nowadays, about 85% of cardboard raw material is recycled paper (which is inferior to virgin fibre). Traditionally, European manufacturers have been able to obtain the most from their machines, because of the raw material supply situation. In the US, machine energy usage is much higher than the European producers, whilst they also use much more virgin fibre. Nonetheless, machines notoriously waste more material. Because of the cheap energy, and high quality paper, Agnati suggest that US machine producers have little pressure to innovate. In the future, Agnati also believe that there will be much fewer board producers worldwide, hence machinery will need to be of best quality, and able to utilise poor quality materials. Agnati is typical of European machine manufacturing. Showing how environmental trends in the EU have led to innovative developments in machine building and contributed to the industry's competitiveness.

The ABB Group[9], with revenues of some US $33 Billion and more than 200,000 employees worldwide, is one of the largest companies in the world. With operating locations in more than 100 countries, ABB is well positioned to serve both local and global customers. Within ABB, the Automation segment is heavily connected to several areas of the forest-based and related industries of the EU. This segment of ABB, generates about US $8.5 Billion in revenues, employs some 55,000, and operates in 44 countries (1500 operating units).

---

9 Source: http://www.abb.com/automation.

Pulp and Paper

ABB has a history of partnership with the Pulp & Paper industry, dating back to the early 1900's when it introduced the world's first paper machine drives. Since then it has become a global automation leader providing state-of-the-art technology and solutions for the forest products industry.

ABB's global pulp and paper team includes more than 5000 professionals worldwide, experienced in every facet of pulp and paper processing operating in more than 40 countries. More than one-third of these people work directly with customers on maintenance and predictive diagnostic services to run their plants at highest efficiency, with others providing high-level application and consulting services to improve product quality and profitability.

ABB has produced countless "first in the industry" developments. In the power and recovery areas, ABB software, sensors, and computers control nearly 50 distinct processes, including energy production, calcinization, causticizing, chemical recovery, evaporation, water treatment, effluent handling, and more. For pulp producers, ABB controls and optimizes the full range of processes, including wood yard, chip digestion, pulp refining, washing, bleaching and drying, chemical preparation, and recycling.

With more than 500 installations worldwide, ABB has acquired the know-how to provide the best control and optimization for pulp mills. ABB's products and services for pulp making range from stand-alone sensors to complete integrated solutions, including special sensors, process control optimization and process simulation.

In the paper mill, ABB offers the industry's broadest range of technologies for measuring quality, controlling production and managing business decisions. These include sensors to measure a wide range of on-line variables; specialized software and industrial computers to automate manufacturing; high-tech hardware to improve quality and increase production; computerized camera systems to identify paper defects; Smart Advisor systems to help predict when equipment will require service; computerized drive systems to synchronize paper machine motors; and drying hoods for faster sheet drying.

For over 25 years, ABB has been a pioneer in the pulp & paper industry with innovative solutions for web inspection on the paper machine. ABB's, ULMA NTi is the market leader in web inspection. With over 800 installations world wide, ULMA has the largest installed base of web inspection systems.

In the finishing area, ABB robots handle paper rolls and other packaging functions, while ABB's manufacturing execution systems share factory floor information with the people who make shipping, production scheduling, purchasing, complaint resolution and other business decisions.

According to ABB, it is the industry's largest automation supplier, providing the broadest products and services for all stages of pulp and paper making: power and recovery, pulp mill, finishing, shipping, order entry and customer service. Its products have either No. 1 or 2 in market share worldwide. These include systems for distributed control, quality control, drives, web inspection, drying hoods, printing, robotics and manufacturing execution.

ABB's global pulp and paper team are experienced in all facets of pulp and paper making. Many come from the pulp and paper industry, while others hold degrees in Paper Science. More than one-third of these persons work directly with customers to run their mills efficiently, while others provide high-level application and consulting services.

ABB is also the recognized leader in drive systems for the pulp & paper industry. ABB was a pioneer in digital sectional control solutions for the forest industry and the first to introduce fully digital AC drive systems more than ten years ago. The latest generation of ABB drive control systems for pulp and paper machinery, is a drive system designed to be used with both AC and DC motors and thus suitable for new installations as well as rebuilds.

The company is also the leading supplier of manufacturing execution systems for the pulp & paper industry, with over 120 customer sites worldwide and centers of excellence in 7 countries. ABB applies information technology to streamline order fulfilment and boost operational efficiency. ABBs customers include forest products companies, such as Consolidated Papers, Stora Enso, UPM-Kymmene, Visy Paper, and Willamette Industries.

The pulp and paper industry is undergoing major changes. It is beginning to focus on service instead of hardware to get more from what they have already invested. Moreover, according to ABB, "what a papermaker needs is someone who can identify and assist with system, system control, and process related issues, leaning more heavily towards process consulting and process control." Since ABB equips or services more than 75% of the world's pulp and paper mills, the pulp and paper industry is somewhat reliant on ABB for solutions.

ABB Fläkt Industri AB has a staff of 450 well-educated specialists. Combined expertise in industrial air process technology for the entire chain of supply from basic research and the development of processes and products, to marketing, design, production, installation and start-up is provided. The company has more than 70 years of experience and is a world leader in pulp, paper and gypsum board drying and advanced fans.

The company also maintains a close partnership with other major suppliers to the forest industry. Large composite plant projects require supply coordination and total integration of ABB and non-ABB products and services. Various automation products are seamlessly integrated with sectional drives and other electrical systems. The company gets involved in the early stages of any project from design to commissioning and support.

The company also supplies energy management systems to enable enterprises as well as single mill sites to optimize produced and purchased energy. Energy is a key element of production in pulp and paper. Mill and corporate wide energy demand is changing all the time due to varying production rates, grade changes, process disturbances, outdoor temperature variations, daily work patterns, and maintenance works.

As the possibilities of energy storage are limited, the total energy procurement is always balanced to match the consumption. The available procurement resources may be numerous, and the liberalisation of electricity markets is further increasing the choices. Consequently, following the opening of electricity trade for competition in Finland, all major Finnish forest industry corporations have purchased energy management systems from ABB, including: UPM Kymmene; Stora Enso; Metsä-Serla; and Metsä-Botnia.

Printing and Publishing

ABB is also active in the area of printing and publishing, and has even helped to shape modern day technology within the industry. In 1973, ABB installed the first programmable controllers on printing presses. In 1977, ABB installed the first computer-assisted production planning and press pre-setting in the world. In 1985, the first screen-based control consoles were introduced, and in 1994, the first shaftless printing press with individual drives, was introduced.

Within the area of newspaper printing ABB has supplied electrical equipment for printing presses for more than 60 years. In fact, since 1973, the year in which the era of programmable control systems started, ABB have equipped most of the main printing houses in Germany and France, and also one or two in the UK. ABB's wide experience in shaftless newspaper printing machines can also be applied to any commercial press, such as, corrugated, flexo, gravure printing machines etc. ABB is also well equipped to supply customized drive and automation solutions for the whole press, including consultancy at the design stage up to engineering, installation, commissioning and after sales service for the equipment being supplied.

One example of supplier co-operation is demonstrated via the recent announcement by ABB to integrate the prepress and printing press systems at Presse Druck und Verlags GmbH, Augsburg. Indeed, both alfa Media Partner, in Rodgau, and ABB have agreed to coordinate their respective prepress and printing press systems to pave the way for a close integration of the two. The aim of the integration is to support the requirements of the prepress through to page layout while taking account of the most economic production alternatives on the printing press and the production sequence.

The coordination of the systems from the two suppliers ensures continuous synchronization between the page layout functions of the prepress, whilst the planning of editions by ABB's "MPS Edition", makes best use of the possibilities of the printing presses and minimizes the make-ready times for production sequences. Production was scheduled to start in mid-1999. The co-ordination of the systems solves many issues and demonstrates the extent of knowledge and experience ABB has accumulated from pulp and paper to printing and publishing.

8.2 Speciality Inputs

As mentioned previously, speciality inputs are numerous and are supplied by many different industries. However, a large proportion of speciality inputs are chemically derived products which are especially designed and manufactured purely for product segments within the forest-based and related industries. As with the machine building industries, speciality inputs are an important source of innovation, often providing a competitive advantage for its customer. In most cases, speciality inputs are designed and developed following close co-operation between customers and suppliers.

In many instances the chemical companies supply speciality inputs to several branches of industry within the forest-based and related industries. For example, Akzo Nobel supplies bleaching chemicals to the pulp industry, adhesive and sizing agent chemicals to the paper industry (through its subsidiary Eka Chemicals), glue adhesives to the wood panel industry (through its subsidiary Casco), and printing inks to the printing industry. Although, the company is headquartered in the Netherlands, it has made numerous strategic acquisitions which have provided access to leading edge technologies via key companies which are located in, or near, important centres of manufacturing within Europe.

Moreover, in utilising a typical multinational strategy to tap into various clusters of industry, not only does Akzo Nobel maintain its competitive edge, but it also means that speciality products are marketed to other customers across Europe. In effect, technologies developed in close co-operation between client and supplier in one cluster are therefore transmitted to another. Whilst this suggests that new technologies are potentially made available to most companies within an industry it also means that chemical companies have a central role in the process of innovation and development within the forest-based and related industries of the EU. This demonstrates why these industries should be considered part of the forest-based and related industries.

To give some idea of these speciality inputs provided we have selected several types of products and have attempted to explain what they are and how they are used. Speciality inputs described in the following sections include, bleaching chemicals, surfactants, starches, pigments and fillers, adhesives, and printing inks. To help understand relationships and linkages between the speciality input providers and their customers details are given about the suppliers themselves. To this end, historical developments of companies are also included since this also demonstrates sources of expertise which have usually developed over a long periods of time.

8.2.1 The European Chemical Industry[10]

The chemical industry supplies virtually all sectors of the economy. Initially however, about one-third of chemical products are further processed within the chemical industry, itself, meaning that it is its own largest customer. In many instances, it is only after several processing stages that the products go to outside customers. After self-consumption by the chemical industry, chemicals are re-allocated to downstream customers. In the EU, the structure of chemical consumption is as follows: 28% of chemicals are absorbed by final consumption, 18% go to services, 9% to agriculture, 5% to construction, and the remaining 40% to the manufacturing industry. The biggest industrial customers of chemicals are the metals, mechanical & electrical industries, textiles & clothing, wood & paper and the automotive industry.

Table 8.6 Leading European Chemical Groups - 1997

Company	Country	Turnover (billions of Euro)
Hoechst	Germany	25.7
BASF	Germany	24.7
Bayer	Germany	24.6
ICI	UK	15.6
Compart	Italy	13.3
Rhône-Poulenc	France	12.9
Montedison	Italy	12.4
Norsk Hydro	Norway	10.5
Akzo Nobel	Netherlands	10.1
Degussa	Germany	7.0
Solvay	Belgium	6.9
BOC Group	UK	5.5
DSM	Netherlands	4.6
Courtaulds	UK	3.1
Rütgers Werke	Germany	2.5
Kemira	Finland	2.3
SKW Trostberg	Germany	2.0

Source: EUROPAGES – The European Business Directory.

---

10 Source: The European chemical industry in a worldwide perspective – facts and figures, European Chemical Industry Council - CEFIC, 1998.

At first glance many people would not associate the above companies with the forest-based and related industries. However, most of the above companies are, in fact, key innovators and very important suppliers to many areas of forest-based and related industries. This is particularly the case in the area of chemicals for the pulp and paper industry, and adhesives for the wood-based panel and wooden furniture industries. In the following sections, this will be demonstrated, by describing several companies who supply to various areas of the forest cluster.

8.2.2 Bleaching Chemicals in Western Europe[11]

Western European pulp and paper industry's bleaching facilities are almost 100% committed to sodium chlorate and hydrogen peroxide, with only a few mills in Portugal and Spain still utilising chlorine gas bleaching. In general, the region's bleached pulp is predominantly Elemental Chlorine-Free or Total Chlorine-Free.

During the first half of the 1990s sodium chlorate demand at pulp mills increased strongly, although demand has since stabilised. Europe's chlorate has met greater competition from producers in North America on exports outside Europe and in South America and, because of the economic situation volumes have fallen.

Sodium chlorate demand in Western European chemical pulp bleaching sector is forecast at about 605,000 tonnes per year in 2000 and is forecast to fall slightly to about 590,000 tonnes per annum by 2010. The hydrogen peroxide market, however, improved during 1998 and prices increased substantially on the European continent from the above level. Western European demand for hydrogen peroxide as a bleaching agent and deinking agent is forecast at 455,000 tonnes in 2000, up from 235,000 tonnes in 1995.

Eka Chemicals, Akzo Nobel's paper chemicals business, was due to start up a chlorate expansion at its Rana facility, in Norway by spring 1999. This follows the start up of an expansion in Chile at the beginning of 1998, a new crystalliser at its Alby facility, in Sweden, and the transformation of its Oulu plant in Finland.

[11] Source: Chemical Market Reporter – CBNB, USA, 8/3/1999.

As well as Eka, the leading producers of hydrogen peroxide in Western Europe include Interox, Solvay, Kemira, Degussa, Elf Atochem and FMC. Combined these companies account for a total annual capacity of over one billion tonnes (1998 estimate). In 1998, Elf acquired 100% ownership of Oxysynthese, its 50/50 joint venture in hydrogen peroxide with Air Liquid.

Through this transaction Elf assumed total control of 105,000 tonnes per year plant at Jarre, Southern France, a 35,000 tonne/year plant at Leuna, Germany, a 73,000 tonnes/year plant at Becancour, Canada, a 25,000 tonne/year plant in Japan and a 35,000 tonne/year plant being built at Shanghai, China, with a local company.

In order to give a general idea of some of the chemicals used within the forest-based and related industries, a selection of chemicals and the companies producing them are listed in the following table. Several companies appear as suppliers to many areas of the forest-based industries. Therefore, we have tried to describe some of these companies as well as other specialist suppliers in the subsequent sections.

Table 8.7 Selection of Chemical Inputs used in Forest-based and related industries

Chemical	Application	Main Producers in Europe (country)
Sodium Chlorate (used to generate chlorine dioxide)	The main application of chlorine dioxide, the active compound derived from sodium chlorate is pulp bleaching. Up to 95 % of all sodium chlorate produced world-wide goes to the pulp industry.	Aragonesas Industrias y Energía (ES) Eka Chemicals (SE) Electroquímica De Hernani (ES) Elf Atochem (FR) Finnish Chemicals (FI)
Aluminium sulphate	Aluminium sulphate is used in the treatment of process water in the paper industry as well as in the treatment of urban waste-water	Akzo Nobel – Eka Chemicals (SE) Alcan Chemicals Europe (GB) Auxiliar Papelera (ES) BK Giulini Chemie (DE) Chemifloc (IE) GFE Umwelttechnik (DE) Kemira Chemicals (FI) Krems-Chemie (AT) Laporte (GB) Quimitecnica (PT) Rhodia Eco Services (FR) Rhône-Poulenc Chemicals (GB) Samar (IT) Solvay Barium Strontium (DE) Union Minière (BE)

Peroxygens	Hydrogen peroxide is mainly used in pulp and paper bleaching, the manufacture of chemicals and textile bleaching. Peroxygens are a family of products comprising hydrogen peroxide (HP), sodium perborate (SPB) and peracetics. Peracetic acid, (PAA) is primarily used for bleaching of TCF (Totally Chlorine Free) kraft pulp.	Aktivsauerstoff (AT) Akzo Nobel – Eka Chemicals (SE) Ausimont (IT) Caffaro (IT) Degussa (DE) Elf Atochem (FR) FMC-Foret (ES) Kemira (NL) Solvay-Interox (BE)
Quaternisation of Starch	The quaternisation of starch, is a process used in the paper industry Two products: 2,3 Epoxypropyl trimethylammonium chloride and 3 Chloro 2 hydroxypropyl trimethylammonium chloride.	Degussa (DE) Dow Deutschland (DE) Inspec Fine Chemicals (NL) Raisio Chemicals (FI) Roquette Frères (FR) Servo Delden (NL)
Hydrocarbon and rosin resins	These have a wide range of applications, from printing inks, adhesives and paper size to chewing gum.	Abieta Chemie (DE) Akzo Nobel (NL) Arizona Chemical (SE) DRT (FR) Eka Chemicals (NL) Hercules (BE) Krems Chemie (AT) Lawter International (BE) Raisio Chemicals (FI) Union Camp (GB) Vianova Resins (DE)
Aminoplast	Aminoplast glues are mainly used in wood-based panels, such as particleboard, MDF (Medium Density Fibreboard) and plywood.	BASF (DE) Borden Chemical Europe (GB) Casco Products (SE) Derivados Forestales (ES) Dyno Industrier (NO) Elf Atochem (FR) Krems-Chemie (AT) Neste Chemicals Belgium (BE) Pfleiderer (DE) Sadepan Chimica (IT)
Melamine	Mainly used in melamine formaldehyde resins: for decorative laminates (worktop surface), high temperature/electrical insulation laminates, hot-setting adhesives (plywood), moulding powders (electrical fitting) and wet-strength additive (paper).	Agrolinz Melamin (AT) BASF (DE) DSM Melamine (NL) Elf Atochem (FR)

Source: data extracted from CEFIC webpages: http://www.cefic.org/product_families/.

8.2.3 Pulp Bleaching and Chlorine[12]

'Virtually no elemental chlorine is used in pulp bleaching in Western Europe. However, chlorine derivatives are natural components of wood, and of other natural materials. All pulp therefore contains organic chlorine derivatives and it is technically impossible to produce chlorine-free paper'.

'Most paper is made by pulping wood (which contains around one-half cellulose fibre), by chemical or mechanical methods. The most popular chemical process involves "cooking" wood with sulphate to form a pulp. This accounts for 90% of total chemical pulping, and produces the strongest papers, most suitable for recycling. An alternative method of producing paper is mechanical pulping, where wood is ground down to fibre. The quality of this pulp is lower.'

'Bleaching is a critical step in transforming dark brown wood pulp into high-quality paper. For many grades of paper, it is needed to meet the standards of brightness, strength, quality and cleanliness demanded by the consumer.'

'Bleaching lightens the pulp by removing lignin, a complex organic polymer, which accounts for the rigidity of wood, and yet weakens paper by preventing fibres from sticking to one another. Strong, white, durable paper cannot be produced unless all traces of lignin are removed from the pulp.'

'Although elemental chlorine was used as an effective bleaching agent in Europe for many years, the need to reduce pulp mill emissions led to the development of alternatives. Chlorine use in pulp bleaching has virtually stopped in Europe. Of the 9.1 million tonnes of chlorine produced in Western Europe in 1994, only 0.4% (30,000-40,000 tonnes) was used as elemental chlorine in pulp bleaching.'

'Apart from chlorine, there are other bleaching methods, including ozone, hydrogen peroxide and the chlorinated oxidising agent, chlorine dioxide. Chlorine dioxide removes lignin efficiently and cost-effectively, whilst producing no persistent, toxic and bioaccumulative compounds as by-products. Chlorine dioxide has vir-

---

12 This section draws heavily from the Euro Chlor web site: http://www.cefic.org/product_families/.

tually replaced elemental chlorine in pulp bleaching in Europe. As a result, the quantity of chlorine-related compounds generated during bleaching has been reduced, and those which are produced, contain only low levels of chlorine.'

'Bleaching with chlorine dioxide, the so-called Elemental Chlorine-Free (ECF) method, is currently used in 40% of chemical pulp bleaching worldwide. Chlorine dioxide has different chemical properties from elemental chlorine, acting as an oxidising agent.'

'As a result, all chlorine-related compounds produced during chlorine dioxide bleaching are biodegradable and do not persist in the environment. In modern mills using ECF bleaching, there is therefore no correlation between discharges of 'organohalogens' (below 1.5 kg/ton of pulp) and toxicity. ECF bleaching is one way to achieve the reductions in organohalogen emissions (AOX) proposed by the Oslo and Paris Marine Commissions (OSPARCOM).'

'Bleaching using only non-chlorine-based agents - such as oxygen, hydrogen peroxide and/or ozone - produces so-called Totally Chlorine Free (TCF) pulp. This term is misleading, since all wood contains organic chlorine derivatives and it is technically impossible to produce chlorine-free paper from wood pulp. From an environmental viewpoint, TCF pulp has no advantage over ECF pulp. Regardless of the bleaching method used, there is a small impact on the environment. The low residual toxicity of both ECF and TCF effluents, are caused by compounds such as fatty and resin acids originating from wood; most of the toxic effects can be removed by activated sludge treatment.'

'All human activities, including pulp and paper manufacture, have an impact on the environment. The two bleaching methods, ECF and TCF, are equally environmentally compatible and comply with European quality standards. However, there may be a small impact on the aquatic environment close to paper mill discharges. The pulp and paper industry recognises the need for continuous improvement in its emission to air and water. It is committed to advancing scientific knowledge and takes its responsibility to the environment very seriously. In fact, investment in improved environmental control represents 20% of the cost of a new mill.'

'The issue in pulp bleaching is no longer the relative merits of ECF and TCF, but how to limit impact on the environment. Closed cycle versions of pulp bleaching processes are in development for ECF and TCF bleaching processes, completely avoiding discharges to the environment. Closing the bleaching plant cycle in this way creates an effluent-free mill. Both ECF and TCF effluents can be recycled, but in both cases, many problems have to be solved before industrial usage is possible. Nonetheless, tests carried out in 1995 indicate that total or partial recycling could be a realistic option, but would be more expensive than current methods.'

'Almost 2 million jobs in Europe are related to chlorine. The 78 chlorine plants in 14 Western European countries employ 42,000 people. The value of the chlorine industry to the European economy is more than ECU 230,000 million per year. More than 9 million tonnes of virgin chlorine are produced in Europe each year.'

'Bleach is produced by reacting chlorine into a dilute sodium hydroxide solution. This solution is also known as "Eau de Labarraque", and "Eau de Javel". Bleach is used for whitening paper, soap, straw and cotton, and for disinfection, water purification and in sanitary cleaners.'

'Sodium Hydroxide (Caustic soda) also has very varied applications. From paper pulp to textile fibres, caustic soda, like chlorine, offers valuable benefits. It is used in the manufacture of soap, for neutralising acidic water in water treatment plants, for cleaning drinking bottles, for removing dyestuffs during paper recycling, for flue-gas scrubbing in thermal power plants, for aluminium production, etc.'

'Hydrogen will doubtless be a source of energy in the future, probably 'the fuel for tomorrow's clean engines'. Currently, hydrogen is used in the food industry (manufacture of margarine), in electronics ('chip' production) and in chemical synthesis (e.g., in the hydrogen peroxide manufacturing process).'

'Usage of caustic soda, the essential co-product of chlorine manufacture, totalled 9.3 million tonnes in Western Europe in 1998. The aluminium sector's use of caustic soda has grown significantly in the past two years from 250,000 to 350,000 tonnes/year, a 40% increase. However, the paper industry is still the main user after chemicals itself. In 1998, the paper industry absorbed 11% of the total 9.3 million tonnes of Caustic soda produced in Western Europe. Chemicals utilised over half of the total production, whilst consumer products used 7%, aluminium 4%, with the remainder being used by others.'

'All industrial processes generate some waste. Research into the reduction of waste has led to the development of new technologies and the introduction of new waste reduction schemes; this ensures that the rate of recovery and recycling of chlorine compounds and co-products is maximised.'

'For many years, pulp and paper producers have used chlorine and chlorinated oxidising agents to bleach pulp. Questions have been raised about the effluent created by this process and, more specifically, the presence of chlorinated organic compounds including dioxins. Thanks to modifications in process technology, the pulp industry is now able to meet the official standards for effluent.'

Akzo Nobel is a leading producer of paints, finishes, stains, and synthetic resins for industrial applications, professional painters, and the do-it-yourself sector. Key product areas are decorative/architectural paint, liquid and powder coatings for industrial use (on wood, plastics and metal), coil, marine & yacht coatings, protective coatings, aerospace coatings and sealants, car refinishes, printing inks, industrial and consumer adhesives, impregnated paper, and speciality resins.

Akzo Nobel, based in the Netherlands, currently employs approximately 85,000 people in almost 70 countries. Consolidated sales for 1998 totalled 12.5 billion Euros. Geographical growth currently focuses on Central and Eastern Europe, Asia-Pacific, and South America, but Akzo is also developing strong market positions in Western Europe and the USA.

Akzo Nobel is a significant global player in speciality, functional, and commodity chemicals, based upon leading positions in selected segments of the chemical industry. Key products are catalysts, and additives for the manufacture and processing of polymers, as well as for the oil refining and petrochemical industries. The company also produces bleaching and paper chemicals, and flame-retardants, as well as Ethylene amines and methyl amines.

According to Akzo Nobel it is a leader in environmentally compatible pulp bleaching chemicals, with sodium chlorate worldwide, and with hydrogen peroxide. It is also prominent in the production of chemicals for the wet-end manufacture of paper and board, notably retention and drainage agents, wet-strength resins, and sizing agents.

Eka Chemicals is the pulp & paper chemicals business unit of Akzo Nobel. It is headquartered, along with its main process plant in Bohus, (near Göteborg) Sweden. In 1999, MPP Systems was incorporated into BU Eka Chemicals. MPP Systems is a project-based business engaged in the development, manufacture and marketing of highly effective purification systems based on the use of Macro Porous Polymers. In addition to pulp bleaching processes and chemicals systems for the wet section of paper making, Eka also markets chemicals for certain industrial and speciality applications as well as engineering, process plants and equipment.

Eka Chemicals is a leading supplier of paper chemicals used mainly in the wet end section of paper manufacturing. In 1997, Eka Chemicals had a turnover of 6.6 million Euros, and employed some 2,800 employees in 20 countries, with about 1,300 people being employed in Sweden.

Paper chemicals, a division within Eka Chemicals, is responsible for the production and marketing of paper chemicals for the world market. The division has production plants and sales offices in 26 countries all over the world. The head office is located in Rollsbo, Sweden. The company maintains tight co-operation with the paper industry enabling it to develop and apply new products such as: retention and drainage systems; sizing agents; wet strength agents; coating additives; surfactants and on-line measurement (Chemtronics).

Research & development in paper chemicals is organised into technical centres. The R&D head office is located in Rollsbo, Sweden, with additional technical centres also being located in Rollsbo, Düren (Germany), Worle (UK) and Atlanta (USA). In total, there are about 100 persons employed in R&D. Research and development forms a very important part of Eka Chemicals' activities. Within the bleaching chemicals division more than 80 persons are assigned to R&D work. Of this staff more than 30 persons are working with pulp technology R&D. Some 40 persons work with R&D related to sodium chlorate, chlorine dioxide and hydrogen peroxide process technology development. In addition, 15 persons work with R&D within the field of hydrogen peroxide special applications, sodium percarbonate and recycled fibre chemicals. Moreover, some 20 persons are working as technical experts and advisors directly with customers, at plants.

Ever since the end of the 60´s Eka has contributed to the development and introduction of technologies which help to produce optimum quality pulp with minimal impact on the environment. Environmentally compatible bleaching technologies are developed and patented by Eka Chemicals. Pulp bleaching R&D is currently focusing on achieving a higher degree of effluent re-circulation in combination with cost reduction and pulp quality improvement.

Eka Chemicals is the world´s largest producer of sodium chlorate and potassium chlorate and is one of the 5 largest producers of hydrogen peroxide. The bleaching chemicals division operates production plants in Sweden, Norway, Finland, France, Brazil, Chile and Venezuela. In addition, Eka has a very strong position as a producer of bleaching chemicals in North America with a total of five production plants.

In the paper chemicals division, resin-based products such as tackifiers for adhesives are produced by Resins International. Several speciality products for adhesives, coatings and the rubber industry are produced. Market shares are high with a focus on Europe and Asia/Pacific.

Box 8.4 Potted History of Eka Chemicals

1895	Elektrokemiska Aktiebolaget (EKA) was founded in Sweden by Alfred Nobel (founder of the Nobel Prize), C W Collander and R Liljeqvist. Chlorine and alkali were the first products.
1924	EKA moves to Bohus, north of Göteborg.
1927	EKA manufactures 3,000 tonnes of chemicals in Bohus. Production of waterglass starts.
1930	Many new chemicals added to the product range i.e. ferric chloride, hydrochloric acid and hydrogen peroxide.
1940	Wartime production with many speciality chemicals. Among others metasilicate directly for consumers use.
1951	EKA is acquired by the forest company Iggesunds Bruk AB.
1956	Start of ammonia production.
1968	New hydrogen peroxide production based on Russian license.
1970	Environment becomes an issue. Restrictions on mercury emissions emerge.
1972	New chlorine-alkali plant in Bohus. 460 employees in all. Large investments in environmental protection
1980	Sodium metasilicate production in Maastricht, the Netherlands begins (Eka´s first plant outside Bohus).
1983	Paper chemicals based on Compozil grows. Subsidiary established in Finland.
1986	The company is acquired by Nobel Industries and becomes Eka Nobel AB. After the merger, sodium chlorate becomes a major Eka product with operations added in North America.
1990	Merger with Stora Kemi and Alby Klorat, as well as, Albright & Wilson paper chemicals division. Heavy investments are also made in new plants. Eka runs production in 14 countries around the world. Lignox, a patented hydrogen peroxide bleaching process, is introduced.
1991	Hydrogen peroxide production starts in Venezuela.
1994	Merger between Nobel Industries and Akzo. Akzo Nobel is the new company where Eka Chemicals forms one of thirty Business Units.
1995	Eka celebrates its 100 years anniversary. New paper chemical plants in Brazil and Finland are added. Paracetic acid introduced as bleaching agent.
1996	Chlorine-alkali production is transferred to Akzo Nobel Base Chemicals and the silicates business is transferred to the joint venture Akzo PQ-silica (APS). New paper chemicals plants in Thailand and Indonesia are added.
1997	Colloidal silica production unit acquired in Taiwan. Eka Chemicals acquires Enso Paperikemia with plants in Oulu, Finland, extending Eka operations to paper coating.

Cellchem AB, Stockholm and technology licensing within the North American division are engineering companies which construct and deliver everything from process equipment to turnkey plants for manufacturing and handling chemicals, primarily for the pulp and chemicals industries. Combined, they form a leading supplier in the world of chlorine dioxide plants.

The bleaching chemicals division is a world-leading supplier of products and technology for pulp bleaching. The majority of products including sodium chlorate, hydrogen peroxide and peracetic acid are used within the pulp and paper industry, where they enable the production of white paper, which would otherwise be brown. And without chemicals it is not possible to remove ink in waste paper for recycling.

Sodium chlorate is produced from two common materials, salt and water. Up to 95 % of all sodium chlorate produced worldwide goes into the pulp industry where it is used to generate chlorine dioxide, a key bleaching agent in the production of pulp for paper products.

Eka Chemicals is the world´s largest producer of sodium chlorate with plants in Sweden, Norway, Finland, France, USA, Canada, Chile and Brazil. Its total capacity is currently 775,000 tonnes per year.

The main components of ***hydrogen peroxide*** are water and oxygen. The most important application for hydrogen peroxide, both in the Nordic countries and in many other regions in the world, is as a bleaching agent in the pulp industry. It is used for bleaching of chemical pulp, mechanical pulp and for deinking of recycled paper.

Eka Chemicals has a strong position in hydrogen peroxide production with manufacturing plants in Sweden, Norway, USA and Venezuela. Its total production capacity is currently 225,000 tonnes per year.

Peracetic acid, (PAA), is the result of a reaction between hydrogen peroxide and acetic acid. In the pulp industry PAA is primarily used for bleaching of TCF (Totally Chlorine Free) kraft pulp to full brightness with maintained strength properties. This bleaching method was developed and patented by Eka Chemicals.

Being the first commercial producer of distilled peracetic acid for the pulp industry Eka Chemicals developed its own patented production process for this product in 1993. At present approx. 200,000 tonnes per year of kraft pulp is being bleached with PAA according to the AcedoxTM method.

Potassium chlorate is produced from 4 different raw materials - sodium chloride, potassium chloride, water and electric energy. Potassium chlorate is used in two main applications - matches and pyrotechnics. Eka has always been focusing on the match industry. Potassium chlorate is tailor made by Eka for the specific demands of the match industry. Eka has over 100 years of experience in potassium chlorate production and also maintains close co-operation with its main customers.

Casco Products (BU Industrial Products) is also a business unit within Akzo Nobel belonging to the coatings group. Casco products carries out industrial operations on a global scale in the fields of impregnated papers, adhesives, and expandable microspheres, with some operations in the field of carbide. In

1998, Casco had an annual turnover of 432 million Euros and employed some 2100 persons.

Casco produces resin-impregnated papers for markets around the world. These are mostly used as decorative surfacing materials for kitchen cabinets, laminated floors, and furniture made from particleboard. It also supplies adhesives and resins to the woodworking industry (for furniture, parquet flooring, and laminated beams). In addition, it also supplies world markets with additives that reduce the weight and improve the properties of printing inks, nonwoven fabrics, paper, polyester, etc.

The history of Casco Products dates back to 1928 when the Swedish company Casco was founded by Lars Amundsen. Initially, Sweden and the Nordic countries were the main focus. Expansion to the rest of Europe did not begin until 1978, whilst global expansion began in Asia in 1984, North America in 1987 and South America in 1998.

In 1964 Casco was acquired by a Swedish chemical company, Stockholms Superfosfat Fabriks AB, and has since then been part of KemaNord, KemaNobel, and Nobel Industries, while today it is part of Akzo Nobel. The name was changed to Casco Products in 1996 following the merger of Akzo and Nobel Industries in 1994.

Casco products, which has its head office is in Stockholm, Sweden, has subsidiaries in most European countries, North and South America and Asia. It is organized into 3 sub-business units: Casco Impregnated Papers, Casco Adhesives and Casco Polymer.

Impregnated papers are used as decorative surfacing materials for particleboard-based products such as kitchen cabinets, cupboards, furniture, etc. A growing area is laminated floors. Surface films for industrial applications are another large product group - e.g. shuttering forms for concrete formwork and boards for truck beds.

Adhesives and adhesives systems are produced for three main application areas: 1) resins for the board industry; 2) adhesives and application equipment for the woodworking industry and 3) corresponding applications (assembly bonding, sandwich constructions and packaging) in other industries.

Casco began producing wood adhesives for the Nordic market in 1928. Today, Casco is one of the world´s leading producers of adhesives and adhesive systems for the woodworking industry. The company has also assumed a preeminent position in research and development, in this area. In fact, Casco cooperates with the woodworking industry virtually worldwide. Casco is a main supplier of adhesive systems to many customer groups such as parquet and laminate floor, laminated beams, furniture; formpressing, veneering, foliating, blockboard, doors, and windows.

Industrial Coatings are another prominent area for Casco, especially the VOC-compliant waterborne paints, high solids, and powder coatings, which are used to enhance and protect metal, plastic, and wooden substrates. Applications range from home appliances to wooden furniture and heavy-duty goods vehicles. Casco are the market leaders in powder coatings, and are strong in industrial wood finishes, coil coatings, and plastic coatings.

Wood coatings are produced for a wide variety of products for the woodworking industry. Casco's operations are organised according to market segments, such as furniture of all types, exterior and interior joinery and flat panels, paper & foil finishes, and industrial floor coatings. The head office of wood coatings Akzo Nobel Industrial Coatings is located in Malmö, Sweden. Wood coatings are also located in the following countries: Belgium, Denmark, Estonia, Finland, France, Hungary, Italy, Netherlands, Norway, Spain, Sweden, Turkey, United Kingdom.

Specialty resins for coatings and printing inks

The business unit Resins (Akzo Nobel) is a leading global manufacturer of speciality resins for the coatings and the printing ink industries. Its product range includes a wide range of resins for alkyd, water-based and high solid paints and printing inks, suitable for a variety of applications and substrates. It manufactures coatings using waterborne and solvent borne acrylics, alkyds, polyesters and melamines, some of which are used in industrial wood and plastic coatings. For the printing ink industry the product range includes alkyds, acrylics, modified phenolics, modified hydrocarbons, hybrids, maleics, fumarics, vehicles, wax compounds and additives.

The sub-business unit, printing ink resins Europe, is part of Akzo Nobel Resin's global activities, and is one of the major ink resin suppliers in Europe. Customers include the major ink producers with a broad range of products and applications, as well as smaller ones active in specialities or niches. To serve this industry, various product lines for different applications have been developed and are still being expanded by new developments. These products are mainly produced on different European sites, of which Bergen op Zoom accounts for the majority. Typical product lines are imported from production facilities in the U.S. or the Far East.

Printing ink products for offset application (heatset, sheetfed and coldset inks) include some 26 different types of rosin esters, 27 different types of resins, various types of varnishes, wax compounds, whilst for water-based liquid inks it produces soluble and non-soluble water-based dispersions, as well as modified rosin esters.

BASF has a product range covering the entire spectrum of chemical products. This is the result of more than 130 years' continuous development, in the course of which the company has written chemical history with a wide variety of pioneering achievements.

BASF operates in many segments such as health and nutrition, colorants and finishing products, chemicals, plastics and fibres, oil and gas. However, BASF is a worldwide leading supplier of wet end and coating chemicals for the paper industry with a strong background in paper technology. With monomers, polymers and paper chemicals, the company offers an extensive range of products for the most diversified processing industries.

In the area of Paper chemicals, BASF's business unit paper chemicals, located in Ludwigshafen, Germany, offers an extensive range of products to its customers for every stage of uncoated and coated paper manufacturing and finishing across Europe. The knowledge of the various interactions in the complex papermaking process enables BASF to tailor the exact combination of chemicals to the precise requirements of a particular customer, ensuring mills operate at the highest technology standard and in a cost-effective manner.

The product range for the production of paper and board includes: retention, drainage, and flocculation, -fixing agents, colorants, defoamers, deaerators, wet- and dry-strengths resins, bleaching agents, polymer-dispersions and solutions for paper and board coating, auxiliaries for paper and board coating and products for the production of carbonless copying paper.

The BASF paper technical centre is one of the largest and most modern pilot facilities in the world, and demonstrates the connection between paper and printing technology. For example, equipment is available from stock preparation, papermaking, and coating, up to finishing and printing. In fact, the paper technical centre provides customers with the opportunity to develop new products and processes which can be used in mill-scale practice - without the inconvenience of having to shut down production. The centre is staffed by an international team of experts who are familiar with the complex chemical interactions and the technical problems encountered in the production of paper.

BASF is also very active in the coating of industrial products, developing comprehensive coating systems. The company possesses various surface finishing technologies designed for a wide range of applications. These technologies include powder, liquid, electro-dip and coil coatings which are used on various applications. Industrial coatings are also manufactured for wood and special foils for the furniture industry, for wooden window frames and for plastic parts for automotive suppliers and the plastic processing industry.

BASF has close co-operation with Hülsta of Stadtlohn, a leading German manufacturer of branded furniture, which has for decades been using BASF wood-coating systems. In fact, a great many products have been developed over the years, the most recent example being water-based, solvent-free UV coatings, (coatings which can be thinned with water and cured by means of ultraviolet light). For example, the eco-efficiency of these products over the whole process cycle, from production to waste disposal, were examined. After findings confirmed that the new products performed better in the energy and environment balances than their conventional predecessors, Hülsta made the necessary planning arrangements and capital expenditures to redesign and equip its existing plants.

With more than 125 years experience in producing printing inks BASF printing systems is one of the leading worldwide suppliers of printing inks for print media, covering the whole range of printing inks. The BASF printing systems printing and technology centre in Stuttgart is available for tests/trials and training. As one of the leading suppliers of printing inks for print media, it provides a wide range of products which are used in the following areas of application: printing inks for sheetfed offset printing, printing inks for heatset, printing inks for coldset, printing inks for publication-gravure, printing inks for UV-curing, printing varnish, and fount solution.

BASF printing systems is one of the leading suppliers worldwide of liquid printing inks for packaging industries, offering a diverse range of Flexo and

Gravure inks. The company works closely with its customers to ensure that products correspond with the demands of the market place, and this is achieved through its advanced development facilities at the newly built printing centres in Stuttgart (Germany) and Clermont (Paris) as well as at other locations throughout Europe.

Innovation is the strength of BASF printing systems, for many years BASF has been the leading manufacturer in water-based printing inks for polyethylene packaging. Printing inks are used for paper and cartons and soluble polymers for coating of ink jet printing speciality papers, insoluble polymers coatings and inks for write-on labelling, adhesive tapes or films and Ink jet papers and films.

Other products include: Sodium sulphite anhydrous grades - for the production of semichemical paper pulp and paper pulp, for processing rags, for pulping straw, additive to improve the quality of paper paste; Sodium hypochlorite bleach for papermaking; Oxidizing agent for bleaching paper pulp, cellulose, textiles, bristles, straw and basket work; Hydrosulphite grades based on sodium dithionite; reducing bleaching agents for wood pulps and wood-containing used paper.

Elf Atochem produces products for many applications within the forest-based and related industries. This is exemplified by its three core businesses areas: basic chemicals, intermediates and fine chemicals and performance products. For example, within its intermediates and fine chemicals products areas include: acrylics and organics (acrylics and derivatives; organics; aminoplaste and phenoplaste resins), formaldehyde, melamine thiochemicals and fine chemicals (sulphur chemicals; fine chemicals), and peroxides and fluorochemicals (peroxides; fluorochemicals), many of which are supplied to forest-based industries.

During 1998, Elf Atochem's intermediates and fine chemicals, acquired the interest owned by its partner Air Liquide in Oxysynthèse - a jointly-owned hydrogen peroxide production subsidiary - and the DuPont hydrogen peroxide operations in Memphis (USA). These two transactions allowed Elf Atochem to strengthen its industrial and commercial positions in hydrogen peroxide (a key input to the pulp and paper industry), becoming the third largest company worldwide, by production capacity.

Other products, relevant to the forest-based and related industries include aminoplaste and phenoplaste resins, formaldehyde, melamine (specifically: Urea-formaldehyde resins, melamine urea-formaldehyde resins, melamine urea-phenol-formaldehyde resins, melamine-formaldehyde resins, phenol-formaldehyde resins). These products are used as binders for wood-based panel boards (particleboards, medium density fibreboards, oriented-strand boards, plywood), for furniture-making, for carpentry and construction; impregnating resins for veneering paper; and other applications (casting, foundry-work, friction, abrasives).

The presence of Grande Paroisse (a major 'urea' producer) in the group, together with the geographical location of its plants in Europe - enhanced in 1993 with the acquisition of the formaldehyde resins activity from Leuna Werke – have secured Elf Atochem's position as one of Europe's leaders in aminoplaste resin production.

With the aid of its major research and development facilities, Elf Atochem is able to fulfil the specific demands of its customers, directly in Europe. Elf Atochem is also a major producer of melamine (a key product for the furniture industry), which helps to strengthen its position in its speciality product range.

In the performance products business area (adhesives/Ato Findley), the following products are produced: construction adhesives such as professional glues; adhesives and sealants for construction and public works (floor and wall coverings, acoustic and thermal insulation, and miscellaneous materials - wood glues). Industrial adhesives include: glues and adhesives for the wood industry (timber, furniture making and joinery), paper and cardboard processing, bookbinding, envelope manufacture, packaging, fireproofing, and compounding processes.

Clariant is a leading global speciality chemicals company with more than 29,000 employees and annual sales of about CHF 9.5 billion. The company has grown out of the Sandoz Chemicals division, which was floated on the stock market as a spin-off in 1995, and the speciality chemicals businesses of Hoechst, which was integrated into Clariant, in 1997. Clariant operates worldwide with more than 100 Group companies in five continents. It is headquartered in Muttenz near Basel/Switzerland.

Sandoz was founded in 1886 and initially began producing textile dyes. In 1919, it began diversification into dyes and chemicals for paper. Before its merger with Hoechst Speciality Chemicals, paper accounted for 14% of Clariant's business, pigments and additives 11%, textile dyes and textile chemicals for about 44%, leather 10%, and masterbatches 17%. Paper chemicals was integrated into Hoechst Speciality Chemicals' division in 1996. At the same time, it acquired the pigments businesses from Cookson/USA. Before being merged with Clariant, surfactants & auxiliaries accounted for 37%, fine chemicals 13%, polymerisates/alkyloses 16%, additives 5%, pigments 19%, paper 2% and masterbatches 8%.

In 1997, Clariant and Hoechst Speciality Chemicals merged. Products and services of Clariant are now separated into six divisions: Process & performance products, pigments & additives, masterbatches, surfactants, fine chemicals and polymerisates & cellulose ethers. All of which are based on speciality chemicals, which play a decisive role in the clients' manufacturing processes, upgrading their end-products. Clariant keeps in tune with the challenges the customers face, and tailor their products to exact specifications, collaborating with clients to come up with convincing solutions.

The process & performance products division is headquartered in Muttenz/Switzerland. Its key products are: dyes and chemicals for the textile, leather and paper industries, such as reactive, direct, sulphur, disperse, acid and metal complex dyes; pre-treatment, dyeing, printing and finishing chemicals; optical brighteners; and process chemicals.

The pigments & additives division is headquartered in Sulzbach am Taunus, Germany. Its key products: pigments for use in printing inks, paints, decorative paints, plastics and special areas; special colorants, e.g. for electro-photographic toner, ink jet inks, thermo transfer printing and aluminium dyes; waxes, light stabilizers, antioxidants, antistats, frame retardents and phosphorus specialities.

Cellulose ethers & polymerisates, is also headquartered in Muttenz/Switzerland. It produces the following products: Cellulose ethers, emulsion powders and emulsions for the production of coatings, mortars, building materials, adhesives as well as for the use in food, hygiene and pharmaceuticals. Polyvinyl alcohol and polyvinyl butyral for the manufacture of adhesives and paper and for use in textile processing, for printing inks, paints and as laminates for safety glass. The company also manufactures Woodstains and Wood protection systems, water based systems and solvent based systems, dyes and pigment dispersions.

Bayer is an international, research-based group with major businesses in life sciences, polymers and speciality chemicals. Employing 120,000 people worldwide, the group has operations in nearly all countries of the globe and a portfolio of some 10,000 products. With annual sales of DM 55 billion (1998) it is considered a world leader in its sector. Bayer's operations are structured into four business segments: Health Care, Agriculture, Polymers and Chemicals whilst it has 17 business groups in operation.

Bayer AG floated its subsidiary Agfa-Gevaert N.V. on the Frankfurt and Brussels stock exchanges in 1999. The portfolio of the Chemicals segment was restructured as part of its strategic focusing on core businesses to align it even more closely with the markets. The basic and fine chemicals activities of its former inorganics and organic chemicals business groups have been merged into the new basic and fine chemicals business group. Within the chemicals business group, Bayer is the world leader in the field of fibre used in paper machinery felt via its perlon and monofils products.

The specialty products business group has now been enlarged to include the paper industry, leather industry, textile chemicals, material protection, ion exchange resins and polymer additives business units. In 1997, the turnover of the specialty products business group was DM 2.2 billion.

Customer focus was made an essential feature of the speciality products business group when it was formed in 1996. Addressing specific user industries directly and adopting a more customer-oriented approach it customized it’s systems to capitalize on additional sales opportunities.

Through this realignment it is now pooling expertise to develop innovative products, increasingly tailoring their performance profiles to meet specific customer needs. Examples are new Baysynthol surface sizing agent for paper manufacturing. Its leading position as a competent partner to the paper industry was enhanced in 1998 by the completion and start-up of the new plant in Leverkusen, in Germany. The facility, which cost DM 60 million to build, manufactures optical brighteners by a patented, fully automated process. A redesigned logistics system ensures fast, reliable deliveries to its customers throughout the world.

At the same time as being transferred to the specialty products group under the restructuring referred to above, its line of polymer additives has been extended, making Bayer one of the market leaders. Today customers can benefit from technical service support and the ability to purchase from a global, single-source supplier.

The speciality products group of Bayer provides a wide variety of speciality products such as paper processing chemicals and optical brightners to the paper industry. More specifically, these include fluorescent whitening agents, dyestuffs, process chemicals, inorganic pigments, lattices, and biocides. Bayer works together to develop comprehensive technologies for the benefit of their customers and partners in the paper industry. Added to this business group's portfolio as of the start of 1999 were polymer additives, microbicides and other material protection products, ion exchange resins, catalysts, water chemicals and specialty chemicals.

Since the discovery of polyurethanes in the Bayer laboratories by Otto Bayer and his team in 1937, these materials have become an essential part of its product range and one of the economic mainstays of the company. With volume sales in excess of one million tonnes per year, Bayer's polyurethanes business group is one of the leading raw materials and systems producers in this field. Sales of over DM 4 billion in 1998 represented one quarter of the total sales of Bayer's Polymers business segment. Polyurethanes are produced at 19 sites around the world - located in Europe, North, Central and South America, Africa and Asia.

The enhanced character of decorative wood in the home is now an affordable luxury thanks to the polyurethane binders used in the production of Oriented Strand Boards (OSB) used for a wide range of applications in the construction sector. The boards represent a genuine alternative to solid wood.

Oriented Strand Board (OSB) is made of roughly six-centimetre-long strands obtained from peeled conifers. They are arranged in three layers and bonded together with Desmodur, a binder produced using polyurethane chemistry from Bayer, in combination with mixed resins. The strands of the two outer layers of the board are oriented longitudinally, while the middle layer has transverse orientation. This crosswise arrangement ensures particularly high mechanical strength. As a result, the longitudinal stiffness of the boards is considerably greater than that of laminated flat pressed board. The boards can be nailed, screwed, sawn and doweled just like solid wood. Screws and nails sit securely, even at the edges.

The size of the strands gives the boards an appearance very reminiscent of wood, making them eminently suitable for decorative applications. They can also be coated with coloured paints and varnishes. The boards are used in structural woodwork and as a building material for partition walls, floors, wall and ceiling panelling, and furniture fronts. The significance of the building sector for Bayer is illustrated by the "constructive solutions" initiative – were expertise in many different types of material for building applications is pooled in the Construction Business Council.

Bayer's subsidiary Wolff Walsrode has achieved worldwide success with products based on cellulose, a natural raw material. It is the feedstock for the production of substances such as methylcellulose - an additive or precursor for building materials, paints and adhesives. Yet cellulose has an even broader spectrum of promising applications, which are now to be researched by experts at a new pilot-plant facility in Walsrode, Germany. Bayer intends to expand this facility into a competence centre for cellulose derivatives. The centre's activities will also focus on increasing the use of other renewable raw materials, such as starch or guar.

In the area of material protection, it expanded its strong position in the markets for wood preservatives and technical preservatives etc. It achieved this by providing more comprehensive customer service, and increasing its active ingredients research and opened up new applications for existing products. To strengthen its overseas presence it has also established regional centres.

Agfa is owned by Bayer. However, Bayer floated Agfa on the stock market in 1999, in order to provide it with new financing options to more effectively implement its growth strategy as one of the world's leading imaging technology companies. This move was being backed by acquisitions and restructuring measures. Its core businesses are especially in prepress and technical imaging systems were it has the expertise and strong market position.

The graphic systems business group accounts for nearly 50 percent of Agfa's sales. In 1998, it had a turnover of DM 4.2 billion. The company acquired the offset printing plates and graphic film activities of the U.S. company DuPont whilst divesting it's copying systems activities later that year. Acquisition of the graphic films and offset printing plates business of DuPont has made Agfa the leading player in the expanding world market for prepress systems. Currently, about 40 percent of all print media worldwide are generated using Agfa products.

Growth in the photographic prepress area continues to be driven by recorder films. These are special films for recording digital data - such as print pages compiled on the computer - in a laser imager. Business in offset printing plates is also showing a stable upward trend and has benefited particularly from the DuPont acquisition.

In addition, through the purchase of Monotype Typography Inc. in the United States, Agfa has acquired the largest font library in the world, as well as relevant design and engineering resources. They were also anticipating that the acquisition will not only extend the product range, but also lead to further joint product development, to which Agfa can contribute its know-how in font management and font compression.

8.2.4 Starch

Starch additives are used in the papermaking process to improve strength and productivity in acid, neutral or alkaline paper production. *Surface Starch* is a group of starch additives used for paper and board, which improve printability and strength. Examples are uncoated office papers, food packaging papers and uncoated book papers. *Corrugating Starch* or modified carrier starches, provide a high degree of water resistance, strength and improved productivity in the manufacture of corrugated boxes. Tissue/towel starch is used as Strength additives for enhancing bulk and softness in tissue and towel manufacturing. *Starch Adhesives* are also used in the manufacture of envelopes, tube-winding, tissues/towels, bags, paper board laminating, general packaging and for binding of paperback and edition bound books, magazines and pamphlets.

The Sveriges Stärkelseproducenter (Swedish Starch Producers) is an economic association of starch potato growers, which operates via four subsidiary companies. **Lyckeby Stärkelsen Industrial Starches AB**[13] produces and sells starch products to the European papermaking industry. Another subsidiary, Svenska Lim AB manufactures, develops and sells adhesives for the automotive, furniture, paper and building materials industries. Together both these subsidiaries account for about 44% of the Group's turnover.

Lyckeby Stärkelsen, turnover of about SEK 230 million, operates a starch plant in Lister Mjällby, in Sweden, and supplies modified starches to the paper industry. In 1998, the company planned to increase production at its Lister Mjällby mill. Amylopectin starch is a totally new type of starch produced from a unique gene modified potato, which has been developed by Lyckeby Stärkelsen in collaboration with Svalöf Weibull. This quality of starch is well suited to the needs of papermaking industry in particular. Amylopectin starch can help industry to be more efficient in the use of resources and energy. For example, Amylopectin starch makes it possible to increase the use of recycled fibres and filling without loss of strength, dewatering can be increased and hence energy is saved in the drying process.

The main uses of these starches are as follows:

- Wet end Starches – applied during the wet part of paper production to strengthen the paper and improve runnability (The demand for such products increases as the paper mills employ closed system production and increase use of recycled paper).
- Surface sizing starches – applied to the paper web during the drying process. These starches provide surface strength and enhance the properties of paper, e.g. for printing, coating or copying.
- Coating starches – used as a bonding agent in the coating colour which enhances the paper finish and improves printing characteristics.
- Special starches – products for dispersions that are used in paper and carton packaging for liquids.

Lyckeby Stärkelsen's markets are mainly in Scandinavia, however in other areas its works with group companies in Finland, Germany, the Czech Republic and Latvia. Lyckeby Stärkelsen GmbH is a sales and marketing company based in Germany. It's prime objective is to represent the products of Lyckeby Stärkelsen Industrial Starches. Today the company is an established supplier of starches to the papermaking industry in continental Europe. Indeed, the sheer size of the recycled papermaking industry in Germany and the rest of Europe offer huge potential for the company's Amlopectin starch products. After much testing of special products for the papermaking industry in 1997, turnover in Lyckeby Stärkelsen GmbH, rose sharply.

---

[13] Sveriges Stärkelseproducenter Annual Report 1997.

Svenska Lim AB, located in Landskrona, Sweden, was founded in 1901 and is Sweden's oldest adhesive factory. In 1997 it had a turnover of some SEK 99 million. The company's most important markets are Sweden and Scandinavia, where it is the leading adhesive supplier to the upholstered furniture and automotive industries. In Denmark, it has a 50% interest of Frede Andersens Fabrik. The company's business activities have also been expanding eastwards into Finland and the Baltic States.

Within Lyckeby Stärkelsen R&D department, the major part of R&D programme concentrates on paper, foodstuffs and animal feed. In 1997, ongoing development work resulted in three new Swedish patents, two for the papermaking industry and one for the food industry. Another area of research has been to secure approval of high cationic starch for the manufacture of packaging paper for the food industry. The starch has already been approved by the German authority, and it was anticipated the US based FDA would follow by 1998. In closed systems high cationic starches help reduce emissions in paper manufacture.

8.2.5 Pigments & Fillers

ECC International[14] is part of English China Clays, dealing primarily in speciality minerals and chemicals. ECC International is the minerals division and is the world's largest producer of white speciality minerals, many of which are used in the paper industry (e.g., coatings and fillers). Since April 1999, ECC International has been part of the IMERYS Group (formerly IMETAL), a worldwide leader in minerals processing with sales of EUR 2,9 billion after the acquisition. IMERYS now has a total workforce of 15,000 employees (with 7,700 in Europe) 40 % of which are in Pigments and Additives.

IMERYS is the world leader in white pigments, pigments for paper, refractory raw materials, and high-purity graphite. It is also the leader in Europe for ceramic clays and bodies, second in Europe in monolithic refractories, and number one in France for tiles and bricks. Pigments and Additives now account for 39% of the business. The geographical area of its sales are about 45% in Europe (including 24% France), 44% North America, and 11% rest of the world (5% Asia).

Within IMERYS, pigments and additives products include kaolin and calcium carbonate. Production includes kaolin or china clay, GCC (ground calcium carbonate), and PCC (precipitated calcium carbonate). These pigments are natural components that are essential in the paper industry, as well as in other industries such as paints, plastics, and adhesives. Their advantages are that they allow a reduction in costs and improvement of performance in terms of resistance, density, and aesthetics.

Paper Pigments are active all over the world, in North America, South America, Asia, Europe (Belgium, Finland, France, Germany, Italy, Portugal, Sweden and United Kingdom). Turnover is about 70% pigments for paper industry and about 30% performance minerals.

---

14 http://www.ecci.co.uk/compinfo/index.htm.

ECC International, part of IMERYS pigments & additives group, offers more than 80 years experience in the supply of pigment solutions from a multi-product portfolio. The new pigments & additives group combines ECC International, Dry Branch Kaolin, Georgia Marble and Rio Capim Caulim to offer a unique combination of pigment solutions and services. By combining the best from the former companies, it intends to be the best in the market through a broader product offering, enhanced technical service, R & D capabilities and logistical excellence.

ECC International produces kaolin, GCC and PCC from its own mineral reserves in Europe. These pigments are used in the paper industry, and other industries such as paints, plastics, film, adhesives and sealants. To service these industries, the commercial and technical facilities are divided into three industry orientated groups – European paper; European performance minerals and ceramics.

China clay occurs in the deposits in the form of china clay rock, a mixture of up to 15 per cent china clay and up to 10 per cent mica, the remainder being quartz. The clay itself varies considerably from pit to pit. In some deposits, such as those at Blackpool, Littlejohns and Goonbarrow, the clay is ideally suited for the filling and coating of paper. With a current annual production ranging between 2 and 3 million tons ECC International is today the world's largest producer of china clay, and, thanks to its known available reserves, is likely to remain so for the future.

Box 8.5 ECC History

The early history of the Company is, as would be expected, very much concerned with the discovery and production of china clays for use in the ceramics industry. The story, though, starts thousands of years ago and thousands of miles away.

China, the pure white porcelain used by the Chinese, was discovered many thousands of years ago and has always been a much prized material; yet despite many attempts to find sources elsewhere, it remained elusive until a few deposits were found in some parts of Europe and in America early in the eighteenth century. The search to find deposits in England was increased.

When china clay, or kaolin, was discovered in England, it was realised that it was of a much finer quality than found elsewhere in Europe. The discovery was made in Cornwall in 1746 by William Cookworthy. He experimented with various samples and in 1768 he took out a patent to use the material, soon producing items at his Plymouth Porcelain Factory.

Potted History of ECC

1746	Discovery of China Clay at Tregonning Hill near Helston by William Cookworthy.
1807	First mention of clay being used in paper manufacture. From the mid 19th Century the paper industry becomes the principal consumer of China Clay.
1837	First mention of steam engines used at Singlerose clay works (listed in mining journal).
1840	Par harbour, new major port facility is completed by Joseph Treffry.
1900	561,000 tonnes produced, 60% for the paper industry. The beginning of the 20th Century was to herald a number of changes in working practice, - the introduction of gas engines to drive dynamos for electric supply and the first steam excavators were on the scene before World War 1.
1919	Formation of English China Clays Ltd bringing together the West of England China Clay Co., Martyn Brothers and North Cornwall China Clays representing 50% of the industry output.
1934	Launch of the best selling, and still made, clay SPS (selected particle size) a great hit at the time in the U.S.A. and still widely sold in the European paper industry.
1946	The first electron microscope introduced into the industry begins a new period of scientific research. The "Cornish Unit" house, using china clay as the aggregate to manufacture the prefabricated unit, is introduced to the market. Many thousands are constructed all over revenue sales is used to secure a new technical base for the industry.
1950	Introduction of Pug Mill Extruders to play an important role in the development of paper coating clays.
1954	The first commercial centrifuges introduced into the industry for producing paper coating clays.
1981	Official opening of calcium carbonate and china clay complex at Lixhe, Belgium.
1988	This century's highest recorded tonnage - 3,277,000.
1999	English China Clays plc acquired by French minerals company IMETAL. IMETAL changes its name to IMERYS.

8.2.6 Printing Inks[15]

The printing ink market

According to the President of CEPE, (the European Confederation of Paint, Printing Ink and Artists' Colours Manufacturers' Associations), Prof. Franz Josef Rankl, "Printing ink producers sold more than 770 000 tonnes, in 1996 and had a turnover of more than 3 billion ECU. Germany is by far the largest producer and exporter. German printing ink producers sold more than 303 000 tonnes worth 1.05 billion ECU. Exports rose by 8.4% to more than 105 000 tonnes, with a value of about 416 million ECU. The biggest growth in sales occurred in Spain, where printing ink producers sold 39% more than the previous year: over 37 000 tonnes in 1996. France imports the largest amount of printing inks in Europe: over 41 000 tonnes worth almost 170 million ECU."

Printing Inks in the UK

Sales of printing inks in the UK are estimated to be some £550 million of which almost £400 million is supplied by members of the British Coatings Federation. The UK is the second largest market after Germany for printing inks in Western Europe.

Print is one of the most visible products - for news, in libraries and offices, packaging, supermarkets, department stores, greeting cards and travel. The range of printing inks is tailored to meet the special requirements of the substrate on which it is printed (paper, foil, film, board, plastic, etc), the printing process, the speed of machinery and the quality of performance required. A major feature in the last decade has been the significant increase in the use of colour, particularly in newspapers.

The ink industry in recent years has seen a considerable merging of companies resulting in 75% of the UK market being supplied by four major international groups operating on a global scale. At the same time printing groups have seen similar mergers and take-overs and these international customers have demanded a more rationalised supplier base involving improved technology, in-plant mixing schemes where appropriate and more efficient methods of ink-

---

[15] Source: http://www.cefic.org/product_families/.

sourcing and bulk handling. The remaining 25% of the market is supplied by approximately 10 medium sized companies and a number of smaller firms, mostly operating in specific niche markets.

About 100 tonnes of ink are used every day on Britain's daily output of 14 million newspapers. In 1998, consumption of 'news inks' totalled 39,000 tonnes, including 13,000 tonnes of coloured inks. Although now re-located, the national newspapers used to be printed in Fleet Street, which was known as the 'Street of Ink'.

Table 8.8 UK sales weight of printing inks by sector in 1997

Ink Application	Type of Ink	Tonnes (000s)	% of total sales
Newspaper Inks - Coldset - Flexo	Mostly coldset inks, which dry by absorption onto paper applied by the web offset process. One national title is printed flexographically. Printing by letterpress holds a small & declining position.	38 34 4	28
Publication Inks - Heatset - Publication Gravure	Heatset and publication gravure inks for web and sheetfed offset printing processes generally used for magazines, periodicals and books	31 17 14	22
Packaging	Mainly liquid inks, comprising water and solvent borne inks sold for gravure or flexographic printing processes and used on paper, plastic, film and foil. This market sector also includes a small amount of sheetfed inks mainly used in cartons.	37	27
Commercial	Sheetfed inks and some UV cured inks for offset lithographic printing used in stationery, forms, pamphlets and high quality brochures.	5	3
Other Printing Inks	Metal decorating inks for beverage cans, screen inks for textiles and specialised security inks.	6	4
Overprint Varnishes	All water and solvent borne coldset, heatset and UV cured varnishes, mainly used in lamination and packaging.	12	9
Sundries	Mainly comprising fount solutions, press room washes and ink additives.	10	7
Total		139	100

As can be seen from the above table, printing inks are mainly used on paper and board (newspaper inks 28%, publication inks 22%, commercial inks 3%, plus proportion of packaging inks used on paper and carton packages). Therefore, if the UK printing industry is representative of European markets, it would be reasonable to assume that this natural link between paper and board manufacturers is fairly strong, whereby, papers and inks are developed through close co-operation between paper and ink producers and printing machine manufacturers.

8.2.7 Adhesives

According to the FEICA, the Fédération Européenne des Industries de Colles et Adhésifs, about 1.62 million tonnes of adhesives were consumed in Europe in 1998. FEICA is the Association of European Adhesives Manufacturers and is comprised of 15 National associations who altogether count 480 member companies.

Since 1996, paper and board related adhesive products, has become the most important consumer of adhesives in Europe. Consumption in this segment has grown by approximately 10%. It is also interesting to not that consumption in the woodworking and joinery segment has grown by some 25%. This segment is still the third most important segment. Combined, the forest-based and related industries account for at least 50% of the consumption of all adhesives in Europe. Moreover, it is also more than likely,

Table 8.9 Adhesive Market Segments, 1998

Segment	Tonnes		Millions DM	
	1996	1998	1996	1998
Paper, board and related products	493.177	550.734	1.717	1.773
Building, construction, civil engineering, craftsmen	520.512	434.449	1.319	1.323
Woodworking and joinery	206.455	246.909	559	653
Transportation	71.873	68.129	514	491
Footwear and leather	56.985	78.135	231	330
Consumer / DIY (retail)	124.432	124.869	1.100	1.167
Assembly operations	69.023	114.581	592	804
Total	1.542.457	1.617.806	6.032	6.541

Source: FEICA, 1998.

Table 8.10 Product Groups within Adhesives, 1998

	Tonnes	Millions of DM
Adhesives based on natural polymers	99.908	261
Polymer dispersions and emulsions	652.625	1.968
Hotmelt adhesives incl. moisture-cure types	237.187	1.067
Solvent based adhesives systems	228.643	1.255
Reactive (polymerising) systems	153.996	1.341
Adhesives based on water-soluble polymers	61.203	302
Other adhesives	177.991	352
Total	1.611.544	6.546

Source: FEICA, 1998.

that both the construction sector and consumer/DIY sector consume a great deal of adhesives in the use of wood and paper products, and therefore the importance of forest-based and related industry products is probably even more significant than shown above.

Trends in Adhesives for the packaging sector[16]

The paper and packaging industry represent one-third of the adhesives market. Packaging exhibits a trend towards higher quality surfaces which require tailor made adhesives. Water-based adhesives are the norm as solvent-based adhesives are only used in special cases. The proportion of packaging adhesives on total production value: paper and packaging 40%, plastics 32%, metals 19%, glass 7% and wood 2%.

Within the European adhesives market, the paper & packaging segment accounts for 28%, construction industry 22%, DIY 18%, assembly 10%, wood & furniture industry 9.3%, automotive industry 8.5% and shoe & leather industry 3.8%. Adhesives for the paper & packaging industry are comprised of: dispersion adhesives 40%, hot melt adhesives 22%, casein adhesives 9%, starch & dextrin-based adhesives 11%, polyurethane adhesives 9%, rubber-based adhesives 5%, and glutine adhesives 1%.

---

[16] Farbe und Lack – CNBC Europe, 28/4/1999.

Table 8.11 Adhesive Markets by region, 1998

Region	Tonnes	Million of DM	Market distribution by region, (% of total value)
Nordic countries (Nor, Swe, Fin, Den)	89.308	316	4,8
United Kingdom	248.706	1.267	19,3
Benelux countries	123.368	414	6,3
France	340.669	1.135	17,3
Germany, Switzerland, Austria	405.623	1.904	29,1
Italy	252.200	914	14,0
Spain, Portugal	154.873	599	9,1
Total	1.614.747	6.549	100,0

Source: FEICA, 1998.

In 1999, the **Henkel Group** generated sales of 5.6 billion Euros. The business sector, organic speciality chemicals contains the paper auxiliary business. Sales in the adhesives business sector grew by 2.5% to 1,23 million Euros. Sales increases were also experienced in the industrial and packaging adhesives, as demand for packaging adhesives was favourable. Adhesives for the wood processing and furniture industry achieved double digit sales growth.[17]

Henkel's Adhesives business sector operates all over the world in three distinct arenas: industrial adhesives, engineering adhesives and consumer and craftsmen's adhesives. More than 3000 different adhesives and sealants are sold in 140 countries. Seventy-five years after it was established, it has a workforce of about 12,000 people all over the world, with production facilities being located in 39 countries.

Industrial and packaging adhesives product groups include: packaging and labelling adhesives; shoe adhesives; cigarette adhesives; bookbinding adhesives; adhesives for the wood processing industry; laminating adhesives; adhesives for non-wovens; leather board. Adhesive systems are produced for all applications in the fields of labelling, packaging, paper converting, graphic arts, production of cigarettes, flexible packaging and technical laminates, nonwovens disposable products, wood and furniture, footwear and a wide range of further general industry applications.

Henkel's business with adhesives for the wood processing and furniture industries is centrally controlled by its subsidiary Dorus Klebetechnik in Bopfingen, Germany. High growth rates were achieved worldwide after systematic international expansion of its marketing and distribution structures. Adhesives for labelling and the commercial arts and graphics industry experienced a considerable upturn in sales. A contributory factor to this development was the introduction of new technologies which enabled its customers to increase the output of their machines.

[17] PR Newswire, 10/8/99.

Hickson International,[18] based in Castleford in the UK, is a chemicals company which produces timber protection, furniture coatings, fine and custom chemicals. In 1998, Hickson had a turnover of £227 million ($372 million) and employed about 1400. Although, the company suffered serious problems several years ago, the company has since been turned around under the leadership of David Wilbraham – the former CEO of Laporte. The company divested 7 businesses, but 4 of its key businesses, such as fine chemicals, furniture coatings, contract manufacture, and timber protection, were retained based on the company's global positions, growth prospects and market shares.

Europe now accounts for 71% of sales, with the UK accounting for about two-thirds of this, and the Americas, which account for about 27%. Hickson's largest business segment is its protection and coatings segment, which accounts for more than 60% of its sales. Since the earlier problems, Hickson has developed more environmentally friendly products based on organic biocides. For example, in the UK to preserve wood timbers the firm has switched to water-based systems from solvent-based systems.

Hickson is the global leader in timber protection, ahead of Osmose from the USA. Historically, Hickson's core product had been copper chrome arsenic (CCA), but the company has since developed more environmentally friendly products. Japan and most Scandinavian countries have switched to new formulations. In the UK, the company moved from solvent- to water-based systems to preserve roof timbers. In the US, the company offers a highly water repellent treated wood product directly to retail customers through an alliance. The company foresees future demand for products to treat softwoods, which are renewable, because the world is running out of hardwood, it claims.

The company focuses in coatings for the furniture market, where it holds number two position in Europe with 8%, behind Akzo Nobel's 10% market share of a highly fragmented market. In Italy, which is believed to be by far the biggest and most technically advanced furniture market in Europe, Hickson is the second largest supplier, behind IMV-Milesi (Milan), whilst in France, Hickson is the leader.

In Italy, polyurethanes account for 55% of the furniture coatings market, compared with only 7% in the UK and 5% in the US markets, where nitrocellulose-based coatings predominate. UV-cured acrylics and water-based finishes are also becoming more popular in Italy. Hickson's skill is formulating these coatings and so it hopes to take these products to markets outside Italy, such as Spain, USA, and Malaysia (who is developing an export-oriented furniture industry). Indeed, Hickson is investing £2.5 million to expand its flagship furniture coatings plant at Pianoro, Bologna in Italy.

Bausch AG, Buttenwiesen-Pfaffenhofen, and Robert Linnemann GmbH & Co, Sassenberg, two German producers of ecologically friendly wood and furniture surfaces covering materials are currently considering a merger, potentially creating the world's largest company in the field, with a turnover of around DM 320 million. The new company will be called Bausch + Linnemann AG.

---

[18] Chemical Week, 21/4/1999.

Summary Conclusions

Machinery and Equipment:

- Some $10.3 billion US was invested in machinery and equipment into the forest-based and related industries of the EU (about 60% into the pulp & paper industry
- Investment levels within capital intensive industries provide an indication of competitiveness (Finland is constantly at the forefront of investment within the pulp and paper industry and is one of the most competitive)
- Investment levels are not representative of competitiveness within some industries such as furniture manufacturing (both Denmark and Italy have relatively low levels of investment yet have the highest export ratios)
- Investment in machinery and equipment is a more appropriate measure of R&D in so-called low-tech industries such the forest-based and related industries, (since most R&D is carried out by suppliers of machinery & equipment and other speciality inputs)
- European companies are the world leaders in woodworking machinery and equipment with Italy and Germany accounting for over 50% of world trade
- European companies are also the world leaders in pulp and paper machinery and equipment with Finland, Germany and Austria, accounting for much of the market
- A review of machine building industry companies provides ample evidence of close co-operation and sources of innovation to the forest-based industries confirming their role as 'related and supporting industries'
- Embodied R&D and Technology within machinery are transferred within the industry (Machinery and equipment developed around world class paper and wood product manufacturers is often transferred to other centres of production).

Speciality Inputs:

- Speciality inputs are wide and varied and include, pulp and paper chemicals (bleaches, starches), pigments and fillers, wood product adhesives, and chemical treatments, and printing inks, to list but a few

- As the name implies these products are usually developed especially for the forest-based industries, by companies who have long established connections with the forest-based industries
- Development of these products usually occurs within competitive regions of industry, and are then transferred to other regions via the input supplier, Hence R&D and technology embodied within the product are transferred to industry
- Suppliers of speciality inputs tend to be large multinational chemical companies with subsidiaries in many parts of Europe and the world
- Speciality input suppliers typically supply to several branches of the forest-based industries, and as such they conduct most of the R&D and are therefore central to the innovation process within the industry
- In some cases the speciality input industry is more oriented towards the forest-based and related industries than any other (more than 50% of printing inks are used on paper and board products; more than 50% of adhesives are supplied to wood and paper manufacturers).

Chapter 9. R&D in the Forest Cluster

Contribution by Mr. Jari Hyvärinen of the Finnish Forest Industries Federation[1]

9.1 Introduction

As noted in cluster studies or other industrial organisation literature, industries do not act alone in the international competitive environment. They have links with customers and raw material producers as well as other related and supporting industries, which combine to form a cluster of industries with a mutual objective. Through this process, clusters create or attain their competitive advantage in the world markets.

The European paper industry, especially in the Nordic Countries, has taken a leading role as regards the fastest growing paper grades, such as mechanical coated and uncoated printing and writing papers. These are used mainly in magazines, catalogues, books, advertising material and various kinds of office papers. In the 1990's, consumption has increased most rapidly in coated papers, i.e. coated mechanical paper increased 4 per cent and coated woodfree 5 per cent, respectively. Consumption of newsprint has increased 2.5 per cent. In the Nordic countries some newsprint machines have been converted to produce other printing papers, and newsprint production has moved closer to the consumers. Also, in light of the FAO's consumption estimates for 2010, the consumption of printing and writing grades will achieve 4.5 per cent yearly growth.

In spite of the increasingly widespread discussion of globalisation, the main markets of the European forest companies are in Europe - Germany, Italy, the UK and France. Outside Europe, in North America and Asia there are also crucial markets, but these are at a different stage. In North America (as well as in Europe) it has been noted that the markets are at a mature phase, where every new innovation step requires extremely "hard work". The situation in Asia is somehow disparate. Comparing pulp and paper engineering, the chemical industry, energy solutions, logistics in pulp and paper

---

[1] ETLA would like to express its gratitude to Mr Hyvärinen for his excellent contribution and for the hard effort shown.

mills, paper grades or, for example, education and the research infrastructure in general, the Asian continent is a 'mystery' as far as "innovation and technology" are concerned. While the pulp and paper markets are expected to grow most in Asia in the future, the technology of logistics and transportation of forest goods, as well as information technology, environment and energy R&D, will become more important in future decades. Another, R&D target is nearer to the EU. As the EU enlarges, the Central and Eastern European countries are likewise expected to become important markets. Therefore, technology transfer and direct foreign investment is expected to grow, and this will increase the importance of R&D in the European forest cluster.

One of the most crucial issues is that the pulp and paper industry is perceived as a low technology industry. Comparing R&D expenditure with that of other industries, for example with electrical engineering or the chemical industry, the gap is considerable. This behaviour is better understood if the problem is approached through the cluster framework. This is because a form of R&D allocation between forest cluster firms is implemented in such a way that R&D expenditures accrue more to other firms than to pulp and paper companies. Throughout the whole logistics chain "from log to printed paper" improvements have largely evolved through better logistics effectiveness. This development is mainly happening in pulp and paper firms, but the technology of harvesting and transportation is based on R&D within engineering works, automotive and information technology industries. Perhaps the strongest supporting industry is, therefore, mechanical engineering, where investments in R&D are noteworthy and where considerable improvements have been made in pulp and paper machine technology.

Another high R&D intensive industry is paper chemicals, which are developed in co-operation between the chemical industry and the pulp and paper industry. As the manufacture of mechanical paper grades especially are energy intensive, the new innovations brought by energy R&D are crucial. Even though the pulp process creates energy, this is insufficient to meet all the energy needs of the pulp and paper industry. Further, taking account of user-producer links, the different paper grades will be accommodated by technology in thousands of printing houses which are located all over the Europe.

Within the forest industry the vast bulk of the capital goods are purchased when the industry launches investment programmes - such as paper machines, recovery boilers, grinders, refiners, forest machines and many other kinds of machinery and equipment. These items play a significant role in the mechanical engineering industry's output. The inputs of companies in other sectors, such as chemicals manufacturers, service providers and the contributions of research institutes and universities have helped to make the European forest cluster a more competitive entity. Furthermore, consulting firms have increasingly enhanced the cluster's competitive advantage. The effectiveness of this entity is further strengthened by such features as its advanced technology in the field of energy in general, and especially in electricity generation, automation and information technology as well as logistics.

The EU forest cluster is both research and technology intensive and has also become more environmentally sound, being based on sustainable forestry and recycling, and helping to maintain the function of forests as carbon sinks. Advanced technology is therefore used throughout the chain. Employees in EU forest cluster can reach the highest level of expertise and enjoy challenging job opportunities.

This chapter discusses several areas of R&D within elements of the EU forest cluster:

* Technology Development within the European forest cluster
* Role and importance of R&D in the Forest Cluster
* Share of Forest Cluster Technology Inputs

9.2 Technology Development within the Forest Cluster

9.2.1 Paper Grades in a Nutshell

The pulp and paper industry has a broad range of products. However, there is a large gap in terms of quality and technology-intensiveness between newsprint and woodfree papers depending on the end-use. Papers can be classified by raw materials or by end-use and include graphic papers (newsprint, printing and writing), packaging materials (packaging paper, paper for liquid containers and for construction), household and sanitary papers, and special papers. There is also a large scale of different paper products which are converted into paper products or are used in the manufacturing of other products. These are packaging products (containers, bags, wrappings), household and hygienic paper goods (cotton tissue, nursing, baby care, feminine hygiene, kitchen towels, toilet paper), stationary and office supplies (envelopes, labels, printing and copy paper, fax paper) and miscellaneous products (tubes, wallpaper, metallised paper).

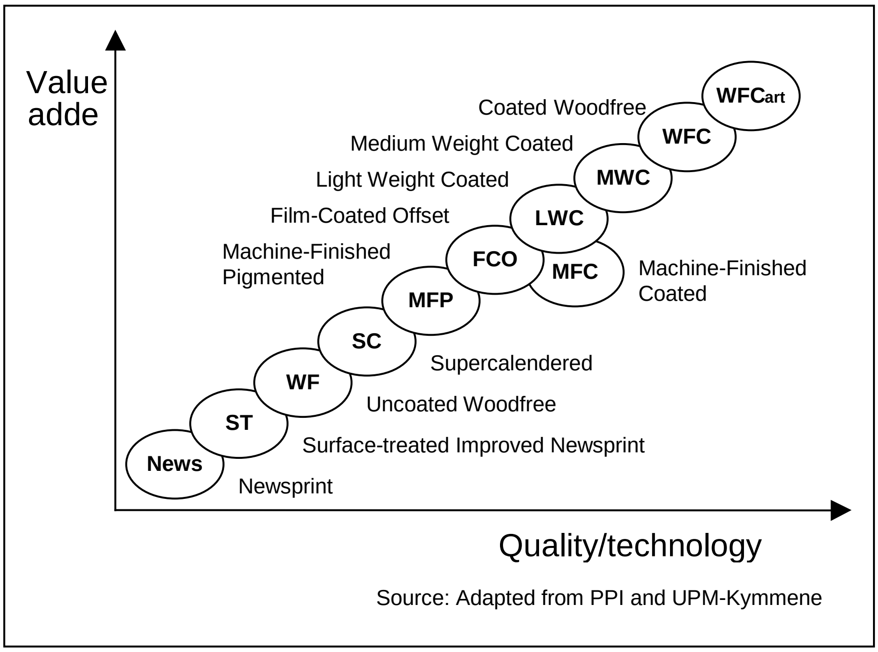
The main technology-intensive grades are coated woodfree papers, and almost at the same level are some mechanical grades such as medium weight coated (MWC) and light weight coated (LWC). There is a broad choice of papers for various press technologies between MWC/LWC and traditional newspaper. LWC is a high quality grade which is used for top magazines and needs a high percentage of valuable kraft pulp in the furnish. Super calendered (SC) paper can replace MWC and LWC in some publications where printing quality is not of overriding importance. Recent entrants to the range of value added mechanical papers include surface treated newsprint and machine finished coated (MFC) papers, machine finished pigmented (MFP) papers and film coated offset (FCO) papers.[2]

Machine finished coated (MFC) papers were developed in Finland in the 1980's in order to allow value-added grades to be made on narrow newsprint machines. All MFC installations use short dwell blade coaters. MFC has found its own markets and does not compete directly with LWC. Machine finished pigmented (MFP) is used as a substitute for LWC and is made by coating the sheet with a gate roll coater before running the web through a standard machine calender. An innovation in press technology in the mid-1980's was the introduction of the metering size press as a device to overcome the speed limitations of conventional size presses on uncoated woodfree machines. The metering size printing provides a contour-type coating with excellent fibre coverage. This press has enabled the development of new film coated offset (FCO) paper, which is more like LWC than MFC, and has become an alternative to LWC.[3]

---

2 PPI (1998).
3 PPI (1998).

Figure 9.1 Technology Intensity in Paper Grades



The pulp and paper industry is often characterised by a low level of technology creation, making less direct use of R&D com-

Table 9.1 Paper Grade Processes

New Grades	Furnish	Surfacing Appl.	Finishing
Surface Treated Newsprint	Chemical pulp, mechanical pulp, deinked old newspaper	Metering size press, gate roll size press	Machine calender, soft nip calender
Machine Finished Offset pigmented (MFP) Papers	Chemical pulp, mechanical pulp, deinked old newspaper	Metering size press, gate roll size press	Soft nip calender, supercalender
Machine Finished Coated (MFC) Papers	Chemical pulp, mechanical pulp	On-machine, short-dwell blade coater	Soft nip calender (gloss 20-25 %, 2.0-2.5 mu PPS-10)
Film Coated Offset (FCO) Papers	Chemical pulp, mechanical pulp	Metering size press	Soft nip calender (gloss 50-55 %, 1.5-1.7 mu PPS-10)

pared to other industries such as electronics or biotechnology. Taking a broader view, however, the situation is not so straightforward. In terms of new technology transfer and as an end-user, the pulp and paper industry is a relatively innovative sector, being a strong investor in new technology and adapting it from related and supporting industries, such as from machinery manufacturers.

9.2.2 Pulp and Paper Technology Characteristics

In pulping, the basic technology was conceived decades ago (groundwood mechanical, soda, sulphite, semichemical, kraft, and thermomechanical). Nevertheless, there has been a revolution in papermaking process technology. In the 1950-60's, the main technological strides in addition to integrated mechanisation of production processes were new instrumentation techniques and process indicators. During 1970s, automation and computerisation of process control systems and installation of new large-scale machines took place.

Since then, the technology has improved tremendously in both chemical and mechanical pulping processes. According to Sunds Defibrator, the needs of reducing energy and protecting the environment are the main guidelines along with customer needs and different raw materials and end products. The R&D of chemical pulping includes the wide range of various technologies such as cooking, de-knotting, screening, brown stock washing, oxygen and ozone delignification and bleaching. Recycled fibre is one significant way to balance the raw material resources. This technology includes R&D processes such as re-pulping, de-trashing, prescreening, de-inking, washing, fine screening, fractionation, dewatering, dispersing, bleaching, post-refining and pulp quality monitoring.[4] Figure 9.2 provides a summary of some pulping processes and end usage.

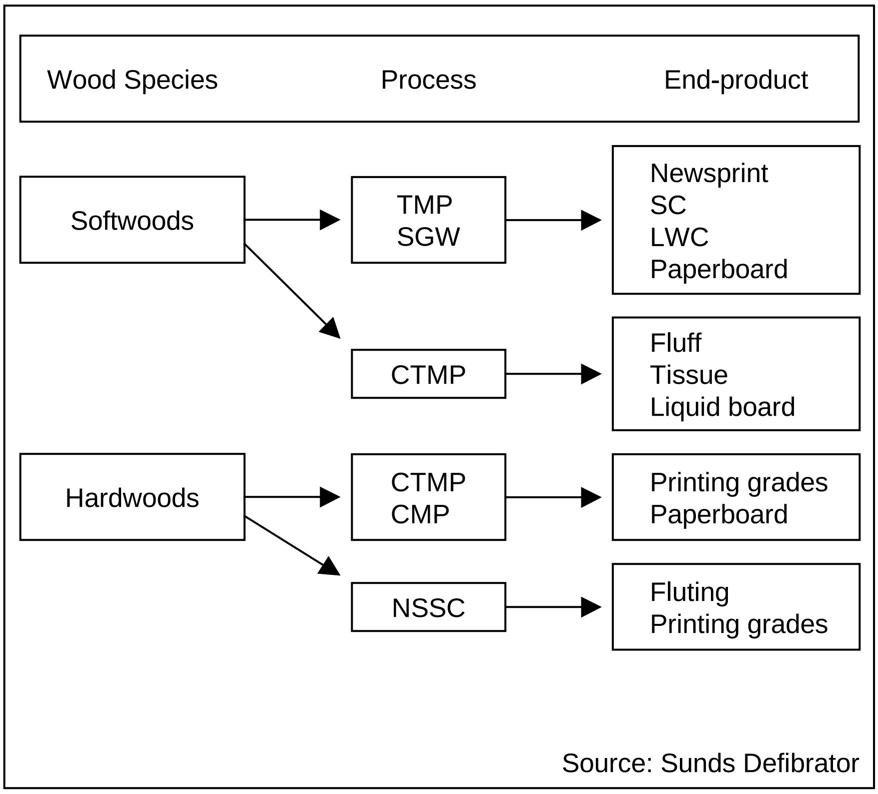
The different wood species and the end-products are the key factor when the mechanical pulping process is selected. Mechanical pulping includes technology and equipment for complete refiner-based fibre lines and from wood handling to pulp baling.[5]

---

4 Sunds Defibrator (1999).

5 See Sund Defibrator (1999) for more specific description of mechanical pulp process.

Figure 9.2 **Selection of mechanical pulping processes by raw material and end-product**



According to Levlin (1997), the main R&D efforts in pulp and paper[6] industry are concentrated on:

- higher value products
- cost-effective and environmentally acceptable production, including efficient and sustainable use of raw materials and innovative technologies
- an increase in the knowledge base, where R&D as well as education levels have a prime role.

6 See section 9.3.5. R&D in Machinery.

9.2.3 Mechanical Forest Industry Technology Characteristics

The panel board industry has used the main R&D resources of the mechanical forest industry covering the whole panel board production process from chipping and screening to sawing and storage. Some of the main panel boards produced are Medium Density Fibreboard (MDF), Particleboard (PD), Oriented Strand Board (OSB) and Wet Hardboard (WHB).[7] As the natural resources are scarce, the R&D innovations are concerned with finding new solutions to economise environmental and lower energy-intensive processes in different types of forests.

9.2.4 Other technology developments

New technology has increasingly made it possible to build larger and faster paper machines. More R&D time has also been devoted to new integrated production control systems and overall planning of production as the mill integrates, and converting and co-operative business operations. In particular, the revolution in control systems and logistics has brought about favourable changes in the forest cluster. New information technology has made it possible, for instance, to optimise the sales-to-delivery-cycle with respect to costs, flexibility, quality and process documentation[8]. Information technology such as CAD/CAM and CIM are exploited in the design and manufacturing of paper products. These systems have improved the sector's productivity rapidly[9].

While chemistry, machinery, electronic and information technology can be seen as the main related and supporting industries in the European forest cluster, other industries such as the life sciences have also become more involved. For example, biotechnology and environmental technology are used to increase the impact of sustainable development and to improve the environment of production processes. The life sciences are also involved in research on sustainable wood fibre producing crops. Biotechnology

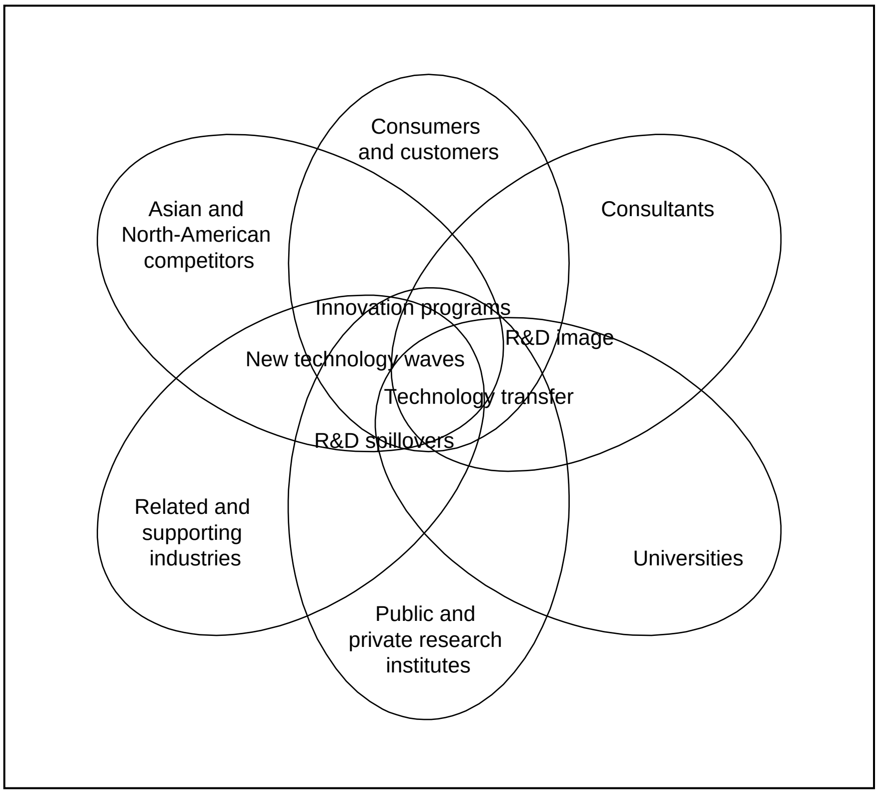
---

[7] Sunds Defibrator (1999).
[8] LeffIner (1993).
[9] Bourque (1987), See also Autio et al. (1997).

research is developing a natural fibre with a reduced lignin content for more efficient pulping[10].

Taking the broader cluster perspective, pulp and paper technology is based on a comparatively large number of sciences, which are harnessed to find new R&D solutions. For example, a recently published Yale study found that pulp and paper ranks in third place, after semiconductors and measuring and controlling devices, with respect to the number of technologies in use[11]. Thus, the pulp and paper industry is classified neither as a high nor as a low-tech industry, but considered as a broad-technology industry[12]

9.3 R&D actors within the European Forest Cluster



---

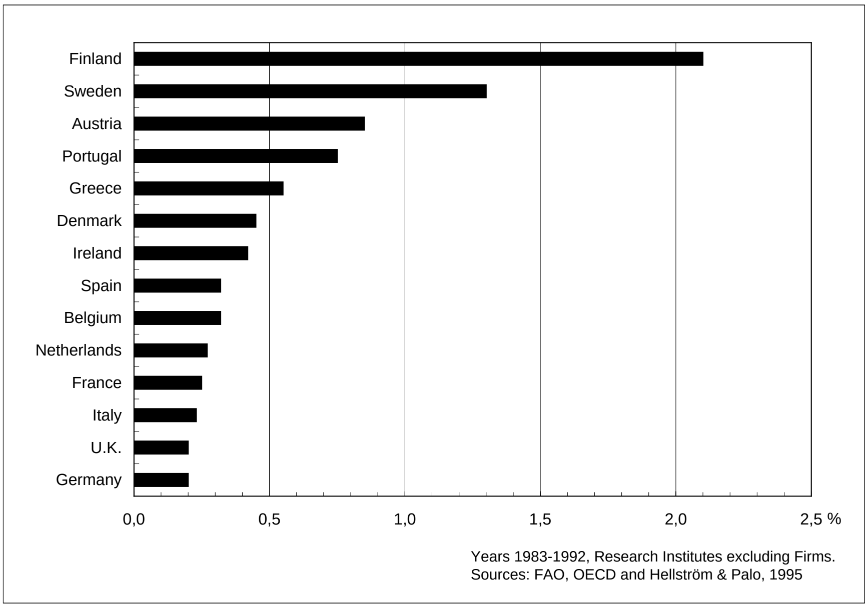
10 CEPI (1995).
11 Klevorick et al. (1995).
12 Lindström (1996).

9.3.1 R&D in Forestry

Research and Development within the area of forestry is conducted throughout Europe. In Figure 9.3, researchers in forestry are compared to the total number of researchers in each country, giving a degree of forestry specialisation. This shows that the proportion is highest in Finland and Sweden.

Table 9.2 shows the European forestry research organisations. The leading research countries measured by the number of researchers are France, Germany, Finland and Sweden. Comparing the type of research organisations in Europe, on average, 40 % of forest research is done at universities, 49 % in public research organisations, and 9 % in private research organisations.[13]

Figure 9.3 Share of Researchers in Forestry



---

[13] Hellström and Palo 1995.

Table 9.2 EU Research Organisations in Forestry

Country	Universities %	Public Research Institutes %	Private Research Institutes %	Other %	Number of Researchers
France	24	70	6	0	709
Germany	39	40	5	16	675
Sweden	58	0	42	0	655
Finland	20	53	27	0	537
U.K.	33	52	15	0	468
Italy	38	61	1	0	308
Spain	64	17	4	15	198
Netherlands	39	52	4	5	186
Austria	31	46	23	0	183
Belgium	58	21	3	18	112
Denmark	36	50	14	0	102
Portugal	*0*	73	27	0	92
Greece	*16*	84	0	0	51
Ireland	*16*	84	0	0	51
Total	*40**	51*	9*	-	4327

*Weighted average, Sources: FAO 1986 and 1993, Hellström and Palo 1995.

9.3.2 R&D in harvesting and transportation

Only some decades ago harvesting and forwarding were an area of high employment in the forest industry. It employed large numbers of forest workers, farming tractors and even horses. The main devices used were the saw, winch, axe and billhook. Today after extensive mechanisation of forest operations forest machinery have mostly replaced the manual work. With the latest state-of-the-art technology being developed forest workers no longer walk in the forests, but mechanical walking forest machines are being tested.

Nowadays harvesting and forwarding tractors contain a great deal of technology whilst highly-trained drivers are required. The principal manufacturers of these machines are Timberjack and Ponsse from Finland and Partek in Sweden. In forest operations, there are basically two different technologies in use. In the cut-to-length method, logs are pre-cut to specified lengths while the logs are sorted for different use, already in the forest. In the other 'full-tree' method, logs are delimbed and then transported in full length to the mill where they are sorted. Timberjack is the world's leading designer, manufacturer and distributor of forest machines. The company produces a wide selection of machines for harvesting - including attachments - terrain transportation, log handling and hauling.[14] The Ponsse Group designs, manufactures and markets forest machines and their principal components for cut-to-length harvesting, as well as information technology related to logging.[15] Partek's Valmet forest machines are also based on this cut-to-length method.[16]

Timberjack supplies a comprehensive line of harvesters for cut-to-length applications, as well as feller-bunchers for full-tree harvesting. The product line includes specially designed machines for all timber harvesting operations, whatever the terrain or harvesting conditions.[17] Ponsse also has information technology products for timber transportation. This product group applies computers for timber trucks and other vehicles and weight indicator systems for loader cranes of trucks.[18]

New harvester technology involves extensive R&D, and these machines can perform many operations. The harvester machine fells, delimbs, cross-cuts, measures and piles the logs at the felling site. A high-tech control system optimises cross-cutting and classifies the timber according to customer needs. The forwarder picks up the cut-to-length harvested logs and transports them from the forest to the roadside. The machines are equipped with efficient loaders for loading and unloading logs.

Timberjack has designed a Total Machine Control system for forwarders which controls all machine functions, including the hydrostatic drive and the loader. They feature fully enclosed forestry undercarriages, powerful boom sets, advanced hydraulic and cooling systems. The product line includes both conventional swing models and no-tail swing tilt-table machines for steep slope

---

[14] Timberjack (1998).
[15] Ponsse (1998).
[16] Partek (1998).
[17] Timberjack (1998).
[18] Ponsse (1998).

applications. In full-tree harvesting, skidders are used to transport the felled trees to a landing or roadside for delimbing.[19]

New information technology used in harvesters includes Ponsse Opti's advanced harvester data system that measures trees to the nearest millimetre, predicts the taper of each trunk, calculates a mathematical model of it and divides trees into the optimum number of logs before cutting it. This system is based on a normal PC using the Windows operating system, and enables data transmission and map applications during logging. A GPS system, and maps of the stand marked for cutting, make it possible for the operator to see on a large colour screen the location of his machine, the borders of the stand marked for cutting, as well as any nature preservation areas. Satellite fixing and map programmes provide information on the location of the vehicle and the target spot in real time.[20]

Partek's Forest Machines include harvesters such as felling machines, forwarders and harvesting heads. The production also includes cranes for forest machines and timber trucks. Partek's production is based on the cut-to-length method, in which it is possible to do both thinning and final felling while at the same time operating with consideration for the environment. The cut-to-length method has become increasingly widespread throughout the world during the 1990s mainly because of the combined effect of the machines' efficiency and their positive attributes in relation to the environment compared with other methods. [21]

These companies work in close co-operation with customers such as pulp and paper companies, and also with drivers who have the most important knowledge, that is how the technology works.

9.3.3 R&D in the Printing Industry

The European printing industry covers thousands of printing and publishing houses. The R&D projects are frequently carried out in co-operation with the research centres and paper manufacturers. The main issues and requirements of printing and writing papers include good appearance, formation and availability in varying

[19] Timberjack (1998).
[20] Ponsse (1998).
[21] Partek (1998).

shades of whiteness and colours; thickness, bulk, stiffness and handling strength and sheetfed printing properties; freedom from curl, stability in conditions of humidity and temperature variations; texture and suitability for use with a wide range of inks and printing technologies.[22]

9.3.4 R&D in the Packaging Industry

The experience of many decades has shown that the leading packaging materials are paper and paperboard. The importance of paper and board in packaging is illustrated by the fact that these materials make up to 40 per cent (by volume) of total packaging materials consumed in Europe. The packaging industry is therefore a significant client for the European paper and board industry, since it purchases on average 35-40 per cent of total European paper and board production. The ten biggest European packaging supply companies represented about 5 per cent of the world's total packaging expenditure in 1995.[23] Packaging industry R&D focuses on improving packaging technology in environmental and other ecological and hygienic issues throughout the entire production chain.[24]

9.3.5 R&D in Machinery

The challenges and pressures faced by the European forest cluster with respect to new innovations, spillovers and technology transfer will come from various sources. The main factors involved are competition and customer needs, but new innovations from other sectors which create substitutes for paper will also present challenges. Active links with related and supporting industries, consultants and research institutes and universities will help face competition.

There are immediate industrial links with papermaking machinery for example Ahlström Machinery and Valmet[25] and Rauma from

---

[22] Pira 1998, The Future of Pulp and Paper to 2007.

[23] Goddard (1997).

[24] See Packaging and the environment (1992), Pira; Global Packaging Trends (1993), Pira.

[25] Rauma and Valmet announced a merger plan on 17th November 1998. The new company resulting from the merger, called Metso corporation, come into effect from July 1. 1999.

Finland, Beloit from the U.S. and the Swiss-German Voith Sulzer group. These companies are especially technology and research-intensive, with typical R&D investments ranging 2-4 per cent of production.[26] As an investment needs a heavy input of capital and takes 2-3 years to complete, design, manufacture and service are carried out in close co-operation with the customer.

New technology also helps to resolve runnability questions, and paper machines and coaters are constantly being developed to run at ever higher speeds, while producing paper of even higher quality. In this, Valmet is assisted by high-speed runnability simulators and pilot facilities.[27] Important research themes have included the development of more efficient and environmentally rational production methods and machine configurations, press technology, paper finishing, pulp drying, board machine R&D, higher product quality and greater productivity in pulp, and paper and board machinery.[28]

Furthermore, Ahlström Machinery offers systems and processes that are used in chemical fibrelines, chemical processing and recovery, wastewater and sludge treatment as well as in the processing of recycled fibre systems and the preparation of paper machine stock.[29]

9.3.6 R&D in Chemicals

Another significant member of the cluster is the chemical industry, which spends about 3-4 per cent of production on R&D[30]. Chemicals are used environment-efficiently in pulp and paper making itself, in coating and recycling and in converting. Some of the principal chemical producers include Raisio Chemicals and Metsä Speciality Chemicals in Finland, EKA Chemicals in Sweden, BASF in Germany, to name a few. The most significant group of paper chemicals is fillers and coating pigments, such as clay, calcium carbonate and talc. These improve brightness, opacity and printability.[31]

---

26 OECD (1995).
27 Valmet (1998).
28 Valmet (1998), Voith Sulzer (1998).
29 Ahlström (1997).
30 OECD (1995).
31 Nurmi et al. (1998).

Many of these companies have their own research centres and co-operate with customers to create new innovations for the pulp and paper industry. For example, Raisio Chemicals has the Paper Technology Centre (PTC) for wet-end and recycling chemicals, offering various services and consulting for their customers. Raisio Chemicals' Coating Technology Centre (CTC) is also a modern, efficient paper coating test centre, where it is possible to test new coating colour and chemicals rapidly and reliably.[32]

Valmet Paper Machinery has a commitment to equip the CTC with the latest coating machine technology.[33] At the same time the need to reduce both the amounts of circulation water and effluent streams is revolutionising the approach to circulation water treatment and the design of chemicals.[34] The development of the pulping and bleaching processes shows how important suppliers are in regard to advances in core pulp and paper technology.[35]

9.4 Science & Education and Consulting

9.4.1 Universities and R&D Organisations

The critical factors in the European forest cluster now and in the future will be human resources, education and R&D. Employees in R&D are, in many parts of Europe, highly-educated and the competitive advantages within the cluster come from skills and know-how from personnel. Table 9.3, compiled by Lappeenranta University of Technology (LTKK), shows that education and research in the forest cluster is broadly distributed throughout EU universities. The cluster as a whole includes various specialised sources of advanced knowledge in universities, private and public research institutes and corporate R&D departments.

Degrees relating to the forest cluster can be studied in at least 97 universities and 151 departments around Europe. Technology engineering degrees cover for example forest products, wood

[32] Raisio Chemicals (1998).
[33] Raisio Chemicals (1998).
[34] Nurmi et al. (1998).
[35] Autio et al. (1997).

Table 9.3 Research Organisations and University Departments in the European Forest Cluster

	Number of Universities	Number of Departments	Number of Research Organisations
Austria	5	15	10
Belgium	5	5	3
Finland	10	26	11
Greece	1	2	1
Denmark	1	1	4
France	5	4	13
Germany	8	10	21
Ireland	6	16	5
Italy	8	12	18
Luxembourg	-	-	1
Netherlands	4	5	12
Portugal	4	4	7
Spain	7	9	8
Sweden	19	28	8
U. K.	14	14	14
TOTAL	97	151	136

Source: LTKK (1998).

technology, automation and process, information technology, biochemistry, industrial management, and the environment as well as chemical and mechanical engineering. University degrees can be taken in biology and other natural sciences, bioenergy, forestry, forest genetics and plan physiology, forest ecology, silviculture and environmental issues etc. There is also a different type of specialised degree, which connects pulp and paper studies with marketing and leadership. Other degrees such as those in economics, social sciences and education also fulfil the needs of companies.

Research institutions play a major role in pulp and paper R&D. Often these research organisations and projects are funded by companies or other funds. Some of these institutes are funded by the government, and conduct a wide range of basic research. The tasks vary widely, but their main role is in projects such as reducing water and air pollution, improving energy efficiency or promoting better use of wood supplies and waste paper.

Table 9.4 Ten largest R&D organisations in the Pulp and Paper Industry

Man years, %	total	scientists	technicians	research students
1. KCL, Finland	223	44	52	4
2. STFI, Sweden	182	50	38	12
3. CTP, France	115	32	62	6
4. PTS, Germany	91	60	34	6
5. VTT, Finland	75	61	31	8
6. PPRI, Poland	70	56	43	1
7. EFPG, France	69	20	28	52
8. TU LUDZ, Poland	65	55	37	8
9. TU Dresden, Germany	49	41	33	26
10. KTH, Sweden	46	28	7	65

Source: Eriksson (1997).

Almost all-European countries have research institutes concentrating on pulp and paper research. Table 9.4 shows the ten largest R&D organisations in Europe. The largest organisations measured in man-years are KCL in Finland, STFI in Sweden and CTP in France.[36] Pira in the UK is also significant, even though it is outside the "top ten" table. KCL, STFI and CTP are funded by companies, VTT and PPRI are government-funded and EFPG, TU LUDZ, TU Dresden and KHT are based on university research.

Comparing man-years used in different R&D areas within these organisations, pulp and paper products take up a significant proportion of the resources. More than 520 man-years were spent on pulp production and almost 300 man-years on paper products in 1995-1996.

After the main themes of research, fibrous raw material (over 260 man-years), paper product properties (almost 250 man-years) and paper finishing have also been among the main focuses of R&D. The main research areas have included effluent and other environmental issues, energy conservation, control technology and the production and development of chemicals from wood. The major research themes are listed in table 9.5.[37]

Table 9.5 Major Research Themes

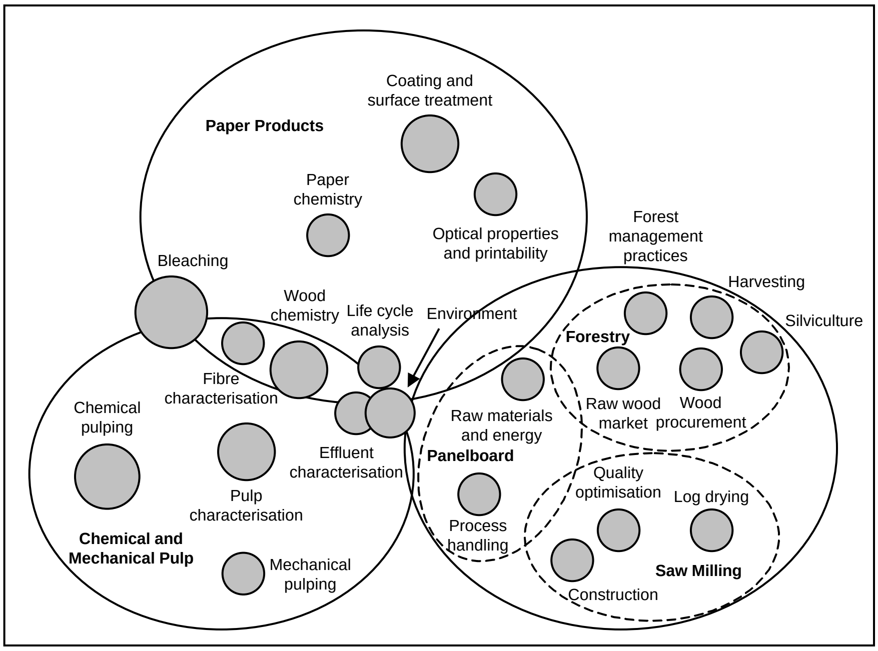
---

[36] Eriksson (1997).
[37] Eriksson (1997).

Rank	Theme	Man-years
1.	Bleaching	126
2.	Chemical pulping	103
3.	Coating and surface treatment	88
4.	Wood chemistry	87
5.	Optical properties and printability	87
6.	Pulp characterisation	68
7.	Mechanical pulping	61
8.	Fibre characterisation	60
9.	Paper chemistry	59
10.	Effluent characterisation	53

Source: Eriksson (1997).

Figure 9.4 Main Research Fields in the EU Forest Industry



9.4.2 Consulting

Consulting services have recently begun to play an increasingly crucial role in the pulp and paper industry. An investment project needs a considerable amount of capital and takes 2-3 years, depending on the scale of plan. Consultants have various tasks to offer from business analysis and engineering services to R&D solutions for innovation and production process bottlenecks. Typical consulting activities are optimisation of logistics, production scheduling or cutting of paper, the engineering of custom-made conversion machinery, or the design of packaging.[38] In forestry consulting, the main areas are services concerning sustainable development of natural resources.

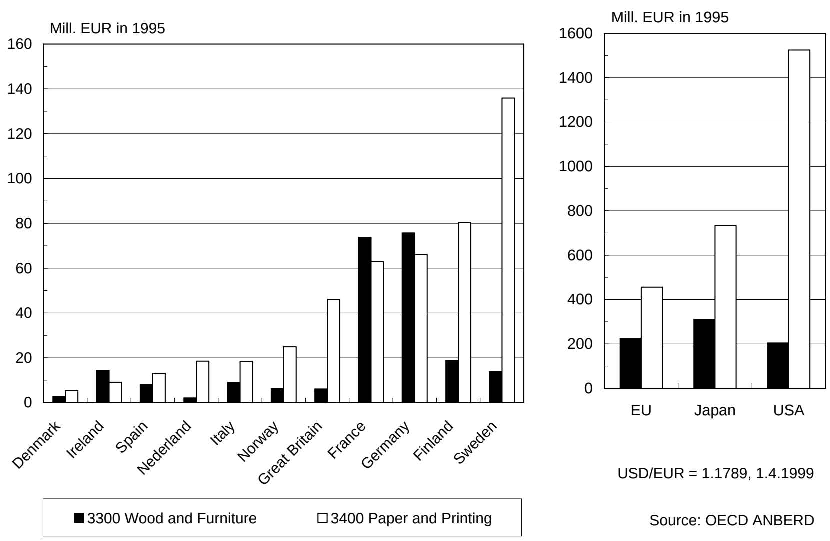
The knowledge of consulting enterprises co-operating with universities and research institutes, engineering and information technology companies, and with pulp and paper enterprises provides a competitive advantage to the European forest cluster.

9.5 R&D Industry Expenditures in the EU Forest Cluster

9.5.1 R&D Expenditures by Cluster Industry

The level of R&D expenditure is a significant indicator of innovation activity. The forest cluster includes wood, pulp and paper,

Figure 9.5 R&D Business Enterprise Expenditures



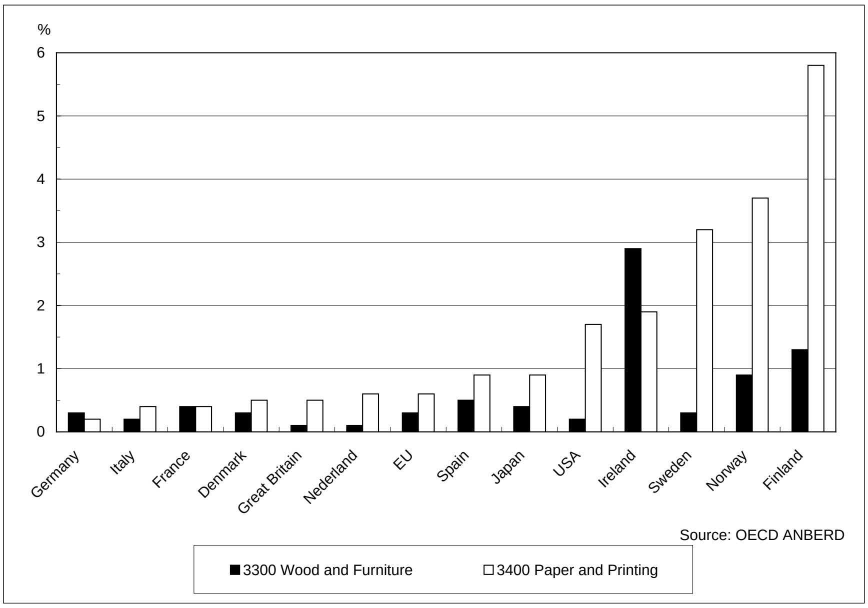
Core Cluster total (ISIC 3300 + 3400): EU (11 countries) 460 mill. EUR, Japan 730 mill. EUR, USA 1500 mill. EUR.

[38] Autio et al. (1997).

printing and publishing, and wood furniture industries. Because pulp and paper is a highly capital-intensive sector, the comparison with other industries gives rather moderate results for the cluster, where R&D expenditure in relation to production is between 0.5-0.7 per cent and in relation to value added about 0.8-1 per cent.[39] Moreover, the pulp and paper industry in Finland has, for example, funded research activities performed outside the firms themselves to an amount that has been about one-fourth of the industry's "in-house" research expenditures.[40]

Figure 9.5 compares enterprise expenditure by country in wood and furniture sector and in the paper and printing industry. German, French, Finnish and Swedish companies have been the most active in investing in R&D in the European Union. Depending on the definitions of the OECD Anberd database, a comparison of the EU, Japan

Figure 9.6 R&D Business Enterprise Expenditures as a percentage of total manufacturing R&D expenditures (1995)



39 Furniture and printing are included.
40 Vuori and Vuorinen (1993).

Figure 9.7 R&D Business Enterprise Expenditures as a percentage of Value-Added

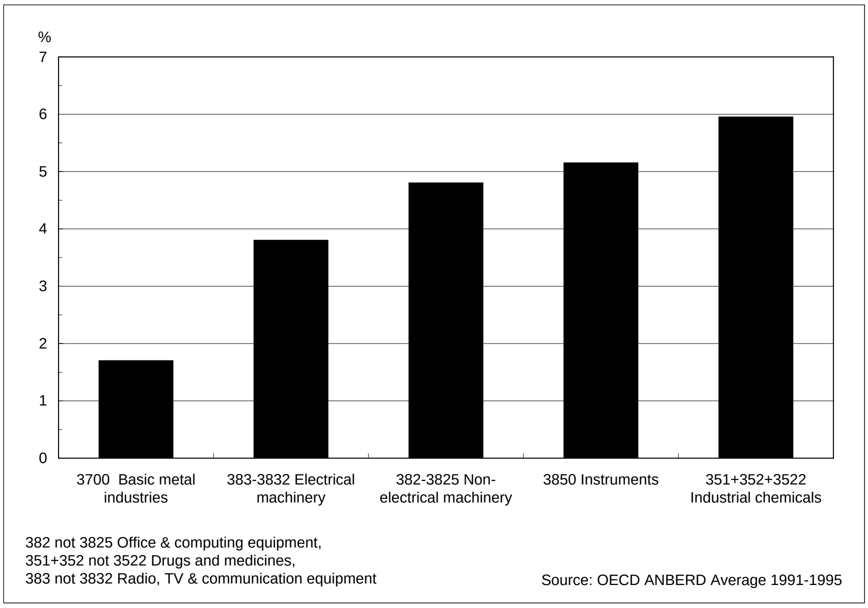
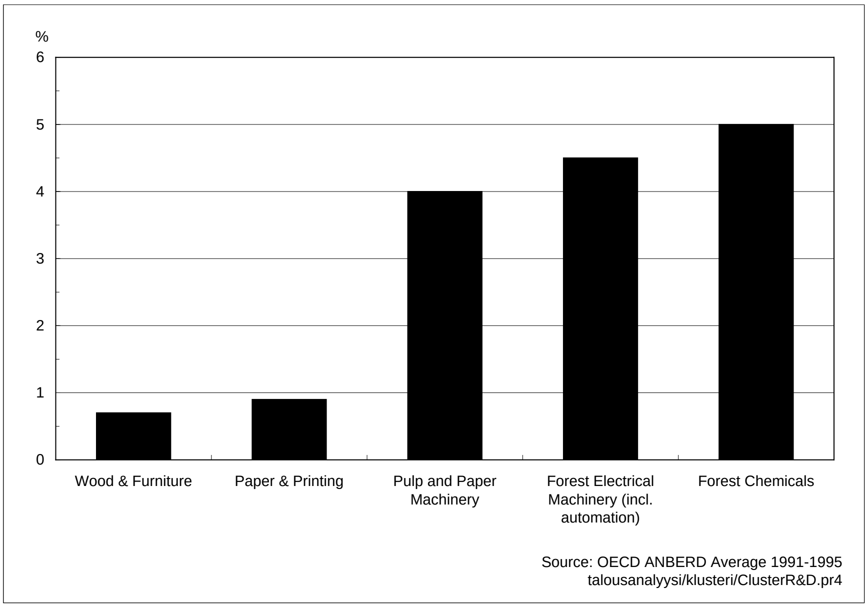


Figure 9.8 R&D Business Enterprise Expenditures as a percentage of Turnover



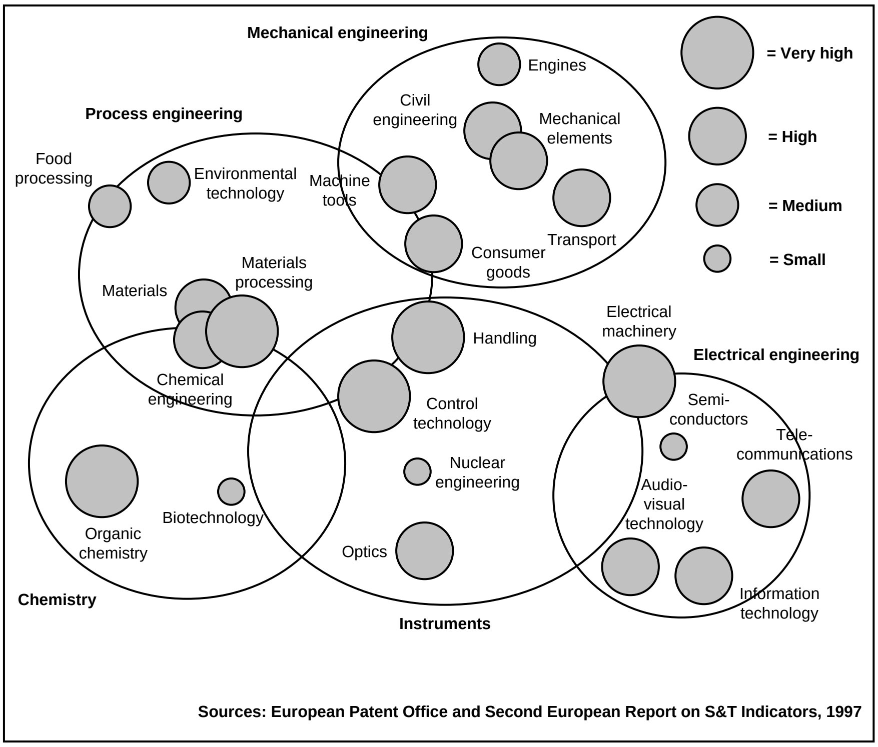
and the USA provides very interesting results. According the database, the US firms spent an enormous 1500 million Euro on paper and printing R&D whilst European firms spent a mere 500 million Euro. In figure 9.6, forest cluster R&D expenditures are related to each country's total manufacturing R&D expenditure. The percentages are highest in the Nordic countries (Finland, Sweden, Norway). This result is anticipated as pulp and paper is a vital industry in these countries.

The non-electronic machinery, motor vehicles, scientific instruments, industrial chemicals and electrical machinery industries have some linkages to the forest cluster. In these industries, R&D related to production is between 3-9 per cent (OECD, 1995). In addition, chemical and machinery industries invest almost 30 per cent of the total business R&D expenditures in the EU. When R&D is related to the industry's value added (figure 9.7), the largest groups are instruments and industrial chemicals. Figure 9.8 gives an estimate of R&D shares in the forest cluster. In some special industries or corporations, such as in automation or pulp and paper machinery, these figures are even higher. Anberd data and company annual reports were used as background information.

9.5.2 Patent Information

Innovation activity is often measured with patents or spill-overs. The clustering between industries can be through several institutions such as universities, research institutes and consultant services. According to a study carried out on the basis of European Patent Office data in 1992-1994, the number of patents is very high in materials processing, organic chemistry, handling and control technology, and in electrical machinery. Some synergies can be found, for example, between materials, chemical engineering and materials processing. Machine tools and consumer goods take advantage of mechanical engineering and process engineering. Instruments and process engineering have synergies with handling and control technology, and electrical machinery is close to both electrical engineering and instruments. The pulp and paper industry has connections with transport, mechanical elements, environmental technology, consumer goods, materials processing and chemical engineering, control technology, electrical engineering and information technology, among others.

Figure 9.10 Technology Patenting and Spillovers



9.6 Visibility of the Forest Cluster in EU R&D Policy

One of the main co-operation instances between the European Commission and the European forest industry is the Confederation of European Paper Industries (CEPI). According to CEPI's Activity Report 1998, the main research field is "The Fifth Framework Programme for Research (1998-2002)". Much of the CEPI Research Group's focus has been on preparing this Fifth Programme and the Specific Programmes through which it will be implemented. CEPI's activities with its forest cluster partners, including private forest owners (CEPF) and the woodworking industries (CEI-Bois) as well printing and allied industries (INTERGRAF), have focused on ensuring that the interests of the wood and paper chains are sufficiently represented in the Fifth Framework Programme.[41]

---

41 CEPI Activity Report (1998).

9.6.1 Industrial and Technology Policy in the EU - Some Evidence

The EU industrial policy is aimed at harmonising the actions of its member states. The joint aim is to promote structural reform of European industry and to improve its international competitiveness.

In the course of 1999, the Commission will submit a formal report (Communication on the Competitiveness of the EU Forest-Based and Related Industries) on the state of the European forest product sector's competitiveness to a council comprising representatives of member states and to the European Parliament. The Commission's intention is to analyse key factors in the sector's competitiveness and issue recommendations for measures to be taken by both the Union and member states. When the Council and the Parliament have made their formal replies to the report, the Commission and the member states will start implementation of the recommended measures.

At the industrial branch level, the role of industrial policy is to guarantee an environment, where dynamic enterprises can survive and prosper, and economic institutions are dedicated to thinking strategically about the economy.[42], Industrial policy must also aim to enhance market flexibility, reduce barriers to mobility, and stimulate adaptability within large corporate bureaucracies.[43] Therefore, a key issue in industrial policy is how the government can influence the activities of businesses in the most flexible way. The possible task of industrial policy is to ensure that the elements determining competitiveness create a favourable environment for the development of competitive industries, industrial networks and competitive clusters.

Another relatively important point of view is that the task of industrial policy is to set up the need in research institutions which the market is not able to support on their own. Since market mechanisms would not allocate sufficient resources for R&D in the long run, it makes sense to allow the public sector a certain role in this area. However, while firms have their own research departments, the main goal is to make co-operation between public-financed and business-financed institutions as flexible as possible.

---

42 Cowling (1990).
43 Geroski and Jacquemin (1985).

Comparing general technology policies it can be noted that the specialisation of innovation systems differs across countries. There are considerable differences in their ability to respond to change and to exploit the potential of new technologies.[44] In the United Kingdom, the major target is to exploit scientific innovations in science-based industries immediately. In Denmark and Finland, the task is in some respect different, since the main task is to increase the knowledge content of resource-based clusters of industries. In France there is a trend towards redefining the traditional missions of innovation and technology policy, directing them away from defence. The technology policy in Sweden, the Netherlands and Germany is based on the major companies i.e. on the effort to cope with the consequences of the internationalisation of R&D strategies in these companies.

National innovation systems are increasingly multinational, and the networks between nations are growing through globalisation. During the ongoing "new global" consolidation process, mergers and acquisitions are expanding company sizes and pushing production and ownership from a national to a multinational level. Productivity growth has increased in countries such as in Denmark and the Netherlands which exploit the technology embodied in imported capital and intermediary goods. This process has rapidly increased the number of international technology alliances and foreign patents and licences. Ireland is an example of a "catch-up economy", where the effect of the absorption of international technology, whether low-or high tech, has had a favourable impact on productivity and economic growth. In locating the technology centre, the position of company's headquarters is important at least in France, Germany and Italy, where it is typical that innovation activity is placed near the company's headquarters. The internationalisation of R&D for firms is emphasised in countries such as in Belgium, Finland, the Netherlands and Sweden.

9.6.2 Research and development in the European Union

The European Union's research and development activities are based on five-year framework programmes, each of which contains 10-20 separate programmes. Sector-specific research pro-

---

44 OECD (1998).

grammes have been phased out over the years and have given way to more general interdisciplinary ones.

The Fourth Framework Programme, which is now nearing completion and has a budget of 13.1 billion EUR, has enabled the forest products sector to participate in at least six different programmes. The most important from the forest industry perspective have been the agriculture and fisheries programme, FAIR, and the industrial and materials technologies programme, Brite-Euram. Also of importance have been the environmental and energy programmes and the standardisation and information technology research programmes.

In the work of the Fifth Framework Programme, to begin in 1999 and to continue until 2003, The Commission has allocated a budget of EUR 13.7 billion for the Programme. The Programme is more "problem-based" and less "technology-based" than previous Framework Programmes.[45]

The Fifth Framework Programme covers four themes: Theme 1 is called "Quality of Life and Management of Living Resources". The area of sustainable agriculture, fishing and forestry includes as a priority area of sustainable and multipurpose utilisation of forest resources and integrated forestry in the wood chain. In general, the research of the entire forest cluster research is comprised in Theme 1. Theme 2 – "User Friendly Information Society" accepts research projects, which are concentrated on the electronic media and paper. Theme 3 – "Competitive and Sustainable Growth" the innovative products and processes contain items such as clean eco-efficient processes and promotion of the use of renewable resources. Theme 4 is called "Energy, Environment and Sustainable Development", and therefore includes research cases such as renewable energy resources, biodiversity and climate change, as well as water management.[46] In general, in the Fifth Framework Programme, socio-economic and environmental issues are emphasised and integrated into all the themes.

9.7 Conclusions

As a result of broad European forest cluster R&D, the European forest industry has kept its competitive advantage in global com-

---

[45] Molkentin-Matilainen (1998).
[46] Molkentin-Matilainen (1998).

petition and created a broad range of new products. In new technology transfer and as an end-user, the pulp and paper industry is a relatively innovative sector, being a strong user of new technology, making competitive advantage with the related and supporting industries.

The European forest cluster has exploited synergies of scale with effective logistics (harvesting, transportation) in production and advantages in raw materials (forestry etc.) and other effective related and supporting industries such as paper machinery and chemical industry. While chemistry, machinery, electronics and information technology can be seen as the main related and supporting industries in the European forest cluster technology, industries such as the life sciences have become more important. The life sciences are also used for research on sustainable wood fibre producing crops, for example, biotechnology research is developing natural fibre with reduced lignin content for more efficient pulping.

Taking the broader cluster perspective, pulp and paper technology is based on a comparatively large number of sciences, which are harnessed to find new R&D solutions. Thus, the pulp and paper industry can with good reason be classified as a broad-technology industry.

While Asia is expected to be the focus of the highest growth rate in the pulp and paper markets in the future, the technology of logistics and transportation of forest goods as well as information technology, environmental and energy R&D will also gain increasing importance in future decades. As the EU enlarges, the Central and Eastern European countries are expected to become important markets. This means that technology transfer and direct foreign investment will likewise grow, and this will increase the importance of R&D in the European forest cluster.

Finding efficient solutions in energy R&D is a matter of great importance for the cluster. As mechanical paper grades in particular are energy-intensive, the new innovations in energy R&D are crucial. Even though the pulp process creates energy, this is insufficient to fulfil all the energy needs of the pulp and paper industry.

The forest cluster as a whole includes various specialised sources of advanced knowledge in universities, private and public research institutes and corporate R&D departments. Degrees relating to the forest cluster can be studied in at least 97 universities and 151 departments around Europe. The knowledge of these universities, public research institutes, research units in engineering and information technology companies and pulp and paper enterprises constitute a competitive advantage for the European forest cluster. In the European forest cluster, R&D personnel are highly educated and the competitive advantages in the cluster derive from the skills and know-how of personnel and students.

The chemical and machinery industries account for almost 30 per cent of the total European Union business R&D expenditure. When R&D costs is seen in relation to the industry's value added, the largest groups are instruments and industrial chemicals. Pulp and paper machinery industry accounted for approximately 9-10 per cent of R&D expenditure related to value added in Finland. The chemical industry spends about 3-4 per cent of production on R&D.

The share accounted for by R&D of the turnover in the forest cluster industries is also estimated. R&D expenditures of wood and furniture were 0.7, and in pulp and paper around 1 per cent of the turnover. This result is satisfactory, although in the related and supporting industries the result is more encouraging. The pulp and paper machinery consumed approximately 4 per cent, forest electrical machinery 4-5 per cent and forest chemicals 5 per cent of turnover. Chemicals are used environmental-efficiently in pulp and paper making itself, in coating and recycling and in converting. Many of these chemical companies have their own research centres and they co-operate with customers to create new innovations for pulp and paper companies.

Innovation activity is often measured by patents or spillovers. New innovations are crucial in environmental issues, finding products for paper and following global economic changes, while greatest challenges for R&D in the European forest cluster are increasing global competition, the mature European markets, expanding synergies with other industries (metal industry, chemical industry, information technology), environmental questions, and cost-reduction in energy and transportation.

List of References:

Ahlström Corp. (1995-1997), Annual Reports.

Autio, E. - E. Dietrichs, - K. Fuhrer, - K. Smith (1997): Innovation Activities in Pulp, Paper and Paper Products in Europe.

Bourque, J. (1987): CIM and Flexible Package Conversion Equipment, in Proceedings of 1987 Tappi Conference on Polymers, Laminations and Coatings, Atlanta: Tappi Press.

CEPI (1995): The European Paper Industry: Competitive and Sustainable, Brussels: CEPI.

CEPI (1998): Activity Report.

Cowling (1990): A New Industrial Strategy, International Journal of Industrial Organization, North-Holland.

Enso Corp. (1995-1997), Annual Reports.

Eriksson, L. (1997): European R&D Resources in Pulp and Paper, Proceedings of the European Conference on Pulp and Paper Research, October 9-11, 1996 Sweden.

European Commission (1997): Second Report on S&T Indicators - Report, Brussels.

Hellström, E. & J. Palo (1995): European Forestry Research – Public and Private Involvement, Journal of Forest Economics 1:3 1995.

FFIF (1994): Research and Development Strategy for Finnish Forest Industry in Fourth Framework, Finnish Forest Industries Federation.

FFIF (1995): Research and Technology Definition of Policy, Finnish Forest Industries Federation.

FIBRE (1997): Annual Report, Turun yliopisto, Turku.

Geroski, P. and A. Jacquemin (1985): Industrial Change, Barriers to mobility, and European Industrial Policy, Economic Policy, 1.

Goddard, R. (1997): Packaging 2005 – a strategic forecast for the European packaging industry, Pira International, UK.

Jaakko Pöyry Corp. (1997, 1998), Annual Reports and www-pages.

Klevorick, A. - R. Levin, - R. Nelson, - S. Winter (1995): On the Sources of Significance of Inter Industry Differences in Technological Opportunities, Research Policy vol. 24.

Lefflner, N. (1993): Process Control: Today and Tomorrow in Proceedings of XXV Eucopa Conference, Vienna.

Levlin, J-E. (1997) The Pulp and Paper Industry Intesifies R&D, in High Technology in Finland 1997.

Lindström, T. (1996): Strategy and Tactics for the Pulp and Paper Industry's R&D, Proceedings of 6th International Conference on New Available Technologies and Current Trends, Stockholm.

Metsähallitus (1998): Environmental Guidelines to Practical Forest management, Helsinki.

Metsäliitto Corp. (1995-1997): Annual Reports.

Molkentin-Matilainen, P. (1998): European Union Fifth Framework Programme, mimeo.

Nurmi, K. - A. Heikkilä - P. Knuuttila (1998): New Records in Paper and Board Markets drive up Sales of Paper Chemicals, Kemia-Kemi Vol. 25.

OECD (1995): Industry and Technology - Scoreboard of Indicators, Organisation for Economic Co-operation and Development, Paris.

OECD (1998): Technology, Productivity and Job Creation - Best Policy Practises, Organisation for Economic Co-operation and Development, Paris.

Ojainmaa, K. (1994): International Competitive Advantage of the Finnish Chemical Forest Industry, Helsinki, ETLA C 66.

Partekforest Corp. (1998): www-pages and Annual Reports.

Pira (1992): Packaging and the Environment, United Kingdom.

Pira (1993): Global Packaging Trends, United Kingdom.

Ponsse Corp. (1998): Annual Reports and www-pages.

PPI (1998): Klass, C. New Grades Fill the Gap with Printing Technology, August.

Raisio Chemicals Corp. (1997, 1998) Annual Reports and www-pages.

Rouvinen, P. (1993): Data-guide to OECD Exports. ETLA Discussion Papers 426.

Sund Defibrator Corp. (1999): Mechanical Pulping Technology.

Sunds Defibrator Corp. (1999): An Investors Guide for Panelboard System.

Timberjack Corp. (1997, 1998): Annual Reports and www-pages.

UPM-Kymmene Corp. (1996-1997): Annual Reports.

Valmet Corp. (1997, 1998): Annual Reports and www-pages.

Voith Sulzer Corp. (1998), Annual Reports and www-pages.

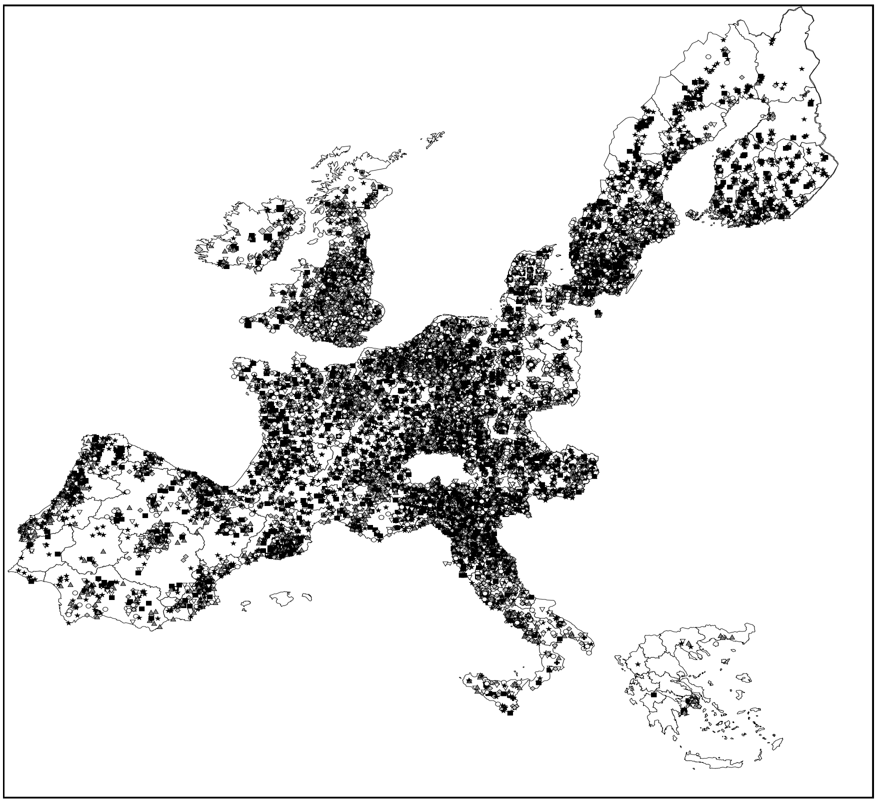
Vuori, S. and P. Vuorinen (eds.) (1993): Explaining Technical Change in a Small Country - the Finnish National Innovation System, Helsinki, ETLA B 84.

Chapter 10. Regional Significance

10.1 Regional importance of the Forest-based and related industries in the EU

To investigate the regional significance of the forest-based and related industries, we have tried to utilise existing databases such as Eurostat. Unfortunately, there are no data on industrial statistics, which provide disaggregated data at the regional level for every country in the EU. Generally speaking, the data are at the national level. Therefore, ETLA have devised its own estimating technique, which utilises a company database of over 30,000 companies within the forest-based and related industries of Europe, and combines these company details with the graphical 'MapInfo' system and other Eurostat data on *total* employment in manufacturing.

Figure 10.1 Location of forest-based and related industries across the EU



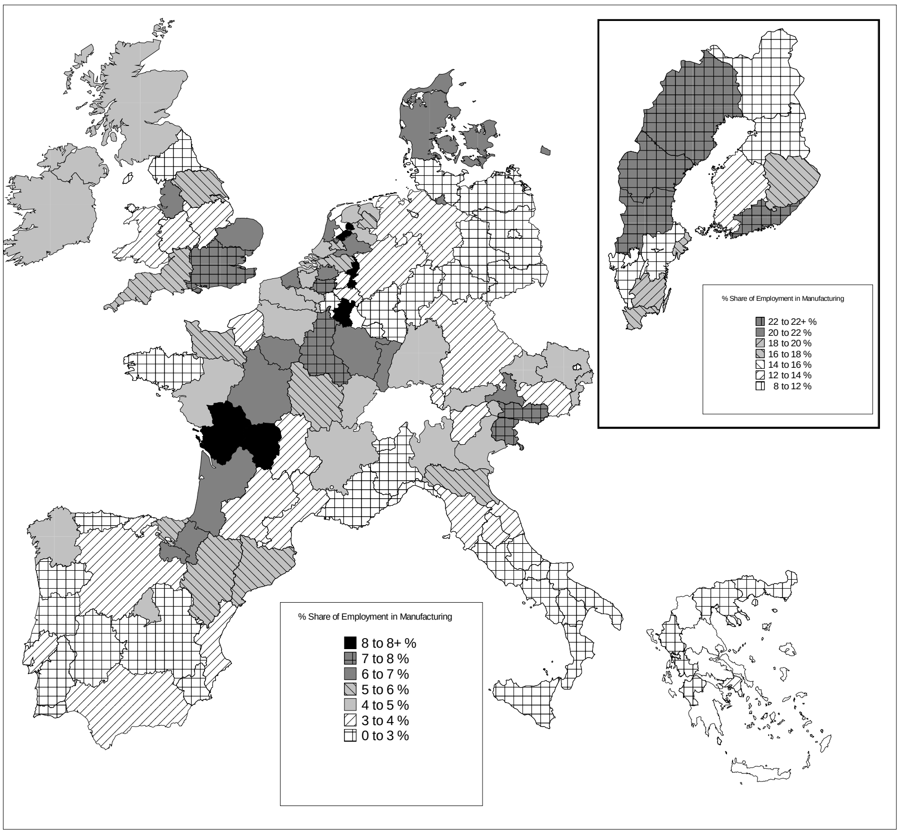
Using this method, we have been able to plot the locations of each company within the appropriate area and then to estimate levels of employment in each of the regions within the European Union. In practice, we were able to fix the position of about 21,000 companies across the EU. Nevertheless, the pattern of company locations and employment should be very representative of the forest-based and related industries of the EU. This is the first time that such a large-scale estimate has been carried out.

In general, our company data comprises five main categories of industries, which include wood processing, wood furniture, pulp and paper, printing and publishing and related machine building industries. What is quite clear is that the vast majority of the forest-based and related industry companies are located in central Europe, especially around the large centres of population. What is also evident, is that companies are widely dispersed across Europe, and they are not located only in Scandinavia. Moreover, we have also tested to see if there are any differences between the main categories of industry. In fact, for each of the main categories, the pattern is the same, companies are widely distributed across the EU, and are mainly located near the large centres of population. More detailed maps are provided for each country in the appendices.

In the thematic map shown in figure 10.2, one should focus on the pattern of employment across the European regions, which are generally shown at the level of Nuts I and II.[1] The shaded areas represent the proportions of total employment in manufacturing that the forest-based and related industries occupy within that region. The darker the shading, the higher the proportion of employment in manufacturing.

[1] Eurostat has drawn up a Nomenclature of Statistical Territorial Units (NUTS). The current NUTS nomenclature subdivides the territory of the European Community into 77 NUTS 1 regions, 206 NUTS 2 regions and 1031 NUTS 3 regions. The following countries belong to several levels: the Grand Duchy of Luxembourg (NUTS 1, 2 and 3), Ireland & Denmark (1 and 2), and Sweden (1).

Figure 10.2 Regional employment within the forest-based and related industries of the EU



If we examine the pattern of employment, the first point to note is that the majority of employment is located in areas of high population densities (urban areas) and *not* the areas of low population densities (rural areas). For example, the higher proportions of employment (the darker areas) are located in Belgium, Netherlands, South east England, Northern Italy, Western Germany and Northern Spain, which are amongst some of the most densely populated areas of Europe (each have population densities in excess of 150 people/km²). Notwithstanding, the forest-based and related industries also provide high proportions of employment in many rural areas of the EU. Some of these areas include South West and Central France, many regions of Sweden and also Finland (i.e. regions with very low population densities of less than 50 people/km²).

One should bear in mind that we are comparing figures for *total* employment in manufacturing, and as such we underestimate the relative importance of the forest-based and related industries. For example, figures for total employment in manufacturing in each region include part-time and casual workers and so tend to inflate total employment in manufacturing. However, we have shown Sweden and Finland separately, since they represent proportions of manufacturing employment in terms of salaried employment. Hence, Swedish and Finnish figures exclude part-time and casual workers, and are therefore more representative of employment levels of the forest-based and related industries within those regions shown.

Returning to the estimated proportions of employment (as on the map) in terms of total manufacturing, there are several points worth mentioning. First of all, we must remember that we have only been able to use data from 21,000 companies, whereas in reality there are over 150,000 companies engaged in the forest-based and related industries within the EU. Secondly, about 90% of these companies are SMEs with less than 20 employees, who also represent about 30% of the total employment of the forest-based and related industries in the EU. Thus, our estimate does not cover a great deal of the SMEs, and therefore it must underestimate the levels of employment in each region.

To examine how accurate our regional estimate has been, we have also calculated the levels of employment within the forest-based and related industries of the EU at the national level, using the Eurostat database for each country. Using these employment figures, we have estimated the proportions of manufacturing employment that the forest-based and related industries hold at national and EU levels. The results are illuminating, for three reasons. The first reason is that forest-based and related industries in the EU account for at least 9% of the total employment in manufacturing. The second point is that the forest-based and related industries in each EU country account for between 8% to 24% of total employment in manufacturing. Thirdly, a comparison of the two estimates (Eurostat and the Company Database) demonstrates that the regional estimates for forest-based and related industries are underestimated by approximately 50%. For example, the table below sets out the employment estimates using the two approaches. The Eurostat figures are accurate at the national level, and show that total employment in the forest-based and related industries of the EU is around 4 million people, whereas the Company Database estimates the total employment to be about 2 million persons.

Therefore, with the exception of Sweden and Finland (figures highlighted in italics), the company database underestimates employment at the national level by approximately 50%. Thus the levels of regional employment must generally be 50% higher than shown on our thematic map. This is quite astonishing given that regional employment figures suggest that the forest-based and related industries are generally higher than the percentages estimated at the national level.

Upon inspection of the regions where the forest-based and related industries are more concentrated (higher proportions of employment), it is clear that employment is widely dispersed around the EU. Moreover, whilst many of the regions listed are well known for particularly high levels of forest-based and related industry activity, there are still many regions which one would not normally associate with these industries.

Table 10.1 Employment within Forest-Based and Related Industries

Figures show 1000s of Employees	*Eurostat data			#Company database	
	Total Employment in Manufacturing	Employment Estimate for FBIs	% of total manufacturing	Employment Estimate using MapInfo	% of total manufacturing
Austria	1096	90	8.2	45	4.1
Belgium	1048	169	16.1	59	5.6
Denmark	691	72	10.5	44	6.3
Finland	479	114	*23.8*	88	*18.4*
France	5890	496	8.4	302	5.1
Germany	12568	1012	8.1	398	3.2
Greece	885	24	2.8	14	1.5
Ireland	356	22	6.1	16	4.6
Italy	6445	483	7.5	226	3.5
Luxembourg	38	4	10.5	0	0.3
Netherlands	1513	154	10.2	87	5.7
Portugal	1386	146	10.5	38	2.7
Spain	3629	276	7.6	149	4.1
Sweden	1030	158	*15.3*	166	*16.2*
UK	7150	762	10.7	378	5.3
Totals	**44203**	**3983**	**9.0**	**2010**	**4.5**

Source: *Eurostat; #ETLA database estimate.

Table 10.2 Regional Employment in Forest-Based and Related Industries of the EU – Major Regions of Employment

Region	Country	*Eurostat	#ETLA Database		
		Total Emp in Manuf	FBI-Emp	% of Tot Emp	No. of companies
Etelä-Suomen lääni	Finland	179800	51932	28.9	509
MELLERSTA NORRLAND	Sweden	46200	11672	25.3	129
NORRA MELLANSVERIGE	Sweden	114800	27100	23.6	287
OEVRE NORRLAND	Sweden	53000	11792	22.2	150
Itä-Suomen lääni	Finland	38200	7670	20.1	99
SMAALAND MED OEARNA	Sweden	127400	23792	18.7	343
Ahvenanmaa	Finland	1400	260	18.6	4
SYDSVERIGE	Sweden	130500	23314	17.9	324
STOCKHOLM	Sweden	139400	23915	17.2	422
Länsi-Suomen lääni	Finland	171700	23650	13.8	301
Lapin lääni	Finland	12100	1621	13.4	24
VAESTSVERIGE	Sweden	222100	25064	11.3	375
OESTRA MELLANSVERIGE	Sweden	196900	19803	10.1	303
LIMOUSIN	France	66500	6412	9.6	58
Oulun lääni	Finland	31900	2890	9.1	44
LUXEMBOURG (B)	Belgium	20800	1771	8.5	27
LIMBURG (NL)	Netherlands	133600	11093	8.3	81
POITOU-CHARENTES	France	169200	14041	8.3	144
FLEVOLAND	Netherlands	22300	1790	8.0	21
CHAMPAGNE-ARDENNE	France	125700	9871	7.9	91
BRABANT	Belgium	168600	12684	7.5	208
SOUTH EAST (UK)	UK	1816000	132999	7.3	1141
KAERNTEN	Austria	65400	4750	7.3	40
FRIULI-VENEZIA GIULIA	Italy	163500	11792	7.2	179
NAVARRA	Spain	71200	4960	7.0	47
RIOJA	Spain	36000	2502	7.0	34
NOORD-HOLLAND	Netherlands	199900	13534	6.8	147
EAST ANGLIA	UK	278200	18754	6.7	176
ANTWERPEN	Belgium	196500	13242	6.7	168
WEST-VLAANDEREN	Belgium	145600	9731	6.7	150
GELDERLAND	Netherlands	212100	14092	6.6	143
LORRAINE	France	254100	16865	6.6	151
SALZBURG	Austria	67900	4490	6.6	42
ILE DE FRANCE	France	963700	61022	6.3	549
DANMARK	Denmark	691100	43677	6.3	515
HAMBURG	Germany	177200	11134	6.3	84
ALSACE	France	241700	15069	6.2	141
CENTRE	France	300300	18593	6.2	151
NORTH WEST (UK)	UK	807600	49383	6.1	371
AQUITAINE	France	247600	14973	6.0	183
BOURGOGNE	France	186300	11110	6.0	120
BASSE-NORMANDIE	France	141700	8381	5.9	83
UTRECHT	Netherlands	83400	4861	5.8	61
CATALUNA	Spain	770000	43720	5.7	503
EMILIA-ROMAGNA	Italy	580000	32104	5.5	416

PAIS VASCO	Spain	236600	13032	5.5	141
ARAGON	Spain	132900	7210	5.4	61
NOORD-BRABANT	Netherlands	287900	15090	5.2	157
YORKSHIRE& HUMBERSIDE	UK	687300	36023	5.2	283
DRENTHE	Netherlands	47700	2470	5.2	23
SOUTH WEST (UK)	UK	534500	26796	5.0	247
GRONINGEN	Netherlands	52500	2610	5.0	28

Source: *Eurostat; #ETLA database estimate.

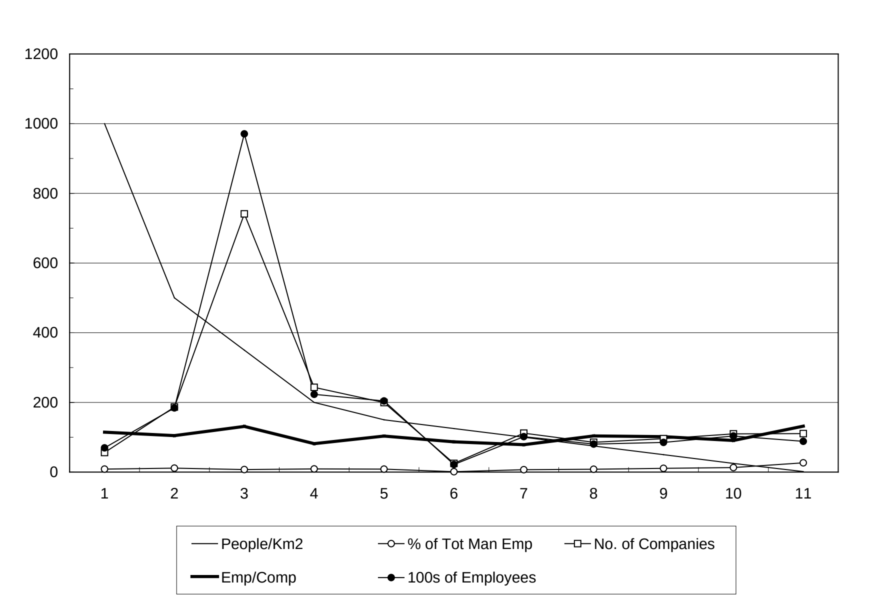
For example, the French regions of Aquitaine and Limousin are known to be important forest industry areas containing considerable forest resources, the region of Friuli-Venezia-Giulia, is known as a region of furniture districts, the northern regions of Sweden are also well known for their forest resources and wood processing industries. However, there are many regions which are not renowned for their connections to the forest-based and related industries. One of these is the South-east region of England, which although it does not have many primary manufacturing forest industries it is home to a vast amount of printing, publishing and furniture industries, which are heavily related to the forest-based industries.

Taking the analysis one step further, we have tested the data to see if there is any correlation between, population density and employment within the forest-based and related industries, across the EU regions. Therefore, we have grouped regions together according to population density and then calculated *average* values for each category of employment or company. From the chart shown below, there is no evidence to suggest that employment within the forest-based and related industries is confined to rural areas. On the contrary, the graph confirms that employment is concentrated more in urban areas, and is directly related to the number of companies.

Upon further inspection, it appears as though forest-based and related industries thrive in population densities of between 200 to 500 persons per Km². In fact, these regions are located in Germany, the Netherlands, Belgium, Northern Italy, with some near fairly large cities. Characteristic of these regions are printing and publishing industries, furniture districts, and machine building, most of which are SMEs. This observation could have implications for the development of SMEs, but is beyond the scope of this research.

One final point to note from the graph is that there is a slight increase in the proportion of employment in manufacturing where population density is very low. However, after further inspection,

Figure 10.3 Relationship between Population Density and FBI Employment



Source: Eurostat, ETLA FBI-company database.

it was observed that regions in this category were generally found in Sweden and Finland. And, given that in Sweden and Finland forest-based industry companies tend to be organised to achieve scale economies - particularly pulp, paper and board and the manufacture and processing of wood products – and hence business units are larger in size, then this is no surprise.

Box 10.1 Why are the forest-based and related industries located near urban centres

Empirical research, into what determines the economic geography of Europe[2], not only highlights the fact that the Industry branches

[2] This section draws heavily on: What Determines the Economic Geography of Europe – J.I. Haaland, H.J. Kind, K.H.M. Knarvik & J. Torstensson, CEPR (Centre for Economic Policy Research, London), Discussion Paper No. 2072, February 1999. (Analysis was based on data from 35 industries in 13 European Countries).

across the EU countries, but also gives some reasons as to why industries locate in certain regions. At the same time, the key findings of this research also serve to demonstrate why there is such a strong incentive for firms within the production chain (forestry through to wood and paper end uses) to develop tighter co-operation and thus to become inter-linked.

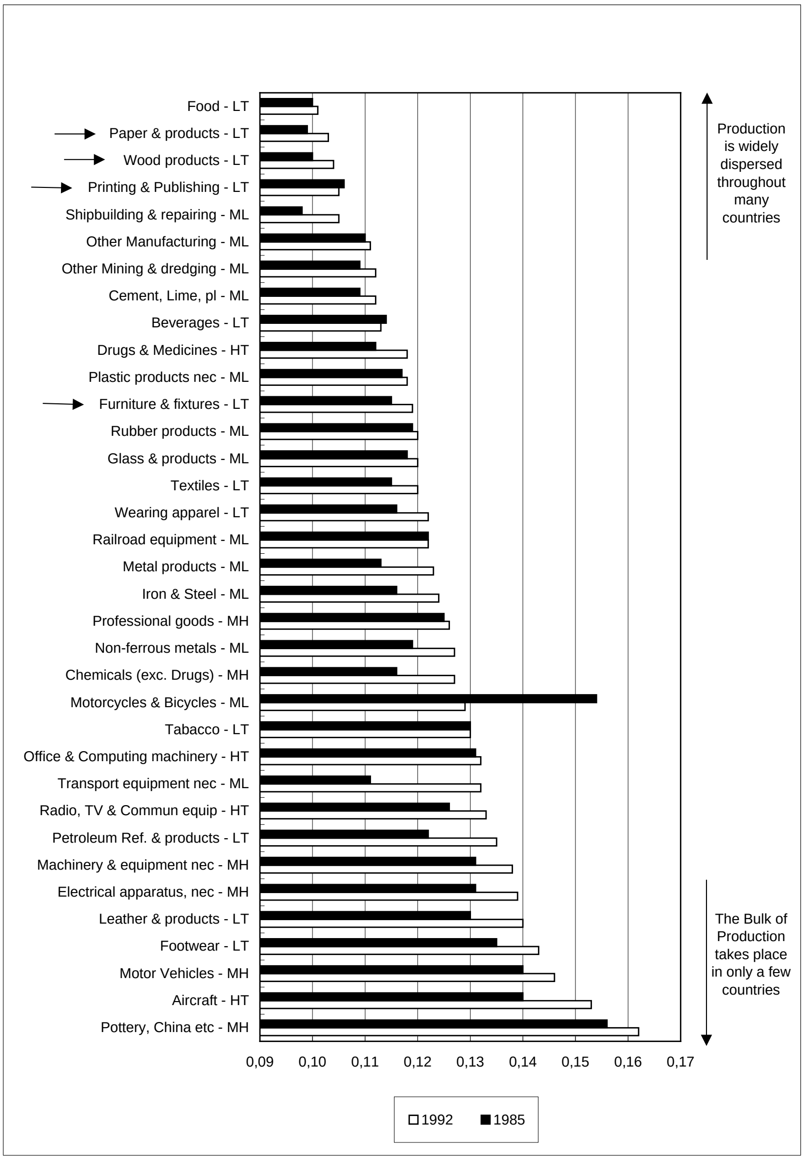
'Traditional trade theory emphasises resource endowments as determinants of specialisation, new trade theory focuses on scale economies, imperfect competition and home market effects, while new economic geography theory stresses the importance of agglomeration and clustering of economic activities within and between industries. Traditional theory of comparative advantage is about whether countries specialise in relative terms, whilst clustering is about agglomeration and large-scale production in absolute terms.' The research drew on each of these approaches in an attempt to explain the pattern of specialisation and concentration.

Two different measures of geographic concentration were used – relative and absolute concentration. The first measures the degree 'an industry is concentrated relative to the average spread of activities between countries (whether some countries produce much more in this industry relative to other industries). The other measure indicates whether the industry is concentrated in absolute terms (does most of the activity take place in only a few countries).'

From both figures it is apparent that some industries have high concentration indexes in *relative terms*, but not in *absolute terms* (textiles, wearing apparel). 'This implies that these industries are important in a few, smaller countries, with specialisation being due to comparative advantages such as low-wage, labour-rich countries producing relatively large amounts of this product. On the other hand some industries are highly concentrated in absolute terms, but not in relative terms (motor vehicles, electrical apparatus etc). This may imply that these industries have a bias towards localisation in larger countries'. However, it is clear that industries within the forest-based and related industries do not follow either of these characteristics.

Rather, in terms of absolute concentration, the forest-based and related industries, exhibit very low values, indicating that production is widely distributed throughout many European countries, and not concentrated in only a few countries. Moreover, the forest-based and related industries also score quite low in terms of relative concentration, confirming again that production is spread throughout many countries.

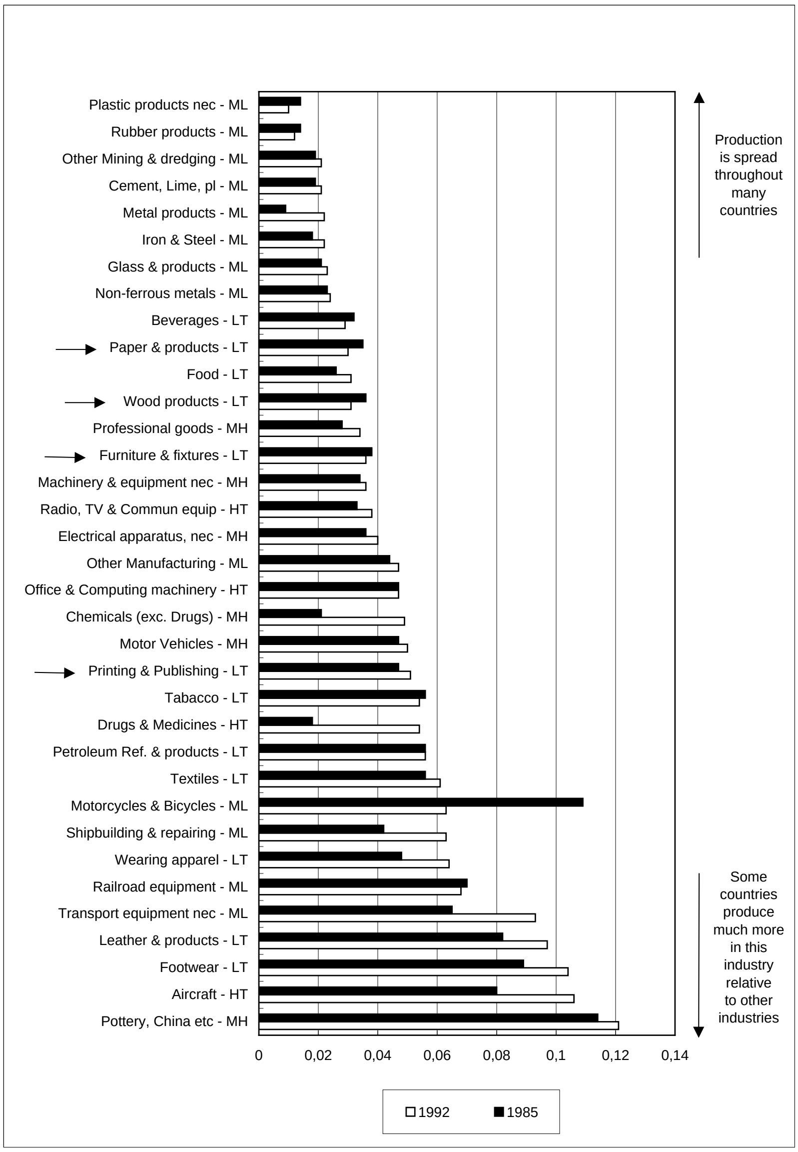
Figure 10.4 Absolute Concentration of Production



Source: CEPR, 1999; ETLA additions.

Moreover, two of the related and supporting industries - chemicals (excluding drugs) and machinery & equipment (nec) are much more concentrated in only a few countries, and are increasingly becoming even more concentrated. 'This type of specialisation could be explained by so-called 'home market effects': with imperfect competition, trade costs and economies of scale, it is an advantage to concentrate production close to the bigger markets. Agglomeration

Figure 10.5 Relative Concentration of Production



Source CEPR, 1999; ETLA additions.

forces, like strong input-output linkages, could reinforce this pattern'. This latter statement partly explains why pulp and paper machinery manufacturing are mainly concentrated in Finland, Sweden and Germany, and why woodworking machinery is mostly manufactured in Italy and Germany (i.e. they are each amongst the largest and most sophisticated producers within the industries they supply to).

The key findings of the research were that:

- 'Concentration on the demand side is – by far – the most important explanatory variable for the relative as well as for absolute concentration. *This implies that industries tend to locate close to the bigger markets*.'
- 'Specialisation according to comparative advantages does have a significant influence on the pattern of relative concentration, although not as strong as the impact from the demand side. *This implies that skill intensive industries do show a tendency towards relative concentration of the production in some countries*.'
- 'Intra-industry linkages – measured by the within-industry input-output linkages – do have a significant impact on absolute concentration. *This implies that industries with strong ties between firms tend to be more concentrated than other industries*. Econometric tests also indicate that the agglomeration forces may be self-reinforcing, in that industries generate their own demand through these input-output linkages.'
- 'Trade costs – in terms of non-tariff barriers – indicate that the higher the non-tariff barriers for an industry, the more concentrated is production, in absolute terms. *Hence, industries with high barriers will tend to concentrate close to bigger markets, while low-trade-cost industries may find it more advantageous to move production to the periphery*, e.g. to take advantage of lower costs of production.'

Whilst the above findings may be applicable to many facets of the forest-based and related industries, one should be careful when generalising in respect of these findings since there are many exceptions. For example, there are sizeable pulp and paper industries in Scandinavia, who overcome disadvantages of distance to markets through product innovations and scale economies, amongst other innovations.

Finally, regarding the two graphs, it is quite noticeable that industries with very low absolute concentration ratios (production widely dispersed across many countries) tend to be low- to medium-technology industries (according to OECD classification system). Whereas industries scoring highly in absolute concentration, tend to be medium- to high-tech industries (production concentrated in a few countries).

This raises the question as to what should national and European R&D funding priorities be. For example, should EU level funding for R&D activities be geared towards high-tech industries, or should it be directed towards lower technology industries.

Hence, this suggests that the successful implementation of well thought out policies for the forest-based and related industries could positively effect more regions of the EU. This is in contrast to policies aimed at some of the 'larger' and more 'high-tech' industries within the EU – eg Aerospace, Autos etc – which, evidently would appear to impact a few countries or regions only.

10.2 Regional Significance in Peripheral Areas of the EU – Case Studies

The following case studies do not wholly adopt the forest cluster concept and have a tendency to focus more on the primary production end of the forestry and forest products, particularly in more rural areas. Nonetheless, they do however, describe most of the forest-based industries very well and are very good examples of some of the regions, highlighting the importance to rural areas.

The case study material has been extracted from the 'FORWARD project' at the European Forest Institute[3]. The FORWARD project was initiated to investigate the opportunities for remote regions of Europe to increase income and employment based on forest resources. Several case study regions were selected across Europe to illustrate the situation as regards the forest sector and its relationship to regional development. The case study regions represent a wide range of possible development paths, and reflect the different strategies of forest policy. We have only presented summaries of each of the case studies to highlight the main activities considered more relevant to the forest-based and related industries. Hence, while no less important, a great deal of the information pertaining to forestry and the multiple use of forest resources (namely non-wood goods and services) has been omitted.

10.2.1 Basque Country - Spain

Spain has a total area of forest and other wooded land of some 25.6 million ha, with only 6.5 million ha of this considered ex-

3 Forest Related Resources, Industries, Services and Know-How, in the Border Regions of the European Union – P. Hyttinen, A. Ottitsch, P. Pelli and A. Niskinen – European Forest Institute, 1998.

ploitable. However, in the Basque Country about 60% of the land area is forest land, whilst a large proportion of this (about 360, 000 ha) is considered exploitable forest area. In 1995, total employment in the forest sector stood at about 15,300. Moreover, about 60% of the forest areas are privately owned, with the remainder being publicly owned.

Softwood is the main source of timber raw material in the Basque Country (mostly pine), and in 1996, around 2,1 million m^3 of roundwood was produced in the region. About 53% of the roundwood went to the sawmilling sector, about 25% went to the mechanical and chemical pulp sectors, with a further 7% going to the board industry. The remaining 15% were exported from the region without further processing.

Within logging and haulage, the timber trade is very fragmented because of the small size of the forest properties and timber companies and contractors. The contractors are the link between the forest owner and the companies utilising the wood. About 50% of the total timber felled in the region pass through the contractors, with the other half being bought directly by the sawmills. All timber harvested in the region is transported by trucks. The average distance between harvesting point and wood processing or stocking place is about 45 km.

The Basque Country is home to a wide variety of forest-based and related industries: sawmills, wood processing, furniture manufacturing, pulp, and paper and board industries. In total, forest-based and related industries provide some 15,350 jobs in the Basque Country. This represents about 4,6% of employment within industry.

Table 10.3 Forest-based industries in the Basque Country in 1995

Branch	No. of Firms	No. of Employees
Forest Owners	20,000	770
Logging	35	618
Sawmills	81	1073
Primary Processing	814	3540
Furniture	1082	5603
Pulp, paper and board	40	3748
Total	2052	15,352

The Basque Country accounts for between 25-30% of Spain's paper and board production (956,000 tons in 1994). As much as 50% of national production of newsprint, printing and writing papers are manufactured in the Basque Country. Although the main paper mill in the area failed, the sector has improved, thanks to decreasing raw material prices and general costs, and increased international orders, which have increased turnover and resulted in higher utilisation of capacity.

Within the sawmill sector, there are a large number of small companies along with several larger ones. Although many of the sawmills focus on value-added production and further processing, none of the larger sawmills reach annual production volumes in excess of 100,000m^3. The sector is comprised of both family-owned and run sawmills and managed sawmills. The family enterprises benefit from the distribution of forest land into small holdings and the fact that they sell to the lower end of the market. However, lack of resources limit the expansion of the smaller sawmills, and also restrict development of their facilities to tackle higher quality segments.

The sector is currently undergoing rationalisation, aimed at adapting the sawmill capacity to the raw material available to increase value added. This development has been supported by incentives for increasing secondary processing in SMEs, encouraging co-operation of medium sized enterprises, and by incentives for co-ordination of extra sawing capacity released from former family enterprises.

Only 17% of pine primary processing is further processed into other products. The main output of the companies is sold as

Table 10.4 Sawmills within the Basque Country 1996

Firm size class (no. of workers)	No. of firms	Percentage	Sawn Roundwood Production (m^3)	Percentage
0-5	27	34%	57,100	9%
6-10	25	31%	140,400	22%
11-15	14	17%	122,300	19%
16-25	5	6%	105,500	16%
> 25	10	12%	223,000	34%
Total	81	100%	648,300	100%

boards or planks within Spain – especially the south eastern region of the country. The main secondary processing products are battenboards for the furniture industry and bricolage, wood packaging products, and laminated beams for the manufacturing of door and window frames (very strong in exports). Residual materials from sawmills are sold to the pulp industries. The high quality wood raw material (radiata pine) offers great potential especially for higher value added products especially in the furniture industry.

10.2.2 The Centro Region – Portugal

The area of forest and other wooded land in the Centro region is around 873,000 ha, which represents more than one-quarter of total area of forest and other wooded land in Portugal. The main species of trees in the region are Maritime pine (48% of forest area) and Eucalyptus (19%). Over recent years the area of Eucalyptus has expanded threefold, generally due to risk of fire to Maritime pine, and the establishment of pulp mills. For example, Eucalyptus has a shorter rotation time and is therefore more profitable. Hence, Eucalyptus plantations have been encouraged.

Roundwood supply of Maritime pine is mainly to the sawmill industries (70%) and also to the pulp industry, a small amount is also exported, but overall supply has decreased. However, demand for Eucalyptus has more than doubled during the 1980s, mainly due to the establishment of large-scale pulp enterprises, such as Celbi and Soporcel. About 80% of the total demand for Eucalyptus are from pulp companies.

Table 10.5 Forest-based industries in Portugal

Sector	No. of firms	Turnover (mill Pts)	Number of employees
Wood industry	11715	310,1	55667
Furniture industry	10643	86,4	38215
Pulp, paper and board	606	268,0	19518
Total forest industry	22964	664,5	113400
Total Manufacturing	125152	6792,6	1046654
Share of Total Manufacturing	18,3%	9,8%	10,8%

Within the manufacturing sector of Portugal, forest-based industries are important to the Portuguese economy: That is, forest-based industries account for more than 18% of the firms, nearly 10% of turnover and 11% of employment in total manufacturing.

Within the Centro region, the role of forest-based industries is even more important in terms of manufacturing. In fact, forest-based industries account for almost 17% of the firms, over 13% of the turnover and as much as 12% of employment in total manufacturing of the region. Indeed, the Centro region is somewhat more specialised in forest-based industries in comparison with forest industries at the national level, i.e. the region accounts for as much as 16% of the firms, 17% of turnover, and 17,5% of the workforce in all forest-based industries of Portugal. Wood industries account for about two-thirds of the forest-based industries in the region, whilst furniture production accounts for between 15-30% of the industry. Pulp paper and board makes up the balance but naturally it is higher than furniture in terms of turnover.

The forest-based industries within Centro region employs almost 20,000 persons. Over 13,000 are employed in the wood industries, almost 4,300 in furniture and about 2,200 in the pulp, paper and board industries. The total turnover of the forest-based industries in the region is worth some 110 million PTE. However, one of the problems in the development of wood and furniture industries is the lack of initiatives in professional training, know-how and the tendency for firms to position themselves within the lower end of the markets.

Table 10.6 Forest-based industries in the Centro Region

Sector	No. of firms		Turnover (mill Pts)		Number of employees	
	Centro Region	% of Portugal	Centro Region	% of Portugal	Centro Region	% of Portugal
Wood industry	2373	20,3	62,2	20,1	13342	24,0
Furniture industry	1126	10,6	15,5	18,0	4271	11,2
Pulp, paper and board	73	12,1	32,0	12,0	2170	11,1
Total forest industry	3572	15,6	109,7	17,0	19783	17,5
Total Manufacturing	21212	17,0	820,2	12,1	164562	15,7
Share of Total Manufacturing	16,8%	-	13,4%	-	12,0%	-

Within the EU, Spain is the most important market for Portugal, accounting for about 90% of roundwood exports, and more than 40% of fibreboard and packing cases & boxes exports from Portugal. The UK is the main destination for sawn wood (45%) and particleboard (46%), whilst France is the main customer for veneer, packing cases & boxes and wood products.

10.2.3 Drama County - Greece

There are some 6,5 million ha of forest and other wooded land in Greece. In Drama county, about 65% of the land area is utilised as forestry. There is about 225,000 ha of forest and other wooded land, and about 50% of this is considered exploitable. The tree species in Drama county are wide and varied but the main types are Beech (35%) and Oak (22%) and different pine species (23%) and Spruce. The forest sector is said to employ more than 3300, but this includes over 1100 workers who are employed in animal husbandry. Logging and hauling are carried out by small crews, who generally adopt manual methods. The timber is felled by chainsaws, then hauled using either animals or machines to roadside for selling.

The forest-based industries in Drama County are fairly important to the local economy. It is estimated that there are between 1100 to 1600 people employed by the forest-based industries, representing about 11-15% of the total manufacturing industry employment in the region. This is divided roughly one-third in the mechanical wood processing sector, and two-thirds in pulp and paper industry. In 1993, there were 34 mechanical wood processing firms, consuming about 65,000 m^3 of roundwood. The sawmills employ about 180 persons, whilst packaging cases and boxes employed about 150. The paper mill, which also has a particle board line, consumed about 100,000 tons of roundwood.

The largest users of Sawmill products (sawnwood) are the furniture and construction industries, absorbing about 70% of the total output. The vast majority of the sawmills are quite small processing less than 10,000 m^3 roundwood per year. However, the sawmills have been estimated to be operating at about 30% of their capacity. It has also been estimated that the local wood industries are quite reliant on their wood supply imports, receiving as much as 40% of their raw material and semi-finished products from Bulgaria. At the same time, sawmills in the region try to maximise the amount of finished products produced by them, to increase their value added content. However, competition is tough from foreign competitors particularly in eastern Europe who operate larger and more efficient plants.

Athens Paper Mill is the most important forest industry company in the region. The mill employs around 770 workers and had an annual turnover of about 46 million ECUs in 1995. The company owns two other mills, which are located close to Athens and produce tissue products. Athens Paper Mill produces pulp, paper, and particle board and it is the only producer of printing and writing papers, and one of four particle board producers in Greece. The mill uses mostly local raw material for particle board, but it imports the vast majority of pulpwood and chemical pulp. The mill was viewed as having good potential for further development since it had good access to many markets and sources of raw materials in nearby Eastern European countries such as Bulgaria, Albania, Macedonia etc. However, the mill was also in need of investment in modernisation and new equipment to compete with foreign companies with access to markets in Greece.

10.2.4 Ireland

Ireland has about 570,000 ha of forest area, representing about 8% of the total land area. There are about 430,000 ha of Forest and other wooded land, with about 400,000 ha of this considered exploitable. In the previous centuries Ireland's forest area was extensively cleared for many reasons but a major cause was for agricultural purposes. During the 1900s, the issue of establishing new forests came to the fore. However it was not until the 1950s that did large scale afforestation programmes get underway. Since the 1980s a series of forestry development programmes were supported by the EU, and indeed these appear to have been very successful. Between 1989 and 1993 over 80,000 ha were afforested, whilst the annual afforestation has increased from 7000 ha in 1986 to 24,000 ha in 1996. The main tree species in Ireland are Sitka spruce (62%) and Lodgepole pine (21%).

The majority of the logging and hauling is presently carried out within the state owned commercial forestry areas operated by Coillte, who is the largest single landowner and forest owner in Ireland, owning most of the productive forest areas. Harvesting operators are crews working for the buyers of the timber – board mills or sawmills, crews or contractors employed by Coillte, or landowners working on their land. Larger sawmills harvest about 75% of timber using their own contract crews.

Harvesting methods employ a variety of manual or mechanised felling and motorised or horse drawn extraction techniques, however, the trend increasingly is towards mechanisation. The average haul distance is around 85 km. There are some 50 harvesting machines, 130 forwarders, and 50 skidders in use, whilst between 1991 and 1996, there has been a total investment of some 30 million ECU in machinery, most of which has been purchased from Scandinavia. The small scale Irish forest machinery industry is therefore beginning to develop.

Domestic wood in Ireland is processed into various products such as construction timber (main product), wooden packages, pallets, impregnated fences, posts and garden furniture. Moreover, as there are no paper mills in Ireland, wood chips are sold to Great Britain or processed into wood based panels. Nonetheless, forest-based industries employ some 16,000 people in Ireland, although 50% of this is in forestry.

In Ireland, there are some one-hundred sawmills and four panel board mills. As there is no pulp and paper mills in Ireland, pulpwood is exported to the UK. Due to the absence of any pulp mills, pulpwood size material goes to the panel board industry in Ireland, making Ireland one of the largest producers of panel board per capita, in Europe. Indeed, the panel board sector is a major contributor to wood exports, and is a net exporter. Irish MDF (medium density fibreboard) has established itself as a quality leader in Europe. At the same time, the OSB (oriented strand board) mill at Waterford Port, is set to become the largest producer of OSB in Europe.

The supply of Irish timber is fully utilised by existing and planned capacity of the sawmills and panel-board mills, whilst it maintains about 60% of the domestic market. In fact, it is forecast that Ireland will become a net exporter of timber by the beginning of next century. In 1995, timber exports were worth 103 million ECUs, and by the year 2000, this figure is expected to grow to about 300 million ECUs.

In terms of domestic production, sawmilling is the most important sector, with an output of some 700,000 m^3 per annum. About 80% of the sawnwood is produced by twelve mills, with capacities ranging from 15,000 m^3, to 100,000 m^3, each employing between 50-250 persons. The remaining 20% is produced by a further 58 mills. In total the sawmill sector employs some 1500 people. The vast majority of the sawmills are family owned enterprises that were originally developed to serve local markets, consequently the sector is fragmented, with production units and output being small in comparison with main competitors, further afield. An exception is the two sawmills owned by Coillte, which has recently acquired a majority interest in a large sawmill in Northern Ireland, which incidentally, owns milling capacity in Estonia.

Panel Board manufacturing plants in Ireland are equipped with state-of-the-art facilities. In fact, two of the world's largest panel board plants are located in Ireland. These were established in 1996, utilising domestic raw material supplies – mostly spruce – and their location to established markets in the UK.

Medite of Europe Ltd, in Clonmel, is the largest MDF plant in Europe. It was established in 1983, and is owned by the US company, Willamette Industries Inc. In 1994, the mill capacity was expanded from 160,000 to 300,000 m^3. It employs about 220 people directly within the mill and a further 500 in harvesting and freight. The mill uses 50% sawmill residue and as much as 65% of its production is exported. The mill is very important to the economy contributing some 50 million ECUs to the GNP of Ireland, in 1993.

Louisiana Pacific Coillte Ireland Ltd, in Waterford port, is a Irish-American joint venture, which produces OSB. Some £40 million was invested into the new facilities at the mill, which has an annual production capacity of 350 million m^3. Fully utilised the mill will employ over 500 persons, about 125 directly in the mill and another 375 in harvesting and transportation. About 95% of the production output is exported, mostly to the EU.

Finsa Ltd, in Scariff, is a Spanish-owned wood processing company, which produces chipboard. In fact, chipboard has been manufactured at Scariff since 1959, and the mill uses domestic raw materials comprising 60% sawmill residue and 40% pulpwood. The mill produces about 90,000 m^3 per year and about 25% is exported. The mill also produces MFC (melamine faced chipboard), veneered chipboard which are primarily used in the manufacture of furniture. The mill, which employs about 170 persons directly in the mill and a further 200 indirectly, contributed about 16 million ECUs to Ireland's GNP, in 1993. A fourth mill, Masonite, opened in Carrick-on-Shanon in 1997, and produces moulded door facings, from sawmill residues.

In the area of secondary wood processing, which includes wooden furniture, panelling and manufactured timber products, there are some 6000 people employed. There are some 400 furniture manufacturing firms, most of which are SMEs. In 1993, the Irish furniture industry had a production value of IR£ 170 million, 40% of which was exported. The UK furniture market (worth about 6.3 billion ECUs) is expected to offer much potential to increase Irish wood furniture exports.

10.2.5 North Karelia - Finland

There are some 23 million ha of forest area in Finland, with about 19.5 million ha considered exploitable. In North-Karelia, the area of exploitable forest is as much as 1.42 million ha, representing almost 8% of the total forest area in Finland. The dominating tree species in the region are Pine (50%), Spruce (33%) and Birch (13.6%). In total there are some 3600 persons employed within forestry and forest-based industries within the North-Karelia region.

In North-Karelia, harvesting and hauling of timber is carried out in various ways. Ranging from more manual methods to highly sophisticated mechanised techniques. About 12% of the roundwood supply comes from forest owners who use their own equipment. However, due to the high investment cost of owning equipment, there are numerous private enterprises supplying harvesting and haulage services in the area. Indeed, it is estimated that there are as many as 700 people employed via private contractors, to harvest and forward the timber.

At the same time, there are several large-scale forest industries in the region, who have their own timber purchasing organisations. These include Enso Ltd, UPM-Kymmene Ltd and Osuuskunta Metsäliitto, who together employ some 630 persons and (about half are contractors) in harvesting, haulage and transport. In 1995, some 4.3 million m^3 of roundwood was purchased.

Within North-Karelia, the forest industry is dominated by several large-scale manufacturing units. For example, the ten largest plants each utilise more than 100,000 m^3 of roundwood annually (about 60% birch). In total, these companies employ about 1840 people and have a turnover of about 650 million ECUs per annum. Enocell pulpmill owned by Enso Ltd, is the largest enterprise in the region, using some 2.6 million m^3 of roundwood in 1995. There are also four large sawmills in the region, two owned by Enso Timber Ltd and two owned by Vapo Timber Ltd. These sawmills employ over 600 people and in 1995, they consumed some 2.5 million m^3 of roundwood. However, in recent years, the sawmill industry has experienced a down town.

Apart from the above mentioned pulp mill and sawmills, there are also other production units in North Karelia, which include a plywood factory, a chipboard factory, and a paperboard mill. Because of the high demand in the region, local pulpwood supply does not meet the local demand therefore a considerable amount of roundwood is imported from Russia (in fact, 1.2 million m^3, was imported in 1995). Enocell Ltd has been the largest importer of pulpwood, importing about 1 million m^3 of birch pulpwood, in 1995. Yet at the same time, some 1 million m^3 of roundwood is transported from North-Karelia to other Finnish regions for processing. Indeed, it is suggested that there is some potential for local plants to use local supplies of pine and spruce.

Despite the dominance of large-scale plants, there are also more than 330 SMEs within the region, who specialise in wood processing and wood product industries. Of this total, 140 are wood-sawing, -planning and -drying enterprises, about 97 are carpentry firms, 55 are wood construction firms and a further 44 produce other wood products. In total these firms employ almost 1100 persons, but about two-thirds of the employment is provided by firms in the size category of less than 20 persons.

The forest-based industries are of vital importance to the North–Karelian region, both in economic and employment terms. During the 1990s, the forest industry has generated over 60% of the export income in North Karelia, and as much as 39% of the export income of Finland. In fact, forest industry exports from North-Karelia amounted to 290 billion ECUs, in 1994.

In addition to the above forest-based industries, there are also two other key related industry companies who are located in the North-Karelian region. The companies manufacture forest machinery in two large workshops in the area. Timberjack Ltd and

Table 10.7 Largest forest industry enterprises in North Karelia (1995)

Company	Roundwood use (1000 m³)	Turnover (millions FIM)	Employees
Pulp Mill			
Enocell Ltd, Uimaharju	2,600	2,000	335
Paperboard Mill			
Pankakoski Boards Ltd, Lieksa	90	320	360
Board Mill			
Puhos-Board Ltd, Kitee	500	230	200
Sawmills			
Enso Timber Ltd, Uimaharju	850	250	140
Enso Timber Ltd, Kitee	700	350	150
Vapo Timber Ltd, Lieksa	450	206	120
Vapo Timber Ltd, Nurmes	220	120	75
Saha-Tapio Ltd, Kiihtelysvaara	155	70	30
Metsä-Timber Ltd, Ukkola	150	80	91
Plywood Mill			
Schauman Wood Ltd, Joensuu	130	170	340
Total	5,845	3,786	1,841

Kesla Ltd, employ some 400 people and have a combined turnover of about 60 million ECUs. The companies produce forwarders, timber loaders, forest trailers and cutting machines as well as cylinders and timber loader grabs, which are sold both domestically and internationally.

10.2.6 The Province of Trento - Italy

In Italy, there are some 8.6 million ha of forest and other wooded land, with around 6.7 million ha of this being exploitable. In Trento, there are about 222,000 ha of exploitable forest area, with about three-quarters being publicly-owned. High forests account for the majority of the output of industrial timber and are mainly located in mountainous areas within the region. There are more than 100 logging and hauling companies in the Province of Trento, which employ about 330 persons in high seasons. Logging and haulage operations are carried out by municipal crews - who are permanently employed, private logging companies - using a seasonal workforce and other Community and Forest Province staff. Logging is typically carried out via manual methods, due to the mountainous terrain and the small size of companies.

The wood industry employs almost 3,800 persons and comprises over 1000 firms, who are typically small in size, in terms of employees or amount of wood processed. Independent workers in the wood industries make up a large proportion of total workforce in the manufacturing sector (45%). Sawmills are a key element of the regional forest industry, since they process local roundwood. In 1994, there were some 170 sawmills, employing 1120 people, who utilised 700,000 m^3 of roundwood, and produced 450,000 m^3 of sawnwood.

The community sawmill, Magnifica Communita di Fiemme, is the largest sawmill in the region, and amongst the largest coniferous sawmills in Italy. It is located in Ziano di Fiemme, within the community estates, and produces boards, which are used for carpentry, joinery and wooden furniture. In 1995, the sawmill had a turnover of 6.2 million ECUs and employed about 38 persons. The mill consumes about 35,000 m^3 of roundwood, and produces about 12,000 m^3 of sawnwood each year. The mill can not compete with the large-scale facilities in central Europe but is more competitive in its niche markets. The wood produced in Fiemme is highly regarded in the Italian wood market, and hence the sawmill's products are marketed outside the province in the Italian regions of Lombardia, Emilia, Tuscany and Campania.

A smaller sawmill is also located in the province. The Foreste Demaniali is owned by the Parks and Province Forest Service and is located in Caoria. The mill has an annual working capacity of about 13,000 m^3, whilst most of the raw material comes from the Province's Forests, although a smaller proportion also comes from other owners.

In total, there are some 160 sawmills in the province of Trento, who mainly process local raw materials (72%), or material from the neighbouring province of Bolzano. It is also claimed that material from other regions of Italy is inferior and therefore not general imported. In general, the main products manufactured are mostly boards (54%) and beams (23%). The main customer industries are carpentry (18%) and joinery (13.5%), construction (25.6%), furniture (3%), and pallets and packaging (34%). Most of the products are sold outside the region, but not exported, with the vast majority being purchased directly by clients.

The wood and furniture industry in Trento comprises some 1050 firms, which employ some 3800 people. The annual turnover of the sector was 470 million ECUs, in 1994. About 95% of the firms are SMEs with less than 20 employees. Carpentry and joinery is the largest sector employing almost 2200, Sawmills employ about 610, Packaging and pallets around 680, and Wood based panels around 60. The sawmills are quite small in terms of processing capacity with some 96% of them processing less than 10,000 m^3 of roundwood each year.

10.2.7 Västerbotten - Sweden

With some 28 million ha of forest and other wooded land, Sweden has one of the largest forest areas in the EU. Of this figure about 22 million ha are considered as exploitable forest area. In the Västerbotten region of Northern Sweden, there are some 3 million ha of exploitable forest area. Forest ownership in Sweden is more than 90% in private hands and Västerbotten is even higher. There are some 5,550 persons employed in the forest sector.

The dominant species of trees are Scots Pine 43% and Norway Spruce 41%. Wood flow within the county is mainly from inland to the coast. Despite being located throughout the county, coastal sawmills absorb 44%, whilst those inland absorb 13% of the local timber. The pulp industry uses local pulpwood and is located on the coast (Umeå/Obbola), two chipboard producers are also in the area one inland and one on the coast. Together these use about 20% of the felled timber. The region is self sufficient in roundwood but transports excess pulpwood to mills in nearby regions.

Some of the largest forest industry companies in Sweden have their timber purchasing organisations in the region. These include AssiDomän Skog, Graninge Skog, MoDo Skog and SCA Skog. Combined these companies purchased nearly 4 million m^3 of timber in Västerbotten, in 1995. These companies employed some 390 people in timber purchasing, silviculture and administration, whilst a further 410 people were employed by contractors for harvesting and transport. The other significant purchasing groups are the forest owners' associations and the commercial sawmills.

Between the 1980s and 1990s forestry practices in Västerbotten have become almost fully-mechanised, reducing traditional loggers considerably. There are some 110 forest machine contractors with about 160 machines (forest tractors and 65 harvesters) operating in Västerbotten. The contractors employ about 170 persons, whilst their turnover is around 22 million ECUs. In the transportation of wood raw materials there are some 150 lorries carrying roundwood and a further 30 carrying wood chips. Transport of the roundwood and chips employs nearly 400 people.

The sawmill industry is the most important forest-based industry in the Västerbotten region. Of the 14 largest forest industry companies consuming more than 100,000 m^3 per year 13 are sawmills. It is also interesting to note that two of these companies also produce chipboard. Together, the total turnover of these companies amounted to 415 million ECUs and employed about 1,500 people in 1995.

With over 400 employees, SCA Packaging Obbola is one of the largest employers in the forest industry in Västerbotten. SCA also has a sawmill in Holmsund and a liner-factory in Obbola. SCA mainly use local timber in its Västerbotten plants however some material is transported to its mill located in Piteå, in Norrbotten. AssiDomän has one sawmill, Nordträ in Malå, which employs over 110 persons. It also has a wood processing plant in Norsjö, which employs 130. Another important company is Graningeverken, which is one of the largest energy producers and electricity distributers in Sweden, also plays an important role in the forest industry.

Although MoDo does not have any of its paper manufacturing plants in Västerbotten, it does have a pulp and paper mill on the coast in Husum, which is very close. Indeed, most of the pulp and paper industry companies in the northern part of Sweden are located in the coastal areas of Västernorrland, but there are also pulp and paper plants in Västerbotten and Norrbotten. These plants are an important source of employment, both directly (through work at the plants themselves) and indirectly (since a great deal of the roundwood is harvested inland and then transported to the mills on the coast, where it is further processed before being exported).

Commercial sawmills in the region have become more active since the 1960s. Today, commercial sawmills account for about

70% of the total sawnwood production output in Sweden, and about 50% of the output in Norrland. There are 17 sawmills in Västerbotten, which vary in the amount of processed raw material ranging from 12,000 m^3 to the largest with 300,000 m^3 per annum. Raw material is bought from the large pulp and paper industry companies such as AssiDomän, SCA and MoDo. However, the sawmills have an agreement to return the saw mill waste to the pulp and paper companies, so in effect they are somewhat reliant on these large companies.

Roundwood is also purchased from the forest owners' associations, which also happen to be competitors of the sawmills, since some own their own sawmill companies. Roundwood supplies also come from private forest owners, jointly-owned forests and state forests, and to some extent some roundwood is also imported from Finland and Russia. In total, the sawmills process about 1,25 million m^3 of raw material and produce some 625,000 m^3 of sawnwood per annum. About 60% of the sawnwood is Pine and around 40% is Spruce. Some products are further processed within the sawmills before exporting. Products are exported mainly to the UK, Germany, the Netherlands, Spain and Italy, and also to France, Egypt and Japan.

Within Västerbotten, the wood products industry is comprised of many small firms, who have limited resources. Companies are often situated in small villages, have low production volumes, but are nevertheless important sources of local employment within the region. Typical products include wooden floors, builders' carpentry, small houses and cottages. However, many of the firms are dependent on the local building markets, as marketing of products is often weak. Few firms have managed to penetrate external markets and very few have developed export operations.

Today, Västerbotten is well-known for its sawmills and the high quality raw material – the North-Swedish Pine. The Forestry sector and the forest-based industries provide significant sources of employment and incomes from exports. Related and supporting industries are also substantial in this region. Machine building engineering workshops employ about 700 people and have an annual turnover of around 89 million ECUs. In addition, the importance of the wood raw material as an energy source is also quite significant. The current energy production from wood chips and peat is 700 Gwh, with capacity increasing as utilisation of forest waste as bioenergy – from processed waste into pellets and briquettes.

Table 10.8 Employment in the forest-based industries of Västerbotten

Industry Sector	No of Companies	Employees
Forestry	*679*	*1753*
Wood Products Industry	*262*	*3142*
- Sawing, planning & wood preservation	88	1500
- Prefabricated houses & joinery	107	Na
- Board manufacture	6	Na
- Wood packaging	8	Na
- Other wood products	26	Na
- Furniture	27	Na
Pulp, Paper and Graphic industries	*144*	*Na*
- Pulp, paper and board	9	653
Totals	*1085*	*5548*
Related Machinery building		700
% of Total Manufacturing (excluding forestry)		22,5%

Total manufacturing employment in the region employs about 20,000 people. Hence, if we take the employment figures from the forest-based and related *manufacturing* industries together, we find that these represent as much as 22,5% of total employment in manufacturing. From our earlier estimations using the mapping technique, we found that the forest-based and related industries in this region to be as high as 24% of total employment in manufacturing. So these case study findings appear to concur with our estimations. However, if one includes forestry, the proportion of employment provided by all forest-based and related industries rises above 30%.

10.2.8 Waldviertel - Austria

In Austria there are about 3.9 million ha of forest and other wooded land. Of this figure 3.3 million ha are exploitable forest area. In the Waldviertel region, there are 240,000 ha of exploitable forest area. Private forests account for over 90% of the forest area. The main species of trees are Spruce (60%) and Pine (22%). Within the small-scale private forest holdings, logging is carried out mostly by the owners, who generally use manual methods and their own equipment. Whereas, in larger forest enterprises, logging crews are increasingly contracted in, as specialist companies who provide specialised equipment and harvesting and forwarding technology..

The main purchaser of domestic roundwood is the sawmill industry, which consumes about half the domestic production. Nonetheless the pulp and paper industry is also a major buyer, with some 30 plants in Austria, which utilise about 5.8 million m³ of wood – 60% pulpwood and 40% woodchip residue from sawmills. However, there are no pulp and paper mills in Waldviertel, itself, only pulpwood buyers. In addition to the processing of domestic roundwood, sawmills also import some 3 million m³.

Within Austria there are approximately 1,700 sawmills, but most of these all relatively small. There are 16 sawmills processing between 50-100,000 m³ per annum and also 17 plants processing more than 100,000 m³. In Waldviertel there are 107 sawmills, with the vast majority (94) processing less 10,000 m³ of roundwood per year. Moreover, it is estimated that these sawmills process about 175,000 m³ annually. In the next size class, up to 25,000 m³, there are nine sawmills who are estimated to consume about 145,000 m³, whilst sawmills processing more than 25,000 m³ per year, are estimated to utilise some 125,000 m³ each year.

In addition, to the above there is also a larger sawmill in Waldviertel, which happens to be the headquarters of the largest sawmill group in Austria, the Schweighofer Timber Industries group. Schweighofer, has an annual turnover around 250 million ECUs, and operates three mills in Austria and one in the Czech Republic. In total, the group utilise about 2 million m³ per year.

The sawmill industry in Austria has continually consolidated over the last few decades. In the mid 1960s there were over 4000 sawmills, whereas in the mid 1990s there are only 1700. At the same time, roundwood consumption has also increased, hence remaining enterprises have increased their output. In the Waldviertel region the same trends have occurred within the sawmill industry, with the number of enterprises decreasing by almost 20% whilst average production levels have increased two-fold.

In Waldviertel the sawmill industry is comprised largely of SMEs, which have shifted their focus to higher quality production. Essentially the value of timber can be increased either by further processing or by endeavouring to provide more customer orientated services.

In the Austrian wood processing sector, there are more than 400 enterprises employing some 27,000 people. In addition, there are also about 7000 enterprises engaged in carpentry and small scale wood processing, and who employ more than 50,000 persons. In Waldviertel, there are eleven wood processing plants, three produce finished and semi-finished wood products such as shelves, boards, boxes and pallets, whilst one produces veneer. In addition, there are also four enterprises who specialise in furniture production, and a further three who manufacture wooden houses and prefabricated houses.

Summary Conclusions

- The forest-based and related industries and companies are widely dispersed across the EU, and are not concentrated in Scandinavia
- Employment within the forest-based and related industries is widely distributed throughout the EU
- Employment within the forest-based and related industries accounts for about 9% of total employment in manufacturing within the EU
- The forest-based and related industries provides between 8-24% of total manufacturing employment within various *regions* of the EU
- Companies and employment within the forest-based and related industries are located mainly in areas of high population density
- The wide dispersed nature of the forest-based and related industries suggest that the successful implementation of well thought out policy within this field, could potentially benefit most regions of Europe.

- The forest-based and related industries are also very important to the peripheral areas of the EU, as demonstrat-

- The case study material also confirms the high propor-

- Case study information also reveals that many firms are actively engaged in Eastern European countries and Russia, particularly on the EU's border with the East, ie Finland imports a substantial amount of roundwood to North karelia; The wood industries in Drama County, Greece, imports as much as 40% of its wood supply from Bulgaria. Sawmill firms in Austria operate in the Czech Republic etc.

Chapter 11. The Role of SMEs within the Forest Cluster

11.1 The Importance of SMEs

Small & Medium Enterprises (SMEs) make up the vast majority of the companies within the industrial cluster of forest-based and related industries of the EU. Based on the SME database of Eurostat, there are over 150 thousand companies within the forest cluster (the most recent figures available are for 1992). Of this total number of companies, as much as 99% of companies are SMEs (companies employing less than 250 persons), with about 85% of these companies employing less than 20 persons. Yet these latter companies are not represented in most industrial statistics – Hence they tend to be 'invisible' and therefore not represented in industry organisations. About one-third of the companies are wood furniture manufacturers, whilst printing companies make up nearly another third. Companies manufacturing carpentry and joinery and wooden flooring etc account for about one-fifth of the total, also.

Figure 11.1 Size Structure of firms within the forest cluster

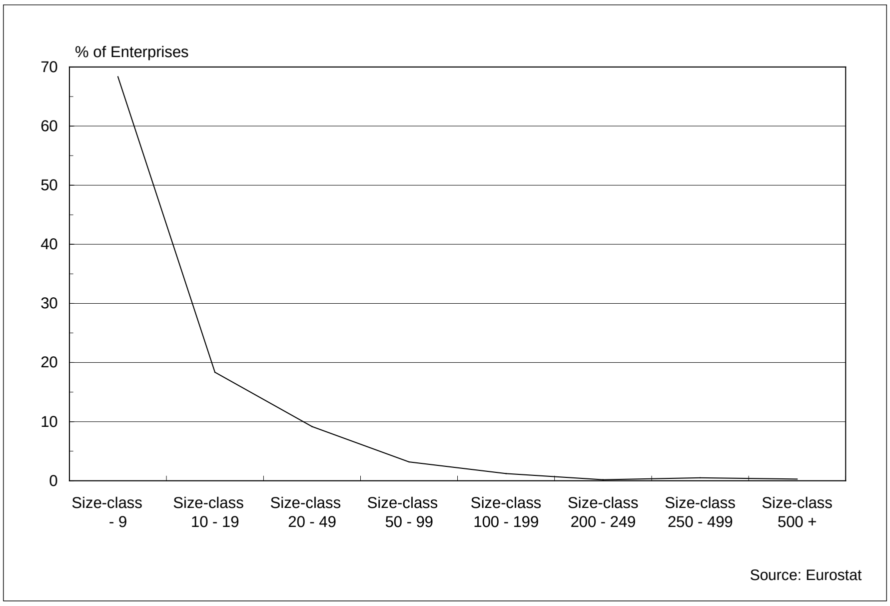


Figure 11.2 SME Employment within the EU Forest Cluster

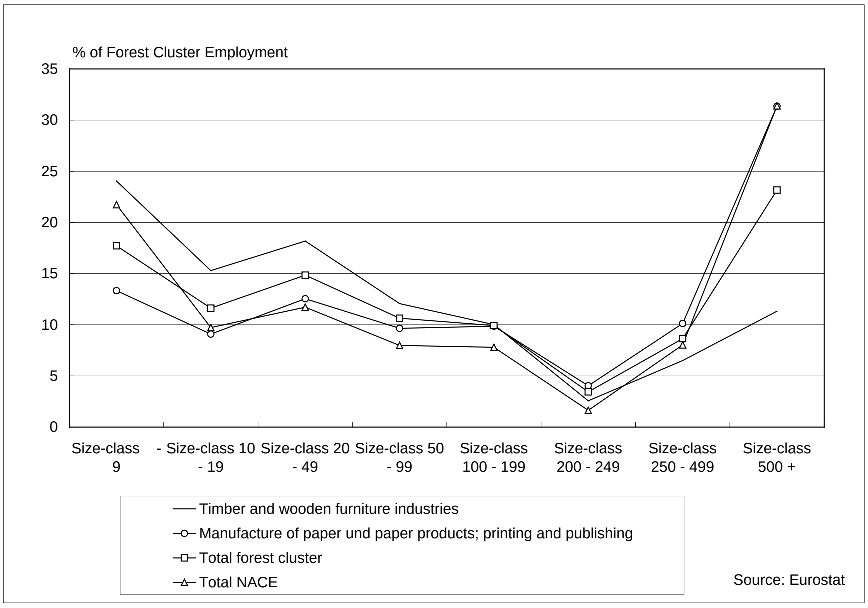
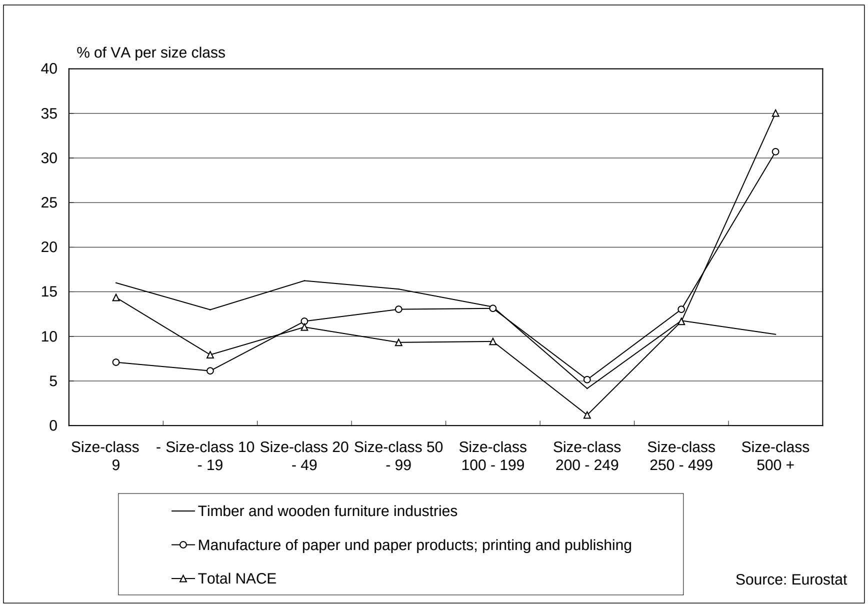


Figure 11.3 Value-added created in SMEs within the Forest Cluster



In terms of employment SMEs account for about two-thirds of the total employment. Within the mechanical wood sector (including wood furniture), SMEs account for about 90% of the employment, whereas within pulp, paper, printing and publishing, SMEs account for about 54% of the employment. The importance of SMEs are also highlighted by the fact that, many large-scale producers, nowadays outsource important tasks to SME type contractors. Hence, large-scale producers have an interest in the development of SMEs since their contractors indirectly affect their own competitive position. Nonetheless, there is some evidence to suggest that some of the larger producers are using their positions to pass on price increases to their suppliers, many of whom are SMEs, and hence they are being squeezed financially.

In terms of value-added, there is a contrast between the mechanical wood sector and the pulp and paper industries. Most of the value added (approximately 75%) is generated by the SMEs, within the mechanical wood and wooden furniture sector. However, within the pulp and paper industry, as much as 40% of the value-added is generated in medium to large scale enterprises of 250 persons or more, following more typically the manufacturing sector in this respect. Within the printing and publishing industries, the share of SMEs is very high, but value-added is higher in proportion to the number of SMEs.

Within our case study material in many sections of this report, we have highlighted the limitations, which can restrict the development of SMEs. However, one of the most significant problem is that of financing of new business activities, be it marketing, investment in new equipment or machinery, or even market intelligence information. To add to this, it is also apparent that, increasing specialisation and outsourcing within production chains, is also being used by some of the larger companies as a means to pass on their costs. The net result is that SMEs are being squeezed financially in many directions, and so possibilities for development would appear to be very limited in some cases.

Due the nature of the forest cluster, being comprised primarily of SMEs, it is therefore essential that policy reform within the forest-based and related industries are designed to facilitate the development of SMEs as well as the larger companies and industrial groups represented in the industry. However, in some of the forest cluster industries (particularly wooden furniture) it is clear that some large companies control networks of specialised production chains, which function very competitively. At the same time, many of these specialised networks are regionally concentrated.

In many other sections of this book, we have provided a great deal of information to describe some of these regional concentrations, industrial districts and agglomerations across the EU. Within there districts, one common feature is that they are characterised by very high proportions of SMEs. Moreover, these Industrial districts tend to be spawning grounds for SMEs. One example, included in this section, is 'The emergeance of industrial districts in Spain'. See box 11.1.

Hence, policies need be designed to cater for SMEs, large scale enterprises and local, regional, as well as national dimensions, in order to facilitate development of the industry. In this respect it is clear that more cluster type studies should be conducted across the regions of the EU, to provide policy relevant information at the micro and meso levels as well.

Box 11.1 The Emergence of Industrial Districts in Spain[1]

Within Spain a number of emerging industrial districts specialising in woodworking or furniture industries comprised mostly of SME's have been identified in the early nineties. The Fuenlabrada-Humanes district of Madrid, and The Vallés Oriental in Barcelona are just two examples.

In Madrid, the emergence of new firms locating in the peripheral areas of the city began in the early 1980s. Some 50% of the 1300 plants located in the peripheral areas, had moved there since 1980, with over three-quarters employing less than 25 workers. Similarly, the vast majority of these companies (70%) were not branches of other companies or firms relocating but single firms.

---

1 Source: 'The Emergence of Industrial Districts in Spain: Industrial Restructuring and Diverging Regional Responses', by Lauren Benton; In 'Industrial Districts and Local Economic Regeneration', By Frank Pyke, Werner Sengenberger, International Labour Organisation, Geneva, 1992, pp 59-68.

A study made in 1985, on two peripheral areas of Paracuellos and Fuenlabrada, showed that many of the firms were engaged in subcontracting for larger plants, and that a high percentage of the firms were woodworking and metalworking shops, with a diverse mix of other industries, especially printing, chemicals, etc. After Madrid, the Fuenlabrada area had the largest number of industrial establishments in the region (1760 plants and an industrial workforce of almost 18000). Humanes, a neighbouring town also had the highest industrial employment per 100 inhabitants in the region.

Within the district, the largest proportion of firms were in metalworking followed by wood shops specialising in wood furniture. The Fuenlabrada zone had a strong specialisation in wood furniture, and is the principal centre for production in the region, with a concentration in Fuenlabrada, Humanes, and La Moraleja of an estimated 30% of establishments in the madrid region and 47% of employment.

By the late 1980s most firms surviving, owned general or special purpose machinery, whilst over half used computers, some of these in a production capacity. Hence, this was seen as a sign that the zone served as a cradle for new enterprises that were moving more towards flexible production for widening markets.

Moreover, a later study revealed that particularly within the wood furniture sector, products were being marketed directly, and levels of skill were much higher among workers, than in other sectors. Furthermore, whilst many of the firms had adopted systems of organising production, emphasising flexible working assignment and production in short series, the wood furniture producers, showed a higher rate of participation in employers associations and co-operated in the organisation of trade shows and fairs.

In conclusion, it was found that the Fuenlabrada area had some of the features of a dynamic industrial district; a sector of innovative small firms; growing complexity of interconnections among firms; and a clear, trend towards co-operation among firms in at least one sector; the wood furniture manufacturing sector.

In Barcelona, The Vallés Oriental district in Catalonia was found to be another emerging district. As one of Spain's leading industrial regions, Catalonia was adversely affected by the economic crises between 1973 and 1983, especially within the seven comarcas that formed the greater metropolitan area of Barcelona. However, Catalonia emerged from this crises in a leading position with its indus-

With industrial growth recovering in the late 1980s, a pattern of relative growth was revealed in a group of comarcas which tend to benefit from their lower costs in land and labour and their easy access to markets via major communication routes. This process was further augmented by the sub-regional specialisations, indicated by the relative growth of industrial investments. In addition, the region also witnessed a substantial decline in the average firm size, as larger firms have been dismantled and replaced with streamlined enterprises engaging in wider networks and subcontracting

In contrast to Madrid, the greater areas of Barcelona, or comarcas, have a long tradition in industrial development and already contained intermediate towns that offered services. Hence, part of the attraction to new investors was that zones offered higher standards of living in close proximity to industrial concentrations. Moreover, these factors such as existing tradition of industrial development and entrepreneurship, established community institutions, high residential value and fluid communications with other industrial zones, appear to offer an environment which is conducive to inter-firm co-operation among new members of small industrial enterprises.

The comarca of Vallés Oriental, had experienced many of the trends described above, including the proliferation of small firms, an influx of resident from Barcelona, and a relative strengthening of its industry specialistion in wood products and plastics, particularly in furniture. However, in contrast to other parts of Spain and Catalonia, the number of industrial jobs in Vallés Oriental actually increased by 29% during the 1970s to 1980s period. In addition, networks of subcontracting and relationships of co-operation among firms appeared to be highly developed, although not to the same levels as in the industrial districts of Italy.

What was found was that the vast majority of firms (96%) in Vallés Oriental were SMEs with fewer than 100 workers, and accounted for over 55% of employment in the comarca, with some two-thirds of firms being classified as micro-enterprises having one to nine employees. Moreover, compared to other comarcas, the area had a particularly strong concentration of firms in wood furniture production and chemicals (mainly plastics), and also a significant proportion of metalworking, textiles and food processing.

In fact, a complex web of relationships in the production networks of the leading sectors in the district, particularly within woodworking, chemicals and metal, was found comprising both ture industry. The sector was characterised by very small firms, with an average of only eight workers per firm. Within the zone, firms were grouped according to product specialisation, with a full range of speciality firms serving each product mini-region.

Classic forms of vertical subcontracting were common, with firms that specialise in design and assembly subcontracting various phases of production to smaller speciality workshops. However, horizontal subcontracting was also common, since the firms need to diversify types of product within a particular style. Furthermore, the firms had also organised themselves into a commercial association to market the district's products, both wholesale and through a large retail outlet run and managed as a joint venture.

This level of inter-firm co-operation found was not as great as that found in the industrial district of Prato, in Italy, but entrepreneurs clearly valued the opportunity they have in an area such as Vallés Oriental to work closely with both clients and suppliers.

To summarise, the Vallés Oriental displays many of the characteristics of an industrial district, a complex structure of relationships among firms, growing inter-firm co-operation, and a diversity and dynamism even during the worst years of industrial recession. In contrast to the Fuenlabrada-Humanes region of Madrid, this consolidating district built upon strong local tradition of industrial development and entrepreneurship.

Growth in both places resulted from a more general pattern of productive decentralisation that drew investment away from metropolitan core areas and from first ring industrial centres and towards a second, less developed ring. This process, also favoured the development of small and medium sized enterprises to allow diversified, flexible production.

Summary Conclusions

- The forest cluster is comprised primarily of SMEs (employing 250 persons or less), which account for about 99% of the total enterprises.
- SME size classes of 20 employees or less make up the vast majority of the industry – accounting for about 85% of all companies within the forest cluster – yet these companies tend to be invisable in industrial statistics.
- SMEs account for about two-thirds of employment and VA within the forest cluster
- Within the mechanical wood sector (including wood furniture), SMEs account for about 90% of the employment, whereas within pulp, paper, printing and publishing, SMEs account for about 54% of the employment.
- Due to the delicate nature of many SMEs within the cluster (financial constraints), many of who are subcontractors – the risk of large-scale unemployment, due to small fluctuations in demand for example, is ever present and hence caution is urged before implementing policy reforms.
- Policies aimed at the more powerful industrial groups – need to be sensitive to the SMEs within the cluster as well.

Chapter 12. Trade Analysis

12.1 Trade Statistics Methodology

Initially, the research carried out to characterise the Finnish Forest Cluster (Lammi 1994)[1] was utilised to help sketch out some of the most likely features of the Forest-Based and Related Industrial Clusters of the European Union. In this chapter, we will refer to this grouping of related industries as the EU Forest Cluster. In addition, further information regarding the make-up of the Swedish forest cluster (Sövell, Zander and Porter 1991)[2] was also incorporated. Finally, company annual reports from forest-based and related industry firms (from all over Europe) were examined to ensure that most aspects of the forest cluster had been considered sufficiently. As a result, a fairly broad version of the forest cluster was developed and this has been termed the 'secondary forest cluster'.

Using this secondary cluster definition, export values have been estimated to test the extent by which the additional products effect the total value of the cluster, in comparison with that value obtained when the Finnish forest cluster definition is used. Using this method, it was found that whilst the total value differed by as little as 5%, in the case of Finland, secondary cluster values also differed by as much as 30% or more, in the case of Germany. This in fact, demonstrates the sensitivity of defining the EU forest cluster.

After, further work and subsequent to attending the pulp and paper conference and exhibition in June 1998 (Helsinki), additional adjustments were made. Thus from an initial list of some 140 products, as identified in the Finnish forest cluster, the list of products had been extended to some 200, which have now been termed as 'Core EU Forest Cluster products'. This list now forms the basis for all calculations of forest cluster trade in exports and

---

[1] 'The success story of paper, machines and know-how – The competitive advantage of the forest cluster'. The Research Institute of the Finnish Economy, ETLA B 99.

[2] Advantage Sweden, Sövell, Zander and Porter. (Section on Industrial Clusters in Sweden, pp 76-85 'Forest Products'.) Norstedts. 1991.

imports mentioned in this chapter, and also helped to clarify some of the industries to include and to exclude. Although, this definition is by no means fixed, and no-doubt regional variations will exist throughout Europe, it is the most representative definition at this present time. Initially, our objective was to determine the EU Forest Cluster, via analysis at three levels – product, industry and firm – indeed, our firm level review has confirmed our definition, although in some cases it is likely that some products (chemical speciality inputs) should be added.

In terms of statistics, every effort has been made to utilise latest available data, which has been compiled for all countries across the European Union and OECD and which is also produced on a comparable basis. In practice, this means that for product statistics, the OECD International Trade by Commodities Statistics (SITC REV3) data base has been used, the latest data available is therefore that for 1995. Appendix A provides details of all geographical classifications and country codes adopted in the OECD database. All products statistics used in this review have been collated at 4 and 5 digit levels, i.e. as accurate as the data would allow.

12.2 General Overview In Terms Of Total Exports[3]

12.2.1 Growth in Export Trade with the World

In 1989, total trade in OECD exports to the world amounted to \$2.1 trillion US. Between 1989 and 1995, OECD exports to the world had grown by 61% to \$3.4 trillion US. During the same period, trade exports to the world from the fifteen countries which now represent the European Union (EU15) grew at 61.9%, slightly more than total OECD trade with the world. If one takes this figure to represent the average growth in trade amongst EU countries, Germany, the UK, Greece and Sweden all experienced lower than average growth in exports to the world. All other countries experienced growth rates in excess of the average (between 64% and 78%) however, both Ireland and Spain experienced growth rates in excess of 92%.

---

[3] Total Exports includes Intra-EU trade.

Table 12.1 Growth in Export Trade to the World (billions US$)

	AUT	BEL	DEU	DNK	ESP	FIN	FRA	GBR
Total trade (World) 1995	58	168	524	47	91	40	284	232
Total trade (World) 1989	32	101	342	29	47	23	173	151
Growth in Exports to World (%)	78.1	66.0	53.2	64.2	92.5	73.5	64.2	53.4
	GRC	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**	**EU15**	**OECD**
Total trade (World) 1995	11	44	231	177	23	77	2008	3392
Total trade (World) 1989	7.5	21	141	108	13	52	1240	2105
Growth in Exports to World (%)	45.3	112.1	64.6	64.4	77.2	50.0	**61.9**	61.15
Growth in Total OECD Trade (%)								**61.15**

12.2.2 Significance of EU countries in OECD trade

During 1989, export trade from the EU15 countries accounted for 58.9% of all OECD export trade with the world. By 1995, the EU15's share had grown to 59.2%. Within the EU, Germany,

Table 12.2 Significance of EU Countries in Total OECD Trade (% of total export trade)

	AUT	BEL	DEU	DNK	ESP	FIN	FRA	GBR
Share of total OECD Exports 1995 (%)	1.7	5.0	15.4	1.4	2.7	1.2	8.4	6.8
Share of total OECD Exports 1989 (%)	1.5	4.8	16.2	1.4	2.2	1.1	8.2	7.2
	GRC	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**	**EU15**	**OECD**
Share of total OECD Exports 1995 (%)	0.3	1.3	6.8	5.2	0.7	2.3	**59.2**	100
Share of total OECD Exports 1989 (%)	0.4	1.0	6.7	5.1	0.6	2.5	**58.9**	100

France, Italy, the UK, Holland and Belgium/Luxembourg make up about 48% of exports to the OECD. Germany has the largest share at 15.4%, France accounts for 8.4%, both the UK and Italy have 5.8% each while Holland and Bel/Lux have about 5% each. During the period 1989 to 1995, most of the EU15 countries gained in market share of OECD exports to the world, however, it is notable that Germany, the UK and Sweden each lost ground during the same period.

12.2.3 Significance of the forest cluster in terms of trade

In 1989, forest cluster trade accounted for about 6.4% of total OECD exports to the world, however this figure has since fallen in relative terms to 6.2% in 1995. Within the EU, the same story is repeated. In 1989, forest cluster trade accounted for 6.7% of total EU exports to the world, whereas in 1995 it has fallen in relative terms to 6.6% of total EU exports.

Table 12.3 Significance of the Forest Cluster in Terms of Export Trade to the World

	EU15	OECD
Forest Cluster Share of Total EU Trade 1995 (%)	6.56	
Forest Cluster Share of Total EU Trade 1989 (%)	6.72	
Forest Cluster Share of Total OECD Trade 1995 (%)		6.22
Forest Cluster Share of Total OECD Trade 1989 (%)		6.35

12.2.4 Growth in forest cluster trade

Between 1989 and 1995 forest cluster exports from the OECD grew by 58% to $211 billion US whilst total export trade in the OECD grew faster by 61%. This therefore reveals that the growth in forest cluster export trade in the OECD was lagging behind total export trade by 3% over the period. Similarly, forest cluster trade in the EU has grown less at 57.9% to $132 billion US, and when compared with total export growth in the EU, of 62%, shows that underlying growth in the EU forest cluster exports has also been lagging behind by 4% over the same period.

Table 12.4 Growth in EU Forest Cluster Trade within OECD (billions US$)

	AUT	BEL	DEU	DNK	ESP	FIN	FRA	GBR
Total Trade Forest Cluster Exports 1995	7.6	8.1	28.6	3.8	4.7	15.5	12,9	9.3
Total Trade Forest Cluster Exports 1989	4.5	4.9	18.7	2.1	2.6	10.2	8.0	5.6
Growth in Forest Cluster Trade (%)	68.0	67.4	52.5	83.4	75.9	51.7	61.2	68.0
Underlying Growth (%)*	10.0	9.4	-5.5	25.4	17.9	-6.3	3.2	10.0
	GRC	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**	**EU15**	**OECD**
Total Trade Forest Cluster Exports 1995	0.3	0.8	14.5	7.7	2.8	15	**131.7**	**211**
Total Trade Forest Cluster Exports 1989	0.15	0.5	8.4	4.8	1.9	11	83.4	134
Growth in Forest Cluster Trade (%)	87.7	51.4	73.6	61.6	44.4	36.6	**57.9**	**58.0**
Underlying Growth (%)*	29.7	-6.6	15.5	3.6	-13.6	-21.4	-0.1	0.0

* Underlying Growth (taking OECD forest cluster exports to the World as average growth).

Table 12.5 Significance of Forest Cluster Exports to the World within the OECD

	AUT	BEL	DEU	DNK	ESP	FIN	FRA	GBR
1995 Share of Forest Cluster Exports to World within OECD (%)	3.60	3.85	13.5	1.79	2.23	7.32	6.10	4.42
1989 Share of Forest Cluster Exports to World within OECD (%)	3.38	3.63	14.0	1.54	2.01	7.63	5.98	4.15
Change in Share of Forest Cluster Exports within OECD	0.22	0.22	**-0.5**	0.25	0.22	**-0.31**	0.12	0.27
	GRC	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**	**EU15**	
1995 Share of Forest Cluster Exports to World within OECD (%)	0.13	0.36	6.88	3.66	1.32	7.19	62.37	
1989 Share of Forest Cluster Exports to World within OECD (%)	0.11	0.37	6.26	3.58	1.44	8.32	62.42	
Change in Share of Forest Cluster Exports within OECD	0.02	-0.01	0.62	0.08	**-0.12**	**-1.13**	**-0.05**	

Taking this figure of 58% as the average growth of OECD forest cluster exports to the world, it is clear that the majority of major forest cluster countries have experienced considerably lower than average growth between 1989 to 1995. For example, Germany, Finland and Sweden each experienced growth rates of 52% or less in forest cluster trade alone. Table 12.4. Moreover, in examining the growth in relative terms in more detail, again, it can be seen that Finland, Sweden and Germany all experienced a decline in relative terms whilst at the same time losing share in forest cluster exports to the world. Table 12.5.

In comparing each individual country's growth rate in forest cluster trade with it's total export trade growth to the world, it is noticeable that in some countries the importance of forest cluster exports is dwindling rather sharply. For example, Finland, Sweden, Austria, Portugal and Spain all show large differentials in respective growth rates between forest cluster trade and total trade. Thus in examining the relative shares of forest cluster exports in proportion to the country's total exports to the OECD, it is no surprise that in each one of these countries the reliance upon forest cluster trade is on the decrease. Tables12.6 and 12.7.

One explanation here could be the trend away from reliance on natural 'physical' resources towards other sectors and the creation of intangible resources, such as those found in knowledge-based

Table 12.6 Growth in Forest Cluster Trade compared to Total Trade 1989-95 (%)

	AUT	**BEL**	**DEU**	**DNK**	**ESP**	**FIN**	**FRA**	**GBR**
Growth in Country's Exports to World	78.1	66.0	53.2	64.2	92.5	73.5	64.2	53.4
Growth in Forest Cluster Exports	68.0	67.4	52.5	83.4	75.9	51.7	61.2	68.0
Growth Differential in exports to World	**-10.1**	1.4	-0.7	19.2	**-16.6**	**-21.8**	-3.0	14.6
	GRC	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**	**EU15**	**OECD**
Growth in Country's Exports to World	45.3	112.1	64.6	64.4	77.2	50.0	61.9	61.2
Growth in Forest Cluster Exports	87.7	51.4	73.6	61.6	44.4	36.6	57.9	58.0
Growth Differential in exports to World	42.4	-60.7	8.9	-2.8	**-32.8**	**-13.5**	-4.0	-3.1

Table 12.7 Forest Cluster share of Country's total trade

Significance of Forest Cluster Trade	AUT	**BEL**	**DEU**	**DNK**	**ESP**	**FIN**	**FRA**
Forest Cluster's Share of Country's Total Trade 1995	**13.1**	4.8	5.4	8.0	5.2	**38.3**	4.5
Forest Cluster's Share of Country's Total Trade 1989	**13.9**	4.8	5.5	7.1	5.7	**43.8**	4.6
Significance of Forest Cluster Trade	**GBR**	**GRC**	**IRL**	**ITA**	**NLD**	**PRT**	**SWE**
Forest Cluster's Share of Country's Total Trade 1995	4.0	2.5	1.7	6.3	4.4	**12.3**	**19.6**
Forest Cluster's Share of Country's Total Trade 1989	3.7	2.0	2.4	6.0	4.4	**15.0**	**21.5**

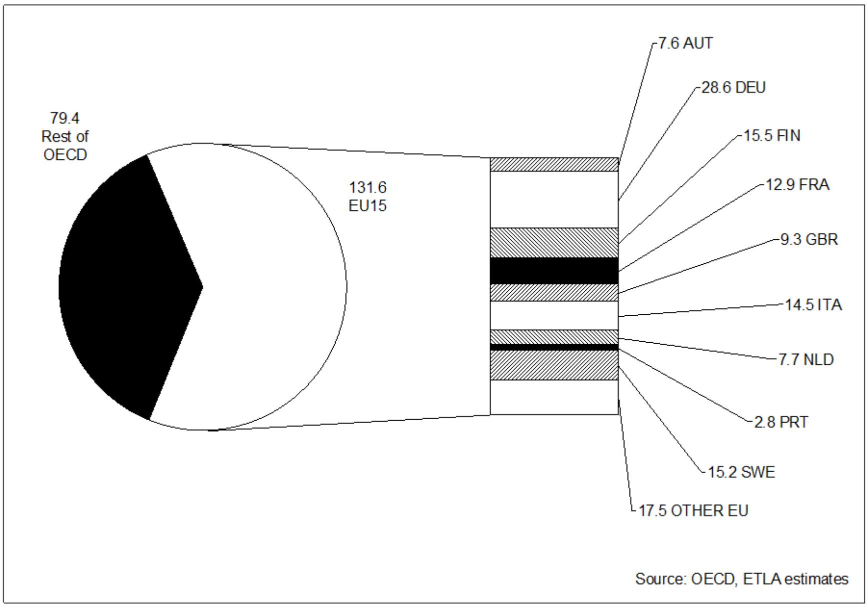
industries, a trend typical in Western European economies.[4] Although service sector activities are not included in the SITC data, it is the indirect impact that this trend may induce as each economy diverts more of its resources to services sector consumables, such as computer and electronic equipment. Hence, this increased demand for services sector related products may cause the decline in relative terms.

12.2.5 Significance of Forest Cluster Trade within EU

In 1995, forest cluster exports originating from all industrialised countries (OECD) totalled some US$211 billion, with the EU15 accounting for 62% of this. This figure of US$131.6 billion, for the whole EU forest cluster, represents about 6.2% of total OECD exports. The respective country values for total forest cluster exports are detailed in table 12.4 and also presented graphically in the figure below.

4 Another explanation could be due to fluctuations in pulp and paper commodity prices over the same period. For example, in terms of trade value in exports, pulp, paper and related inputs make up for a large proportion of the total value in the forest cluster. Because of this fact, price movements may exaggerate growth or decline in forest cluster trade figures. However, this factor requires further scrutiny.

Figure 12.1 OECD Exports of Forest Cluster Products to the world 1995 (Billions US$)



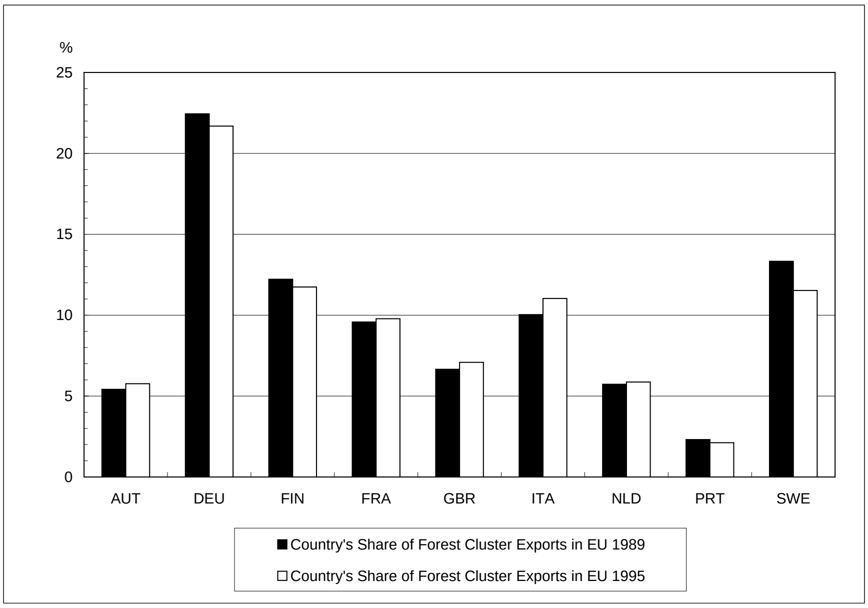
12.2.6 Share of Forest Cluster Exports

The origin of forest cluster exports is widely dispersed around the EU and not concentrated in Scandinavia for example. In the past Germany, Sweden and Finland tended to dominate the export scene having the largest share of forest cluster exports. However, this situation has been changing. In recent years, other countries within the EU have increased their share of forest cluster exports. Most notably, Italy's share is growing, rapidly catching that of Finland and Sweden. However, despite advances made by some countries, the EU forest cluster is very slowly losing its share in total exports to the OECD. Figure 12.2 below provides a selection of relative shares.

12.2.7 Significance of Forest Cluster Export Trade within the EU

In terms of export trade, the significance of forest cluster exports is more important to some countries than others. Although, it is no surprise that notorious resource based economies of Sweden, Austria and Finland are quite reliant on forest cluster exports, it may

Figure 12.2 Share of Forest Cluster Exports within the EU



be surprising to some that Portugal is also equally as reliant on these exports. One striking feature however, is the sharp decline in reliance that these countries have witnessed in recent years. In contrast, other countries such as Italy, the UK and the Netherlands have become somewhat more reliant on forest cluster exports.

12.2.8 Make-up of Export Value

To examine were most of the export value is derived from, statistics collated for EU forest cluster exports, have also been grouped together in certain categories of products based on aggregate level SITC classifications. By grouping the data together, at the three-digit level, it is evident that the largest proportion of export value, 43%, is derived from paper and paperboard products. Printed matter accounts for a further 11%, whilst wooden furniture accounts for another 10%. Manufactured wood products together adds an additional 8%, simply and roughly worked wood another 7%, whilst machinery for working and treating wood add a further 3%. Pulp and waste paper adds about 5% and paper and pulp mill machinery about 4%. The remainder consists of many speciality inputs such as kaolin or china clays used in paper production. A selection of EU countries is presented in the figure below.

Figure 12.3 Forest Cluster's Share of Country's total exports (%)

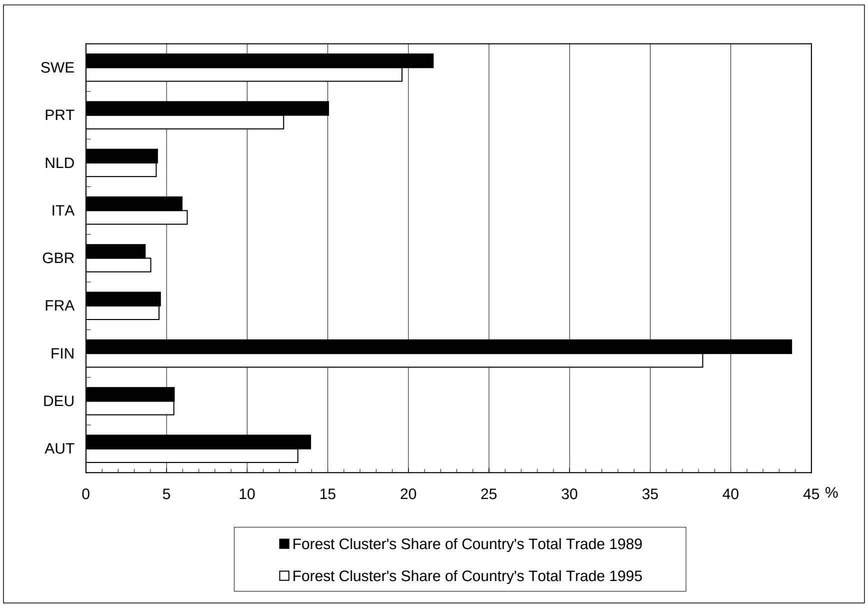
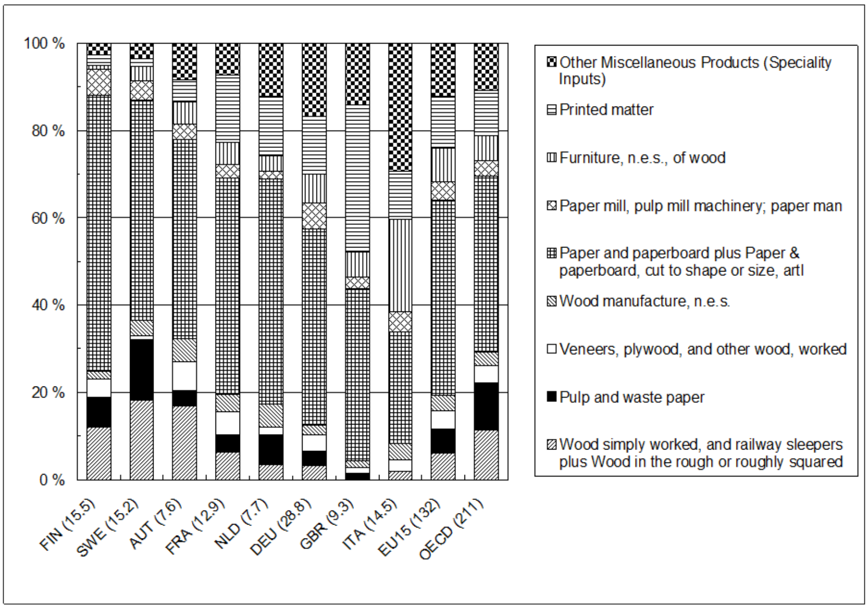


Figure 12.4 Where Export Value is derived in the EU Forest Cluster (1995)*



* Note: Includes Intra-EU trade.

As a result of producing this summary it also becomes clear that countries whom are naturally endowed with wood raw material resources appear to specialise in the major groups of forest products, whereas, the remaining countries tend to supply more of the miscellaneous or 'speciality input' type forest cluster products. For example, Finland, Sweden and Austria all have relatively high shares in the main products category yet very low shares of the miscellaneous categories (speciality inputs). In contrast, countries such as Germany, Italy and perhaps the UK have higher shares in this miscellaneous category, and at the same time also relatively high shares in the major products grouping.

12.3 Forest Cluster Trade

12.3.1 EU Forest Cluster Trade, General (1989-95)

In 1989, the total value of EU Forest Cluster exports to the World (including intra-EU trade[5]) amounted to $84 billion US and accounted for 6.7% of the EU's total exports to the World and as

5 Intra-EU trade is trade between EU countries only.

much as 7.2% of total exports to the OECD area. Of this total,

Table 12.8 EU Forest Cluster Exports to Regions 1989 (billions US$)

	EU EXP TO WORLD	EU EXP TO OECD24	EXTRA EU TRADE*	INTRA EU TRADE	OECD24 - INTRA EU TRADE
Total Trade to Region	1241	1002	444.7	796.3	205.6
Total Forest Cluster Exports to Region	83.6	72.2	24.4	59.2	13.1
Forest Cluster Exports (as % of Total Trade to Region)	6.7	7.2	5.5	7.4	6.4
Forest Cluster Exports (as % of total FC Exports to the World)	100.0	86.4	29.2	70.8	15.7

*EXTRA EU TRADE = WORLD - INTRA EU TRADE

about 86% went to the OECD area with about 71% remaining inside the EU (intra-EU trade). Consequently, some $24 billion US, or 29%, were exported outside the EU (extra-EU trade) with about 16% being exported to other OECD countries located outside the EU. Table 12.8.

The destination of EU15 exports to the rest of the world (extra EU trade) was directed predominantly to Asia, 6.5%, and to North America, 5.8%, with about 2.6% being exported to Central and Eastern Europe (CEE) and the Former Soviet Union (FSU) and about 2.4% to Africa. Oceania and Central and South America (CSA) received about 1.3% and 1.0% respectively. Extra-EU trade in forest cluster exports accounted for about 5.5% of total extra-EU trade, while intra-EU trade in forest cluster exports was higher at about 7.4% of total intra-EU trade. Tables 12.8 & 12.9.

By 1995, the total value of EU forest cluster exports to the World had grown by 58% to $132 billion US, accounting for 6.6% and 7.0% of total EU exports to the World and OECD, respectively, which represents a slight decline relative to total trade. At the same time, the structure of exports has also changed since 1989. Forest cluster exports to the OECD accounted for about 83% of total EU forest cluster exports, whilst intra-EU trade accounted for 68%, both of which represent a fall relative to total trade. More importantly, however, extra-EU trade in forest cluster exports has grown to represent about 32% of total EU forest cluster exports to the world. Table 12.10.

Table 12.9 Destination of Extra EU Exports 1989 (billions US$)

	EU EXP TO NA	EU EXP TO ASIA	EU EXP TO OCEANIA	EU EXP TO AFRICA	EU EXP TO CSA	EU EXP TO CEE	EU EXP TO CEE +USSR
Total Trade to Region	100.6	122.9	11.0	43.2	18.1	13.8	31.5
Total Forest Cluster Exports to Region	4.8	5.5	1.1	2.1	0.8	0.7	2.2
Forest Cluster Exports as % of Total Trade	4.8	4.4	9.8	4.7	4.6	5.4	7.0
Forest Cluster Exports (as % of total FC Exports to the World)	5.8	6.5	1.3	2.4	1.0	0.9	2.6

Table 12.10 Growth Trends in Exports to Regions 1989-95 (billions US$)

	EU EXP TO WORLD	EU EXP TO OECD26	* EXTRA EU TRADE	INTRA EU TRADE	OECD26 - INTRA EU TRADE
Total trade to Region (1995)	2011	1568	767	1244	324
Total Forest Cluster Exports to Region (1995)	132.1	109.4	42.4	89.7	19.8
Forest Cluster Exports as % of Total Trade to Region	6.6	7.0	5.5	7.2	6.1
Destination of Forest Cluster Exports (as % of total FC Exports)	100.0	82.9	32.1	67.9	15.0
Growth in Total trade to Region	62.1	56.5	72.5	56.2	57.6
Growth in Total Forest Cluster Exports to Region	58.0	51.6	**73.4**	51.6	51.1
Underlying Growth in Exports to Region #	-4.0	-4.9	**0.9**	-4.6	-6.5

*EXTRA EU TRADE = WORLD - INTRA EU TRADE

Underlying Growth (Taking Growth in Total Trade to the Region as Average Growth).

As in 1989, North America and Asia were still the main destination for EU forest cluster exports in 1995, however, Asia now accounted for about 9.2% and North America about 5.2%. Forest cluster exports to Oceania, Africa and CSA were roughly the same, but exports to CEE and the Russian Federation accounted for about 4.7%. This later share can partly be attributed to the composition of product statistics, which have changed since the break-up of the Former Soviet Union. However, the increase also demonstrates the rapid growth of forest cluster exports to the east due to the fact that figures for the Russian Federation do not include the Republics of the Former Soviet Union. Table 12.11

Notwithstanding growth in absolute terms of total EU forest cluster exports, which generally ranges between 60% and 70%, for the period 1989-95, it should be noted that 'a rising tide lifts all boats'. Therefore, one should also compare growth rates in forest cluster exports to growth rates in total exports, within each region of interest. Using this method, it can be seen that the underlying growth in forest cluster exports to the World was -4%, to the OECD area, -5%, about -5% for intra-EU trade and also about -7% for extra-EU trade to the OECD. In other words forest cluster trade lagged behind the growth in total export trade. However, extra-EU trade had grown by about 1%. Within extra-EU trade, forest cluster exports to Asia, CEE, Africa and CSA grew much faster than total exports to each region by between 12% and 100%. In contrast, the underlying growth of forest cluster exports to N. America and Oceania, was also lagging in the growth in total exports. Tables 12.10 and 12.11.

Table 12.11 Trends in Extra EU Exports[6] 1989-95 (billions US$)

	EU EXP TO NA	EU EXP TO ASIA	EU EXP TO OCEANIA	EU EXP TO AFRICA	EU EXP TO CSA	EU EXP TO CEE	EU EXP TO CEE +Russia

[6] Extra-EU exports refer to products exported from the EU to external destinations outside the EU.

Total trade to Region 1995	147	253	17	59	45	69	89
Total Forest Cluster Exports to Region 1995	6.9	12.2	1.5	3.3	2.2	4.6	6.2
Forest Cluster Exports as % of Total Trade	4.7	4.8	9.0	5.6	4.8	6.7	6.9
Forest Cluster Exports (as % of total FC Exports to the World)	5.2	9.2	1.2	2.5	1.6	3.5	4.7
Growth in Total trade to Region (%)	45.9	106.1	56.8	35.6	147.2	397.0	183.4
Growth in Total Forest Cluster Exps to Region (%)	42.0	123.1	43.6	61.2	158.8	516.1	178.8
Underlying Growth in Exports to Region #	-3.9	17.0	-13.2	25.5	11.6	119.2	-4.6

Underlying Growth (Taking Growth in Total Trade to the Region as Average Growth).

12.3.2 Forest Cluster Trade in 1989

In 1989, EU forest cluster exports accounted for about 71% of forest cluster exports within the world. Of this figure, the main destination of intra-EU exports was Germany whose share was 14.3%, followed by France and the UK with 11.6% and 11.5% respectively. Other notable recipients of forest cluster exports were the Netherlands with 7.2% and Belgium/Luxembourg with 5.8%.

The origin of forest cluster exports within the EU, although intuitive, is not what one might first perceive. Germany was the biggest exporter with 15.6% of the EU's forest cluster exports. Sweden was the second largest exporter with 9.9%, followed by Finland, who exported 8.1%. The next most significant forest cluster exporters were France and Italy with about 6.7% and 6.5%, respectfully.

In terms of imports, intra-EU trade accounted for about 73% of forest cluster imports. The most significant importer was Germany attracting about 20% of forest cluster imports, closely followed by the UK with 17%, and France, 16%. Other major recipients of forest cluster exports were the Netherlands, with about 10% and Italy and Bel/Lux at around 8% each. The origin of these imports naturally follow the patterns mentioned in the above export trends, although one or two discrepancies are discernible.

From this trade analysis, it was clear that most forest cluster trade takes place between neighbouring countries. For example, Austria's forest cluster exports are delivered mainly to Germany and Italy. However, Sweden and Finland appear to be exceptions to this, directing most of their exports to the two major markets of Germany and the UK.

An in-balance within the trade figures for the whole EU was found, however these in-balances are due to statistical discrepancies, which are within acceptable tolerances.[7] For example, comparing both imports and exports for 1989, the EU forest cluster trade balance, was in deficit by some $1.94 billion US (about 3% of exports).

Nonetheless, the figures also reveal which countries within the EU15 were net exporters or net importers of forest cluster products. The most significant net exporter was Sweden with a forest cluster trade surplus of $6.1 billion US, closely followed by Finland with $5.6 billion US. Germany was the next major net exporter with about $1 billion US. In terms of net imports, the UK was by far the largest market with some $7.2 billion US. The next most significant market for imports of forest cluster products was France at $4.2 billion US. Other large import markets were the Netherlands and Spain with $1.8 and 1.0 billion US, respectively.

As mentioned previously, the main destination of exports is the OECD, which in 1989 accounted for about 86% of the EU's forest cluster exports to the world. Of these exports to the OECD, Germany, Sweden and Finland rank in this order as the top exporters. In examining the main destination of extra-EU exports around the world Germany is the most substantial exporter, occupying first position in exports to Central and Eastern Europe, N. America and second place in Asia. The two latter regions representing the largest two markets outside the EU. Finland were the most significant exporters to Asia and the Former Soviet Union, whilst France were the biggest exporter to Central and South America and Africa.

---

7 Statistical discrepancies relate to the difference between 'cif' (cost including freight) and 'fob' (free on board) prices related to imports and export statistics. At the same time the EU15 did not exist as an entity until 1995, so information is not readily available to check this in more detail.

Imports of forest cluster products from other parts of the world generally followed the same patterns as exports. For example imports from the OECD represented nearly 88% of total forest cluster imports from the world, whilst imports from N. America and Asia represented about 10% and 6% of total imports. Of the total forest cluster imports Germany was the main destination for imports receiving about 20% whilst the UK was the second most important destination, accounting for about 18.5%. In fact, the UK was the main destination for forest cluster imports from N. America, Asia, the FSU, CSA and Oceania. Germany was second in these markets but also ranked first in imports from CEE.

In 1989, the EU's forest cluster trade balance with the world was in deficit by about $374 million US, although this was only 1% of the total trade deficit with the rest of the world. The most significant net exporter was Finland with $8.6 billion US, then Sweden $8.1 billion US and then Germany with $1.6 billion US. The main destination for imports was the UK who had a staggering $9.9 billion US trade deficit, whilst France was also in deficit by about $4.6 billion US.

As already noted the EU was a net importer of forest cluster products in 1989. However, a substantial amount of deficit, $3.2 billion US, was also induced through trade with N. America, and also $1.6 billion deficit by CEE. On the positive side, the EU had a trade surplus of $1.2 billion US with Asia and $1.1 billion US with Oceania.

12.3.3 Forest Cluster Trade 1995

In 1995, trade in forest cluster exports within the EU accounted for about 68% of forest cluster exports within the world. Of this figure, the main destination of intra-EU exports was Germany whose share was 16.5%, followed by France and the UK with 10% and 9%, respectively. Other notable recipients of forest cluster exports were the Netherlands with 7% and Belgium/Luxembourg with 6%. With the exception of Germany, these figures represent a decrease in relative shares since 1989, especially in the UK. Table 12.12.

In the following tables, percentage shares within the tables refer to proportions of each country's total forest cluster exports. Within the Import tables, shares listed under each column refer to the percentage of that country's exports to each country listed in each row, whereas within the export tables, the reverse is the case. Export shares are listed for each country across the table.

The origin of forest cluster exports within the EU, followed the same sort of patterns to those in 1989. In 1995, Germany was the biggest exporter with 19% of the EU's forest cluster exports. Sweden was the second largest exporter with 12%, followed by Finland, who exported 11%. However, France and Italy followed quite closely with shares of about 10% each. Again these shares were similar to those found in 1989, but the shares for France and Italy reveal rapid increases.

In terms of imports, intra-EU trade accounted for about 70% of forest cluster imports. The most significant importer was Germany attracting about 21% of forest cluster imports, closely followed by France with 15%, and the UK, about 13%. Other major recipients of forest cluster exports were the Netherlands, Italy and Bel/Lux, with about 9% each. These figures show an increase in relative terms, although the UK was the exception to this indicating a large decrease in imports. The origin of these imports, as in 1989, followed the patterns mentioned in the above export trends.

Table 12.12 EU FOREST CLUSTER *EXPORTS* WITHIN EU - BY COUNTRY - 1995 ($ mill)

	AUS	BEL-LU	DEN	FIN	FRA	GER	GRE	IRE	ITA	NET	POR	SPA	SWE	UK	EU15
AUSTRIA Exports to:	0,0	133,7	23,4	23,4	322,5	2762,7	60,0	6,0	1317,1	256,5	8,4	122,1	31,2	288,1	**5355,2**
BELGIUM Exports to:	65,6	0,0	63,9	34,9	2303,7	1516,6	18,0	24,6	390,2	2032,9	39,2	136,5	79,0	541,3	**7246,5**
DENMARK Exports to:	78,0	113,4	0,0	65,2	185,3	1647,4	4,7	10,3	59,8	176,5	8,9	34,2	496,4	241,9	**3122,1**
FINLAND Exports to:	177,7	767,8	528,2	0,0	1019,7	2722,5	141,3	104,9	369,5	692,3	92,2	644,3	691,8	2202,3	**10154,4**
FRANCE Exports to:	161,0	1649,4	90,2	37,0	0,0	2761,2	73,9	64,2	1198,8	730,3	136,9	1046,8	103,6	1194,2	**9247,4**
GERMANY Exports to:	2644,2	1912,4	640,7	222,8	3375,7	0,0	206,7	84,2	1645,4	2793,4	140,7	662,6	629,1	1868,0	**16825,9**
GREECE Exports to:	0,4	1,2	0,5	0,8	3,7	28,4	0,0	0,1	24,0	7,8	0,2	2,7	0,2	10,3	**80,2**
IRELAND Exports to:	1,5	41,0	9,0	0,9	40,2	37,5	2,8	0,0	16,8	29,0	0,7	6,3	6,3	438,7	**630,7**
ITALY Exports to:	409,8	525,8	97,9	55,5	2205,7	3020,6	298,5	27,5	0,0	387,4	112,5	593,9	130,0	814,6	**8679,7**
NETHERLANDS Exps to:	127,6	1367,4	140,9	75,3	1002,2	2274,7	41,7	39,6	152,5	0,0	64,1	174,3	140,9	823,1	**6424,3**
PORTUGAL Exports to:	43,2	50,2	16,7	2,4	440,2	315,6	26,6	2,4	159,0	203,1	0,0	640,9	23,4	328,8	**2252,4**
SPAIN Exports to:	60,4	92,3	16,6	21,9	922,7	486,0	38,7	11,3	309,3	113,6	633,9	0,0	38,1	427,2	**3171,9**
SWEDEN Exports to:	275,5	417,3	1138,3	400,8	964,8	3052,7	98,9	172,9	788,5	1067,4	106,5	363,5	0,0	2251,1	**11098,3**
UK Exports to:	74,7	403,4	129,4	148,6	943,8	1140,4	93,6	926,3	362,4	632,5	79,7	286,1	206,5	0,0	**5427,1**
Total Forest Cluster Exports to EU Country	**4119,6**	**7475,4**	**2895,6**	**1089,7**	**13730,2**	**21766,2**	**1105,4**	**1474,2**	**6793,1**	**9122,8**	**1424,0**	**4714,0**	**2576,5**	**11429,6**	**89716,2**
As a % of Total EU FC Exports to World	3,1	5,7	2,2	0,8	10,4	16,5	0,8	1,1	5,1	6,9	1,1	3,6	2,0	8,7	67,9

Source: OECD, SITC Statistics.

Table 12.13 EU FOREST CLUSTER *IMPORTS* WITHIN THE EU - BY COUNTRY - 1995 ($ mill)

	AUS	BEL-LU	DEN	FIN	FRA	GER	GRE	IRE	ITA	NET	POR	SPA	SWE	UK	EU15
AUSTRIA Imports from:	0,0	88,1	77,0	213,8	132,8	3165,7	1,5	3,8	380,8	152,3	42,9	59,2	303,8	87,6	4709,4
BELGIUM Imports from:	110,8	0,0	114,4	853,3	1645,2	2008,7	6,4	41,3	485,7	1542,3	47,8	93,0	396,4	415,5	7760,8
DENMARK Imports from:	22,2	67,6	0,0	566,7	93,3	768,7	1,0	8,7	116,2	176,7	20,7	17,4	1223,9	163,5	3246,7
FINLAND Imports from:	16,9	56,1	56,9	0,0	50,6	300,9	0,7	3,1	54,5	67,7	7,3	22,9	383,6	175,0	1196,0
FRANCE Imports from:	276,8	1910,7	174,5	1223,3	0,0	3463,1	13,2	64,0	1862,2	873,7	423,5	841,4	1046,7	939,5	13112,6
GERMANY Imports from:	1833,1	1241,0	1057,0	2586,0	2311,9	0,0	18,1	51,6	2263,4	1686,6	382,9	372,1	2787,4	1054,8	17646,0
GREECE Imports from:	64,6	21,2	4,4	146,5	74,0	235,3	0,0	3,3	294,7	48,7	26,0	47,1	108,9	98,5	1173,0
IRELAND Imports from:	4,0	18,3	7,2	103,5	63,2	90,2	0,1	0,0	17,6	45,1	3,6	10,0	142,4	835,7	1340,8
ITALY Imports from:	1320,9	372,0	69,1	395,7	1350,1	1862,3	25,2	22,9	0,0	235,7	161,7	314,9	844,4	375,1	7349,8
NETHERLANDS Imps from:	169,9	1326,2	126,7	593,1	622,7	2715,6	2,1	51,9	263,4	0,0	158,7	80,1	1115,7	504,4	7730,5
PORTUGAL Imports from:	8,3	46,7	8,6	94,8	135,2	128,4	0,3	1,5	95,2	40,6	0,0	592,3	125,8	82,2	1359,9
SPAIN Imports from:	100,4	151,4	37,2	685,9	1084,2	704,6	2,7	7,9	551,4	193,2	620,4	0,0	382,1	263,3	4784,6
SWEDEN Imports from:	28,6	90,2	382,6	631,3	82,9	609,9	0,7	7,3	108,0	179,0	21,5	34,8	0,0	198,7	2375,6
UK Imports from:	198,2	473,0	222,7	2072,8	1178,7	1984,2	10,8	413,3	721,9	792,0	289,7	396,3	2320,9	0,0	11074,5
EU's Total Forest Cluster Imports from:	**4154,4**	**5862,4**	**2338,3**	**10166,7**	**8824,7**	**18037,4**	**82,9**	**680,6**	**7215,1**	**6033,6**	**2206,8**	**2881,5**	**11181,9**	**5193,7**	**84860,1**
FC Imports as % of total FC Imports from World	3,4	4,8	1,9	8,4	7,3	14,9	0,1	0,6	6,0	5,0	1,8	2,4	9,2	4,3	70,1

Source: OECD, SITC Statistics.

Table 12.14 EU FOREST CLUSTER *TRADE BALANCE* WITHIN THE EU - BY COUNTRY - 1995 ($ mill)

	AUS	BEL-LU	DEN	FIN	FRA	GER	GRE	IRE	ITA	NET	POR	SPA	SWE	UK	EU15
AUSTRIA Trade Balance with	0,0	45,6	-53,6	-190,4	189,7	-403,0	58,5	2,2	936,3	104,2	-34,5	62,9	-272,6	200,5	**645,8**
BELGIUM Trade Balance with	-45,1	0,0	-50,4	-818,4	658,5	-492,2	11,6	-16,7	-95,6	490,6	-8,6	43,5	-317,4	125,8	**-514,3**
DENMARK Trade Balance with	55,8	45,8	0,0	-501,5	92,0	878,7	3,7	1,6	-56,4	-0,2	-11,9	16,9	-727,5	78,4	**-124,6**
FINLAND Trade Balance with	160,9	711,8	471,3	0,0	969,1	2421,6	140,6	101,8	314,9	624,6	85,0	621,4	308,1	2027,3	**8958,4**
FRANCE Trade Balance with	-115,8	-261,3	-84,3	-1186,4	0,0	-701,9	60,7	0,3	-663,5	-143,4	-286,6	205,4	-943,1	254,6	**-3865,2**
GERMANY Trade Balance with	811,1	671,5	-416,3	-2363,2	1063,8	0,0	188,6	32,6	-618,1	1106,8	-242,3	290,4	-2158,3	813,3	**-820,0**
GREECE Trade Balance with	-64,2	-20,0	-4,0	-145,7	-70,3	-206,9	0,0	-3,2	-270,7	-40,9	-25,8	-44,4	-108,6	-88,1	**-1092,8**
IRELAND Trade Balance with	-2,5	22,7	1,8	-102,6	-23,0	-52,6	2,8	0,0	-0,7	-16,1	-2,9	-3,7	-136,1	-397,0	**-710,1**
ITALY Trade Balance with	-911,1	153,8	28,9	-340,1	855,6	1158,3	273,3	4,5	0,0	151,7	-49,1	279,0	-714,4	439,6	**1329,9**
NETHERLANDS Trade Bal with	-42,3	41,3	14,2	-517,8	379,5	-440,9	39,5	-12,3	-111,0	0,0	-94,6	94,2	-974,8	318,7	**-1306,2**
PORTUGAL Trade Balance with	34,9	3,5	8,1	-92,5	305,0	187,2	26,3	0,9	63,8	162,5	0,0	48,6	-102,4	246,6	**892,5**
SPAIN Trade Balance with	-40,0	-59,1	-20,7	-664,0	-161,4	-218,6	36,0	3,4	-242,2	-79,6	13,5	0,0	-344,0	163,9	**-1612,6**
SWEDEN Trade Balance with	246,9	327,1	755,7	-230,4	882,0	2442,8	98,2	165,6	680,5	888,4	85,0	328,7	0,0	2052,4	**8722,7**
UK Trade Balance with	-123,5	-69,7	-93,3	-1924,2	-235,0	-843,8	82,7	513,0	-359,5	-159,5	-210,0	-110,2	-2114,4	0,0	**-5647,4**
Total FC Trade Balance	**-34,8**	**1612,9**	**557,3**	**-9077,0**	**4905,5**	**3728,8**	**1022,5**	**793,6**	**-422,0**	**3089,2**	**-782,8**	**1832,5**	**-8605,4**	**6235,9**	**4856,1**
Country's Share of FC Trade Balance	-0,7	33,2	11,5	-186,9	101,0	76,8	21,1	16,3	-8,7	63,6	-16,1	37,7	-177,2	128,4	**100**

Source: OECD, SITC Statistics.

As in 1989, proximity of markets appears to be a major factor in trade, with most forest cluster trade taking place between neighbouring countries. Again by examining exports from Austria or France one can see how much of each country's forest cluster exports are delivered to their neighbours. Yet again, Sweden and Finland were exceptions to this, directing most of their exports to two of the larger markets of Germany and the UK.

Similar to 1989 data, statistics for 1995 reveal discrepancies in the EU15 trade balance. However, as this represents about 5% of total trade within the EU15, it can therefore be explained due to differences in the way import and export statistics are recorded. Nevertheless, the individual trade balances between EU countries are still of interest, since they reveal the flow of forest cluster trade within the EU. Table 12.14.

The most significant net exporter was Finland with a forest cluster trade surplus of $8.9 billion US, closely followed by Sweden with $8.7 billion US, a reversal of 1989 positions. Italy was the next major net exporter with about $1.3 billion US but Germany, a net exporter in 1989, had changed position to become a net importer. In terms of net imports, the UK was again the largest market with some $6.2 billion US. The next most significant market for imports of forest cluster products was France at $4.9 billion US, followed by Germany with $3.7 billion US. Other large import markets were the Netherlands and Spain with $3.1 and 1.8 billion US, respectively.

As in 1989, the main destination of EU forest cluster exports was the OECD, which in 1995 accounted for about 83% of the EU's forest cluster exports to the world. This represents a 3% decrease in relation to total trade. Of these exports to the OECD, Germany, Sweden and Finland rank in this same order as the top exporters. These positions were unchanged from 1989, however, it is notable that both Italy and France have gained considerably in relative shares closely to Finland. In terms of extra-EU exports to other parts of the world, Germany is the most substantial exporter, occupying first position in CEE, N. America, Asia (from second in 1989) and second place in Africa. These four regions represent the largest markets outside the EU. Finland were the most significant exporters to the FSU and second to Asia, whilst France were the biggest exporter to Africa. Spain was the biggest exporter to CSA and the UK to Oceania. Table 12.15.

Table 12.15 EU FOREST CLUSTER *EXPORTS* BY REGION - 1995 ($ Bill)

	EU15	OECD 26	CEE	RUSS FE	EUROPA	AFRICA	N. AMER	ASIA	OCEANIA	CS AMER	WORLD
AUSTRIA Exports to:	5,36	6,36	0,67	0,06	6,70	0,11	0,16	0,53	0,03	0,04	**7,59**
BELGIUM Exports to:	7,25	7,66	0,09	0,03	7,47	0,09	0,17	0,28	0,05	0,06	**8,13**
DENMARK Exports to:	3,12	3,79	0,06	0,02	3,62	0,02	0,17	0,18	0,02	0,01	**4,13**
FINLAND Exports to:	10,15	12,48	0,43	0,43	11,08	0,40	0,99	2,34	0,28	0,26	**15,46**
FRANCE Exports to:	9,25	11,01	0,17	0,07	10,38	0,69	0,59	0,73	0,16	0,33	**12,89**
GERMANY Exports to:	16,83	22,01	1,76	0,36	21,45	0,41	1,38	2,80	0,24	0,39	**28,56**
GREECE Exports to:	0,08	0,14	0,05	0,01	0,22	0,01	0,00	0,04	0,00	0,00	**0,28**
IRELAND Exports to:	0,63	0,72	0,00	0,00	0,67	0,00	0,05	0,02	0,00	0,01	**0,76**
ITALY Exports to:	8,68	11,31	0,66	0,43	10,35	0,38	1,31	1,99	0,20	0,28	**14,52**
NETHERLANDS Exports to:	6,42	6,99	0,12	0,03	6,85	0,08	0,18	0,38	0,04	0,05	**7,73**
PORTUGAL Exports to:	2,25	2,53	0,02	0,00	2,35	0,10	0,12	0,15	0,04	0,03	**2,79**
SPAIN Exports to:	3,17	3,61	0,04	0,04	3,38	0,24	0,26	0,40	0,01	0,40	**4,71**
SWEDEN Exports to:	11,10	13,45	0,35	0,05	13,01	0,37	0,42	1,16	0,10	0,12	**15,18**
UK Exports to:	5,43	7,42	0,15	0,05	5,96	0,40	1,08	1,15	0,38	0,16	**9,34**
Total Forest Cluster Exports to Region	**89,7**	**109,5**	**4,6**	**1,6**	**103,5**	**3,3**	**6,9**	**12,2**	**1,6**	**2,2**	**132,1**
% Shares of Forest Cluster Exports to World	**67,9**	**82,9**	**3,5**	**1,2**	**78,4**	**2,5**	**5,2**	**9,2**	**1,2**	**1,6**	**100**
Significance of FC Exports to Region	7,2	7,0	6,7	7,7	7,3	5,6	4,7	4,8	9,0	4,8	**6,6**

Source: OECD, SITC Statistics.

Table 12.16 EU FOREST CLUSTER *IMPORTS* BY REGION - 1995 ($ Bill)

	EU15	OECD 26	CEE	RUSS-FE	EUROPA	AFRICA	N. AMER	ASIA	OCEANIA	CS AMER	WORLD
AUSTRIA Imports from:	4,71	5,37	0,64	0,03	5,61	0,06	0,14	0,08	0,00	0,04	**5,94**
BELGIUM Imports from:	7,76	8,54	0,13	0,05	8,08	0,06	0,52	0,34	0,00	0,15	**9,17**
DENMARK Imports from:	3,25	3,58	0,15	0,05	3,56	0,01	0,11	0,21	0,00	0,01	**3,90**
FINLAND Imports from:	1,20	1,48	0,13	0,48	1,30	0,02	0,19	0,64	0,00	0,05	**2,20**
FRANCE Imports from:	13,11	15,23	0,34	0,12	14,21	0,49	1,31	0,70	0,00	0,47	**17,20**
GERMANY Imports from:	17,65	22,97	3,13	0,24	22,53	0,23	2,64	1,51	0,01	0,41	**27,46**
GREECE Imports from:	1,17	1,36	0,13	0,07	1,37	0,07	0,11	0,13	0,00	0,02	**1,70**
IRELAND Imports from:	1,34	1,51	0,01	0,01	1,37	0,03	0,14	0,05	0,00	0,02	**1,62**
ITALY Imports from:	7,35	9,87	0,71	0,36	8,90	0,53	1,69	0,85	0,00	0,36	**12,33**
NETHERLANDS Imports from:	7,73	9,04	0,28	0,09	8,33	0,09	0,85	0,74	0,00	0,15	**10,25**
PORTUGAL Imports from:	1,36	1,44	0,00	0,00	1,39	0,16	0,05	0,04	0,00	0,13	**1,78**
SPAIN Imports from:	4,78	5,57	0,05	0,08	4,97	0,27	0,61	0,29	0,00	0,18	**6,32**
SWEDEN Imports from:	2,38	3,07	0,47	0,13	3,03	0,00	0,20	0,48	0,00	0,04	**3,76**
UK Imports from:	11,07	14,74	0,42	0,22	12,02	0,20	2,79	1,61	0,03	0,60	**17,44**
Total Forest Cluster Imports to EU from:	**84,9**	**103,8**	**6,6**	**1,9**	**96,7**	**2,2**	**11,3**	**7,7**	**0,1**	**2,7**	**121,1**
Region's share of Total Forest Cluster Imports from World	70,1	85,7	5,4	1,6	79,9	1,9	9,4	6,3	0,0	2,2	100

Source: OECD, SITC Statistics.

Table 12.17 EU FOREST CLUSTER *TRADE BALANCE* BY REGION - 1995 ($ Bill)

	EU15	OECD 26	CEE	RUSS-FE	EUROPA	AFRICA	N. AMER	ASIA	OCEANIA	CS AMER	WORLD
AUSTRIA Trade Balance with	0,65	0,99	0,03	0,02	1,09	0,04	0,02	0,45	0,03	0,00	**1,65**
BELGIUM Trade Balance with	-0,51	-0,88	-0,04	-0,01	-0,61	0,03	-0,35	-0,05	0,04	-0,09	**-1,04**
DENMARK Trade Balance with	-0,12	0,21	-0,09	-0,04	0,06	0,01	0,06	-0,03	0,01	0,00	**0,23**
FINLAND Trade Balance with	8,96	11,00	0,29	-0,04	9,78	0,38	0,80	1,70	0,28	0,21	**13,26**
FRANCE Trade Balance with	-3,87	-4,22	-0,17	-0,05	-3,83	0,20	-0,72	0,03	0,15	-0,14	**-4,31**
GERMANY Trade Balance with	-0,82	-0,96	-1,36	0,12	-1,08	0,18	-1,26	1,29	0,24	-0,02	**1,11**
GREECE Trade Balance with	-1,09	-1,22	-0,08	-0,06	-1,14	-0,06	-0,11	-0,10	0,00	-0,02	**-1,42**
IRELAND Trade Balance with	-0,71	-0,78	0,00	-0,01	-0,70	-0,03	-0,09	-0,03	0,00	-0,01	**-0,86**
ITALY Trade Balance with	1,33	1,45	-0,05	0,06	1,45	-0,15	-0,37	1,14	0,20	-0,08	**2,19**
NETHERLANDS Trade Bal with	-1,31	-2,04	-0,16	-0,06	-1,49	-0,01	-0,67	-0,36	0,03	-0,10	**-2,52**
PORTUGAL Trade Balance with	0,89	1,09	0,02	0,00	0,96	-0,06	0,06	0,12	0,04	-0,10	**1,01**
SPAIN Trade Balance with	-1,61	-1,96	0,00	-0,04	-1,59	-0,04	-0,35	0,12	0,01	0,23	**-1,61**
SWEDEN Trade Balance with	8,72	10,38	-0,11	-0,08	9,97	0,37	0,22	0,69	0,10	0,07	**11,42**
UK Trade Balance with	-5,65	-7,32	-0,27	-0,17	-6,06	0,19	-1,70	-0,46	0,35	-0,43	**-8,10**
Total EU FC Trade Balance with Region	**4,9**	**5,7**	**-2,0**	**-0,3**	**6,8**	**1,1**	**-4,5**	**4,5**	**1,5**	**-0,5**	**11,0**
Region's Share of Total FC Trade Balance with EU	44,1	52,1	-18,3	-3,1	62,0	9,6	-40,5	41,0	13,6	-4,4	100

Source: OECD, SITC Statistics.

Imports of forest cluster products from other parts of the world generally followed the same patterns as in 1989. For example total imports were worth some $121 billion US. Of this sum, imports from the OECD represented nearly 86% of total forest cluster imports from the world. As in 1989, imports from N. America and Asia represented about 9.4% and 6% of total imports. Of the total forest cluster imports, Germany was the main destination for imports receiving about 23% and the UK was the second accounting for about 14%. In fact, the UK was the main destination for forest cluster imports from N. America, Asia, CSA and Oceania. Germany was second in most of these markets but also ranked first in imports from CEE attracting almost 48% of its imports. Finland, however, were the biggest market for the FSU. Table 12.16.

In 1995, the EU forest cluster had a very healthy trade balance with the world of around $11 billion US. According to these figures this trade surplus represented a staggering 13% of the EU's trade surplus with the world. This is in stark contrast to 1989 deficit of $374 million US for EU forest cluster trade. The most significant net exporter was Finland with $13.2 billion US, then Sweden $11.4 billion US and then Italy with $2.2 billion US. One significant point to note is that Germany had become a net importer. The main destination for imports was the UK who had a $8.1 billion US trade deficit, whilst France was also in deficit by about $4.3 billion US. The major change appeared to be that the UK's trade deficit had reduced by about 20%. Table 12.17.

As with EU trade with the world in 1995, the EU was also a net exporter of forest cluster products with the OECD area. Again this was in contradiction to the trade deficits of 1989. However, a substantial amount of deficit, was still, as in 1989, generated through trade with N. America, and CEE, $4.5 and $2 billion respectively. On the positive side though, the EU had a trade surplus of $4.5 billion US with Asia and $1.5 billion US with Oceania.

12.3.4 Major Forest Cluster Products Traded in 1995

In terms of specific groups of forest cluster products, the major categories, which were exported to the world, were virtually the same as those exported to the OECD and as intra-EU trade. Table 12.18. These were as follows: coniferous sawn-wood; chemical wood pulp; graphic papers; coated and uncoated papers; newsprint, journals, and trade advertising materials; wooden furniture; builders carpentry and joinery; particle boards; packaging materials, and personal health and sanitary articles of paper and pulp. In general, many of these products listed can be described as high value-added, and in many cases the products can be traced back to the most competitive clusters producing these items, at the national and even regional levels.

Table 12.18 Main EU Forest Cluster Exports to the World

SITC – PRODUCT	1995 (US$ bill)	EU EXPORT TO THE WORLD
2482	Wood of coniferous species, sawn, sliced, thick> 6mm	6.12
64134	Paper for graphic purposes, coated, fib. by mec.>10%	5.79
82159	Other wooden furniture	5.71
89219	Other books, brochures & simil., printed, excluding sheets	4.73
64132	Paper for graphic purposes, excluding mec. fib., m2<150g	4.45
64126	Other paper (40g/m2<weight<150g/m2), excluding mec. fib.	4.11
82116	Seats, n.e.s., with wooden frames	3.66
64129	Other paper & paperb., >10% fibres by mechan. Proc.	3.43
6411	Newsprint, in rolls or sheets	3.07
89229	Journals & periodicals, appearing < 4 times/week	2.90
89286	Trade advertising material, commer. catalogues, etc.	2.77
72812	Machi.-tool for working wood, cork, bone, rubber, etc.	2.71
64295	Sanitory art. of paper pulp, paper, cellulo. Wadding	2.54
64177	Other paper, coated with inorg, subst., rolls, sheets	2.27
25151	Chemical wood pulp, coniferous, soda, sulph., bleached	2.23
82155	Furniture, of wood, of a kind used in the bedroom	2.14
64133	Paper for graphic purposes, excluding mec. fib., m2>150g	2.12
25152	Chemical wood pulp, non-coniferous, soda, bleached	2.09
64212	Folding cartons, boxes, cases, of non-corrugat. Paper	2.02
63422	Particle board & similar, whether or not agglomera.	1.96
64172	Other paper, coated with platics (excluding adhesives)	1.95
63539	Other builders' joinery & carpentry of wood	1.72
72591	Parts of the machines of heading 7251	1.68
64248	Papers & paperboard, for graphic purposes	1.67
64141	Kraft paper, uncoated, in rolls or sheets	1.62
64211	Cartons, boxes & cases, of corrugated paper, paperb.	1.48
82153	Furniture, of wood, of a kind used in the kitchen	1.44
64294	Handkerchiefs, towels & other paper linen; garments	1.42
64157	Other paper & paperboard, uncoated, weight<150g/m2	1.28
64179	Other paper & paperboard, cellulose wadding, coated	1.24

Source: OECD, SITC Statistics.

As far as extra-EU trade is concerned the picture was a little different. Whilst most of the above products were exported, the extent of machinery for producing and processing the above products formed a much larger proportion of exports – demonstrating EU strengths in related machine building industries. In addition to most

Table 12.19 Main Forest Cluster Exports to Countries Outside the EU (Extra-EU Trade)

SITC – PRODUCT		1995 (US$ bill)	EXTRA EU EXPORTS*
89219	Other books, brochures & simil., printed, excluding sheets		2.31
82159	Other wooden furniture		2.20
64132	Paper for graphic purposes, excluding mec. fib., m2<150g		2.00
64134	Paper for graphic purposes, coated, fib. by mec.>10%		1.85
72812	**Machi.-tool for working wood, cork, bone, rubber, etc.**		1.51
2482	Wood of coniferous species, sawn, sliced, thick> 6mm		1.34
82116	Seats, n.e.s., with wooden frames		1.17
64126	Other paper (40g/m2<weight<150g/m2), excluding mec. fib.		1.15
89229	Journals & periodicals, appearing < 4 times/week		1.02
64129	Other paper & paperb., >10% fibres by mechan. proc.		1.01
72591	**Parts of the machines of heading 7251**		1.00
64172	Other paper, coated with platics (excluding adhesives)		0.71
64299	Other articl. of paper pulp, cellulose fibres, n.e.s		0.65
64133	Paper for graphic purposes, excluding mec. fib., m2>150g		0.64
64177	Other paper, coated with inorg, subst., rolls, sheets		0.63
82155	Furniture, of wood, of a kind used in the bedroom		0.62
64212	Folding cartons, boxes, cases, of non-corrugat. paper		0.61
6411	Newsprint, in rolls or sheets		0.60
89286	Trade advertising material, commer. catalogues, etc.		0.59
72512	**Machinery for making or finishing paper, paperboard**		0.58
72844	**Machinery for treating wood or cork, n.e.s**.		0.57
82151	Furniture, of wood, of a kind used in office		0.49
82153	Furniture, of wood, of a kind used in the kitchen		0.49
72521	**Cutting machines**		0.47
64295	Sanitory art. of paper pulp, paper, cellulo. wadding		0.44
74367	**Filters & purifying machinery for liquid, n.e.s**.		0.42
64179	Other paper & paperboard, cellulose wadding, coated		0.42
72511	**Machinery for making pulp, fibrous cellulosic mate.**		0.42
63539	Other builders' joinery & carpentry of wood		0.41
64194	Wallpaper & similar, window transparencies of paper		0.38

Source: OECD, SITC Statistics.

*WORLD - INTRA EU TRADE = EXTRA EU TRADE of the above products, extra-EU trade included the following: machinery for making and finishing pulp, paper and paperboard, machinery for working and treating wood and machinery for filtering and purifying liquids. Table 12.19. Considering extra-EU exports, it is clear that product exports tend towards the processing end of forest-based industries and perhaps to some of the lower value-added products depending on the market region. Nevertheless, a good deal of high value-added products is still exported to all regions.

Product lists have also been prepared to examine which products generate the highest trade surplus for the EU. While there appears to be a close correlation between this method and lists prepared based on top exports, one striking feature is the type of products, which generate trade surpluses and which are traded between OECD countries. From this list, it is evident that these products range from the production and processing end of the forest cluster to the production of final products (particularly the higher value-added end). This find is a significant one since it demonstrates a high level of expertise right across the forest cluster, which is held within the EU. Table 12.20 lists the major surplus generating products for the EU, or EU ‘strengths’.

Imports from within the OECD are of a similar nature as exports from the EU. However, a further observation can be made regarding forest cluster activity. For example, the list of main products imported from outside the EU, reveals that most products are within the raw material and down-stream processing end of the forest cluster production process. Nonetheless, this still reveals that a certain degree of forest cluster activity is being conducted outside the EU. Whether this constitutes a threat or not requires further investigation. These imports include the following products coniferous and non-coniferous wood, chemical wood pulps, particle board and plywood, builders joinery, wood marquettry, door frames and kaolin and ammonia (also used in paper production) plus other finished paper and wood products. At the same time however, many of the products are not manufactured in Europe – such as tropical woods. Table 12.21. Nonetheless, these could be viewed as opportunities for EU companies to substitute these products by creating innovative new products. One example, is the lamination of particle-boards incorporating decorative paper-based coatings etc, as an alternative to tropical wood veneered panels.

Table 12.20 Trade Surplus Generating Products - Strengths

SITC	- PRODUCT 1995 (US$ bill)	EU Export Surplus with OECD26
82159	Other wooden furniture	1.80
82116	Seats, n.e.s., with wooden frames	1.38
64134	Paper for graphic purposes, coated, fib. by mec.>10%	1.25
89286	Trade advertising material, commer. catalogues, etc.	0.86
89219	Other books, brochures & simil., printed, excluding sheets	0.86
72812	Machi.-tool for working wood, cork, bone, rubber, etc.	0.74
64129	Other paper & paperb., >10% fibres by mechan. proc.	0.59
64133	Paper for graphic purposes, excluding mec. fib., m2>150g	0.56
89229	Journals & periodicals, appearing < 4 times/week	0.53
82155	Furniture, of wood, of a kind used in the bedroom	0.53
82153	Furniture, of wood, of a kind used in the kitchen	0.52
63539	Other builders' joinery & carpentry of wood	0.43
72591	Parts of the machines of heading 7251	0.29
64295	Sanitory art. of paper pulp, paper, cellulo. wadding	0.24
82151	Furniture, of wood, of a kind used in office	0.21
64294	Handkerchiefs, towels & other paper linen; garments	0.21
89221	Journals & periodicals, appearing > 4 times/week	0.20
72521	Cutting machines	0.19
64211	Cartons, boxes & cases, of corrugated paper, paperb.	0.19
72512	Machinery for making or finishing paper, paperboard	0.19
74367	Filters & purifying machinery for liquid, n.e.s.	0.17
64126	Other paper (40g/m2<weight<150g/m2), exclude mec. fib	0.17
63532	Doors & their frames & thresholds, of wood	0.16
64194	Wallpaper & similar, window transparencies of paper	0.16
63422	Particle board & similar, whether or not agglomera.	0.16
64179	Other paper & paperboard, cellulose wadding, coated	0.15
72844	Machinery for treating wood or cork, n.e.s.	0.14
63431	Plywood, sheets of wood, ply of tropi. or non-conif.	0.14
63311	Cork and stoppers, of natural cork	0.13
64214	Other sacks & bags	0.12
72196	Other agricultural, hortic., forest., etc., machinery	0.12
64146	Kraft paper, uncoated, rolls, sheets, n.e.s., m2<150g	0.11
64172	Other paper, coated with platics (excluding adhesives)	0.11
89283	Unused postage or similar; cheque forms; banknotes	0.11
64192	Other composite paper & paperboard, not impregnated	0.10
72511	Machinery for making pulp, fibrous cellulosic mate.	0.10
52261	Ammonia, anhydrous or in aqueous solution	0.10
64212	Folding cartons, boxes, cases, of non-corrugat. paper	0.10
2482	Wood of coniferous species, sawn, sliced, thick> 6mm	0.10
63452	Fibreboard, ligneous mater., 0.5g/cm3<dens<0.8g/cm3	0.10

Source: OECD, SITC Statistics.

Table 12.21 Main Forest Cluster Imports from Outside EU

SITC - PRODUCT	1995 (US$ bill)	Extra EU Imports
25151	Chemical wood pulp, coniferous, soda, sulph., bleached	3.52
2484	Non-coniferous wood, sawn length-wise, thickness>6mm	2.57
2482	Wood of coniferous species, sawn, sliced, thick> 6mm	1.99
25152	Chemical wood pulp, non-coniferous, soda, bleached	1.87
89219	Other books, brochures & simil., printed, excluding sheets	1.42
24752	Wood (excluding coniferous, tropical), rough, not treated	1.33
82159	Other wooden furniture	1.30
6411	Newsprint, in rolls or sheets	1.01
82116	Seats, n.e.s., with wooden frames	0.97
64141	Kraft paper, uncoated, in rolls or sheets	0.93
63431	Plywood, sheets of wood, ply of tropi. or non-conif.	0.68
63539	Other builders' joinery & carpentry of wood	0.61
63599	Other articles of wood	0.61
63412	Sheets, wood sawn length-wise, non-coniferous, < 6 mm	0.56
2474	Wood, coniferous species, in the rough, not treated	0.54
52261	Ammonia, anhydrous or in aqueous solution	0.51
24751	Tropical wood, in the rough, not treated	0.49
63439	Other plywood, with sheets wood, each ply < 6 mm	0.49
2513	Chemical wood pulp, dissolving grades	0.47
82155	Furniture, of wood, of a kind used in the bedroom	0.43
64129	Other paper & paperb., >10% fibres by mechan. proc.	0.40
25162	Chemical wood pulp, sulphite, bleached	0.40
64126	Other paper (40g/m2<weight<150g/m2), excluding mec. fib.	0.38
89286	Trade advertising material, commer. catalogues, etc.	0.33
27826	Kaolin and other kaolinic clays, calcined or not	0.33
2485	Non-coniferous wood, continuous. shaped, edges, faces	0.32
63532	Doors & their frames & thresholds, of wood	0.30
63549	Wood marquetry & inlaid wood; wooden arti., excluding 82	0.30
63422	Particle board & similar, whether or not agglomera.	0.29
64299	Other articl. of paper pulp, cellulose fibres, n.e.s	0.29

Source: OECD, SITC Statistics.

In addition, lists have also been compiled to demonstrate which product imports generate the largest trade deficits. As before, this method reveals that the main products imported are also those giving rise to large trade deficits. However, the lists also show that a considerable amount of speciality inputs and other forest cluster products are imported from outside the EU. These include some of the chemical wood pulps, and chemicals used in the paper and board making process and other finished products. However, some

Table 12.22 Trade Deficit Generating Products - Weaknesses

SITC - PRODUCT	1995 (US$ bill)	Net Imports to EU from World
25151	Chemical wood pulp, coniferous, soda, sulph., bleached	-3.11
2484	Non-coniferous wood, sawn lenghtwise, thickness>6mm	-2.32
25152	Chemical wood pulp, non-coniferous, soda, bleached	-1.60
24752	Wood (excluding coniferous, tropical), rough, not treated	-1.42
64141	Kraft paper, uncoated, in rolls or sheets	-0.76
6411	Newsprint, in rolls or sheets	-0.74
2474	Wood, coniferous species, in the rough, not treated	-0.52
2513	Chemical wood pulp, dissolving grades	-0.49
24751	Tropical wood, in the rough, not treated	-0.48
63431	Plywood, sheets of wood, ply of tropi. or non-conif.	-0.47
63439	Other plywood, with sheets wood, each ply < 6 mm	-0.44
52261	**Ammonia**, anhydrous or in aqueous solution	-0.38
63599	Other articles of wood	-0.31
25162	Chemical wood pulp, sulphite, bleached	-0.28
63412	Sheets, wood sawn lengthwise, non-coniferous, < 6 mm	-0.27
2485	Non-coniferous wood, continuous. shaped, edges, faces	-0.21
27826	**Kaolin and other kaolinic clays**, calcined or not	-0.21
63549	Wood marquetry & inlaid wood; wooden arti, exclude 82	-0.19
25113	Waste of paper or paperboard, of mechanical pulp	-0.18
63512	Pallets, box pallets and other load boards	-0.17
57551	Cellulose acetates, non-plasticised	-0.15
59814	Rosin & resin acids & derivatives; rosin oils, spir.	-0.15
63451	Fibreboard of ligneous materials, density>0.8g/cm3	-0.15
2482	Wood of coniferous species, sawn, sliced, thick> 6mm	-0.15
26339	Other cotton waste	-0.14
64175	Kraft paper, coated with inorg. subs., blea., m2>150g	-0.14
52263	**Sodium hydroxide** in aqueous solution	-0.13
52491	**Hydrogene peroxide**, solidified with urea or not	-0.12
64131	Copying paper & simil., printed or not, width > 36cm	-0.11
25191	Semi-chemical wood pulp	-0.10
64151	Semi-chemical fluting paper, uncoated, rolls, sheets	-0.09
63531	Window, french-window & their frames, of wood	-0.08
64176	Other kraft paper, coated with inorg. subst., rolls	-0.08
77843	Scies et tronconneuses, self-cont. electric motor	-0.08
57554	Cellulose ethers	-0.08
24502	Wood charcoal (incl. shell or nut charcoal)	-0.08
63542	Tableware and kitchenware, of wood	-0.07
63411	Sheets, wood	-0.07
25119	Other waste & scrap of paper or paperboard	-0.07
25112	Waste of other paper, of bleached chemical pulp	-0.06

Source: OECD, SITC Statistics.

Table 12.23 Trade Deficit Generating Products - Weaknesses

SITC	- PRODUCT 1995 (US$ bill)	Net Imports from outside the EU (Extra-EU Imports)
25151	Chemical wood pulp, coniferous, soda, sulph., bleached	-3.22
2484	Non-coniferous wood, sawn lenghtwise, thickness>6mm	-2.38
25152	Chemical wood pulp, non-coniferous, soda, bleached	-1.70
24752	Wood (excluding coniferous, tropical), rough, not treated	-1.27
64141	Kraft paper, uncoated, in rolls or sheets	-0.73
2482	Wood of coniferous species, sawn, sliced, thick> 6mm	-0.65
63431	Plywood, sheets of wood, ply of tropi. or non-conif.	-0.55
24751	Tropical wood, in the rough, not treated	-0.49
52261	Ammonia, anhydrous or in aqueous solution	-0.49
63439	Other plywood, with sheets wood, each ply < 6 mm	-0.45
2513	Chemical wood pulp, dissolving grades	-0.44
63599	Other articles of wood	-0.42
6411	Newsprint, in rolls or sheets	-0.41
2474	Wood, coniferous species, in the rough, not treated	-0.38
63412	Sheets, wood sawn lengthwise, non-coniferous, < 6 mm	-0.33
25162	Chemical wood pulp, sulphite, bleached	-0.25
63549	Wood marquetry & inlaid wood; wooden arti, exclude 82	-0.23
2485	Non-coniferous wood, continuous. shaped, edges, faces	-0.23
27826	Kaolin and other kaolinic clays, calcined or not	-0.21
63539	Other builders' joinery & carpentry of wood	-0.20
63512	Pallets, box pallets and other load boards	-0.19
25191	Semi-chemical wood pulp	-0.15
59814	Rosin & resin acids & derivatives; rosin oils, spir.	-0.14
26339	Other cotton waste	-0.13
64176	Other kraft paper, coated with inorg. subst., rolls	-0.12
2512	Mechanical wood pulp	-0.12
63451	Fibreboard of ligneous materials, density>0.8g/cm3	-0.12
77843	Scies et tronconneuses, self-cont. electric motor	-0.10
63532	Doors & their frames & thresholds, of wood	-0.08
63531	Window, french-window & their frames, of wood	-0.08
63542	Tableware and kitchenware, of wood	-0.08
24502	Wood charcoal (incl. Shell or nut charcoal)	-0.08
57551	Cellulose acetates, non-plasticised	-0.07
69554	Chain saw blades	-0.07
25113	Waste of paper or paperboard, of mechanical pulp	-0.07
64151	Semi-chemical fluting paper, uncoated, rolls, sheets	-0.06
63441	Other plywood, > one ply of non-coniferous wood	-0.06
64235	Albums for samples or for collections	-0.05
25119	Other waste & scrap of paper or paperboard	-0.05
64231	Registers, account books, order books, diaries & sim.	-0.04
63411	Sheets, wood	-0.04

Source: OECD, SITC Statistics.

products such as tropical woods and plywood sheets are products, which are not, or can not be made in the EU. Implications could be that the competitive advantage of some key suppliers or speciality input providers could be displaced to outside the EU. Table 12.22 and Table 12.23 present these 'weaknesses'.

12.3.5 Revealed Comparative Advantage and Market Shares

In today's global markets and the ability of Multi-National and TransNational firms to utilise resources scattered across many trading blocs (via transfer pricing etc), revealed comparative advantage (RCA) has become less meaningful. Notwithstanding this fact, the RCA value does provide a good indication of a particular product's ability to be traded between two entities.

In deciding on what entity/ies to compare the forest cluster with, one also has to be able to calculate each entity's total value in export trade. In regard to the EU's export figures this did not present a problem. However in calculating total exports for other regions, it was thought that import values from other regions to the EU could be used to estimate total exports from each region concerned. This approximation has therefore been used as the basis for all calculations of RCA and market shares in this section. However, further estimations of total exports from other regions are still required to ensure that a more equitable comparison is made between the EU and other regions and, in particular, North America and Asia.

In practice, two methods for calculating RCAs have been adopted here. The first method used values for extra-EU exports and compared these with world imports to the EU, in terms of extra-EU imports. Extra-EU trade has been calculated simply by deducting intra-EU trade (total export trade between EU countries) from total world trade. The second approach adopted again utilised extra-EU exports but this time compared values with imports from the rest of the OECD (i.e. OECD minus intra-EU trade). At the same time, market shares were also estimated for the total EU forest cluster market. The size of the EU market was estimated by adding intra-EU trade to extra-EU imports.

Whilst the first method did have some degree of correlation between high RCA values and products generating the largest trade

Table 12.24 Comparison of RCA values with EU Market Shares (1995)

SITC - PRODUCT	RCAs		Share of EU Market
	Extra EU Trade vs. Extra EU Imports	Extra EU Trd vs. R.O. OECD Imp	EU's Top 40 (%)
59213 Potato starch	1235.9	**773.0**	**99.9**
64161 Sack kraft paper, creped, crinkled, rolls or sheets	29.9	**13.0**	**99.9**
24402 Cork, natural, debacked, roughly squared, sheets, strip	9.9	**9.4**	**98.3**
63321 Blocks, sheets, solid cylinders of agglomerated cork	18.3	**59.4**	**98.2**
27891 Chalk	9.9	**18.5**	**97.3**
64191 Paper & paperboard, laminated internally with tar	13.6	**1.9**	**96.6**
63493 Wood wool; wood flour	5.4	**2.5**	**96.4**
64133 Paper for graphic purposes, excluding mec. fib., m2>150g	9.8	**6.3**	**96.3**
64295 Sanitory art. of paper pulp, paper, cellulo. Wadding	4.2	**2.8**	**96.0**
63319 Other articles, of natural cork	14.0	**62.9**	**95.8**
64134 Paper for graphic purposes, coated, fib. by mec.>10%	9.0	**8.8**	**95.7**
64291 Bobbins, spools, cops & similar of paper, paperboard	6.4	**5.7**	**95.7**
64192 Other composite paper & paperboard, not impregnated	6.2	**3.0**	**95.6**
63311 Cork and stoppers, of natural cork	12.1	**27.4**	**95.4**
64194 Wallpaper & similar, window transparencies of paper	14.0	**13.1**	**95.2**
63329 Other articles of agglomerated cork	7.8	**10.7**	**94.7**
64158 Other paper, paperb., uncoat., 150g/m2<weight<225g/m2	2.7	**1.0**	**94.6**
82153 Furniture, of wood, of a kind used in the kitchen	7.4	**41.4**	**94.4**
72511 Machinery for making pulp, fibrous cellulosic mate.	39.6	**11.2**	**94.3**
64245 Filter paper and paperboard	10.0	**7.9**	**93.4**
72844 Machinery for treating wood or cork, n.e.s.	38.4	**10.3**	**93.4**
64177 Other paper, coated with inorg, subst., rolls, sheets	4.4	**1.6**	**93.0**
64127 Other paper (weight>150g/m2), excluding fib. by mec. pro.	5.0	**5.1**	**92.9**
24403 Cork, natural, raw or simply prepared	1.0	**10.5**	**92.7**
64178 Gummed or adhesive paper & paperboard	3.1	**2.2**	**92.6**
74185 Dryers for wood, paper pulp, paper or paperboard	18.7	**11.4**	**92.5**
64132 Paper for graphic purposes, excluding mec. fib., m2<150g	8.4	**3.7**	**92.3**
64241 Cigarette paper, cut to size	16.0	**4.5**	**91.9**
64234 Manifold business forms & interleaved carbon sets	6.0	**5.9**	**91.9**
64164 Paper & paperboard, corrugated, in rolls or sheets	1.6	**0.8**	**91.8**
69553 Circular saw blades with work. parts of other mat.	4.5	**6.5**	**91.8**
64131 Copying paper & simil., printed or not, width > 36cm	5.2	**2.2**	**91.7**
63452 Fibreboard, ligneous mater., 0.5g/cm3<dens<0.8g/cm3	3.2	**4.8**	**91.5**
64243 Toilet paper, cut to size, in rolls or in sheets	1.6	**3.7**	**91.4**
64211 Cartons, boxes & cases, of corrugated paper, paperb.	3.1	**1.6**	**91.3**
89221 Journals & periodicals, appearing > 4 times/week	1.7	**2.2**	**90.8**
64242 Carbon paper, other copying papers, cut to size	3.9	**1.9**	**90.6**

64157 Other paper & paperboard, uncoated, weight<150g/m2	1.6	**0.9**	**90.4**
64213 Sacks & bags, base of a width > 40cm	4.3	**1.6**	**90.2**
64146 Kraft paper, uncoated, rolls, sheets, n.e.s., m2<150g	2.1	**1.1**	**89.8**

Source: OECD, SITC Statistics.

surplus in extra-EU trade[8] (table 12.20), there was less correlation with the EU's top exports to the world and extra-EU exports (tables 12.18 and 12.19). However, very high market share values within the EU did appear to coincide with high RCA values.

The second method utilises the fact that about 85% of forest cluster trade are conducted between the countries of the OECD area. Results from this method similarly show that high RCA values correlate fairly well with extra-EU trade surplus generating products (table 12.20), with extra-EU exports (table 12.19), and also with high market shares.

Table 12.24 has been produced to demonstrate which products have the highest market shares within the EU. An interesting point to note is that in a few cases, high market shares do not necessarily coincide with high RCA values, no matter which method has been used. From this table, it is clear that many of the forest cluster products are represented, however it is also evident that there are many other forest cluster products which are more technologically sophisticated or higher in value-added but are not highlighted through RCA analysis. We can therefore conclude that traditional economic analysis, using RCA, fails to capture many competitive strengths within these industries, and hence, the advantage of the cluster method is highlighted.

By comparing RCA values with products generating trade surpluses and deficits, it is thought that this should highlight some areas of strengths and weaknesses within the EU forest cluster. However, as indicated earlier, further work is required in this area before any conclusions can be made. Nonetheless, the combined analysis should provide the basis for any future research in this area.

---

8 About one third of the products generating the largest trade surplus in extra-EU trade matched products with high RCA values.

Summary Conclusions

- The EU forest cluster has slightly lost its share of total exports to both the World and OECD
- The EU forest cluster accounts for about 60% of OECD forest cluster exports
- Reliance on forest cluster exports has declined in terms of total exports in the traditional forest cluster countries whilst increased in non-traditional forest cluster countries
- Much of the forest cluster trade takes place between neighbouring countries
- The origin of forest cluster exports is widely dispersed around the EU and not concentrated in Sweden and Finland
- Forest cluster exports account for about 7% of the EU's total exports to the world
- About 85% of forest cluster exports are exported to the OECD
- About 70% of forest cluster exports remain within the EU as intra-EU trade
- About 30 % of forest cluster exports are to regions outside the EU. Asia is the largest market. However, exports to Eastern Europe and Russia have grown the quickest (200%) and now represent a market as big North America
- In 1995, the EU forest cluster had trade balance with the world of around $11 billion US, representing 13% of the EU's trade surplus with the world
- The EU still has large trade deficits in forest cluster products with North America and Eastern Europe and Russia
- North America and Eastern Europe are the main origins of forest cluster imports to the EU
- The majority of forest cluster products, which generate trade surpluses (strengths), are products used within the production and processing end of the cluster (especially machinery)
- A considerable amount of speciality inputs and other forest cluster products are imported from outside the EU, generating trade deficits (weaknesses)
- Traditional economical trade analysis, using Revealed Comparative Advantage, has been shown to fail in capturing competitive strengths within the EU.

Chapter 13. Industrial Statistics

13.1 Industrial Statistics for the EU Forest Cluster

In the previous chapters we have demonstrated how the forest-based and related industries within the EU are inter-related in a variety ways, especially within industrial districts, networks and agglomerations. We have also detailed some of the previously identified forest clusters. Therefore in this section, we will now adopt the term, which is most fitting for the industry, the 'forest cluster'.

All statistical data in this section have been extracted from the Eurostat NewCronos database. In particular, the data used to estimate the size of the EU forest cluster, in terms of employment, turnover, value-added have been taken from the NewCronos domains 'Daisie' and SME. Data within 'Daisie' is the annual industrial survey of enterprises of 20 persons or more, whilst 'SME' covers small and medium enterprises in nine size classes ranging from 0-9 to 250-500 employees. Therefore the industrial statistics for manufacturing include *available* data on all enterprises. In practice, the most up-to-date data is that for 1994/5.

At the same time, it is worth mentioning that within some of the industrial sectors we have omitted some branches of industry, which we do not consider to be part of the forest-based and related industrial cluster. For example, a great deal of furniture manufacturing uses materials other than wood. Hence, based on wood material usage within the furniture industry we adopt a conservative approach to estimate the amount of wood furniture, which is then included in the total values from industrial statistics (wood accounts for about 30% of furniture manufacturing). Moreover, we also exclude certain industrial branches from publishing such as the 'reproduction of sound recording', 'video recording', 'computer media production and the recording of media', since these are clearly not part of the forest cluster.

Based on data for 1994, the size of the EU forest cluster has been estimated to comprise at least 150,000 enterprises, employs about 4.2 million people, has a turnover of about 399 billion ECUs and yields approximately 161 billion ECUs in value-added (includes wood furniture only). Table 13.1 summarises the totals. These fig-

Table 13.1 Forest-based and related industrial Cluster of the EU (1994)

Nace Code	Total EU15 by Industry Branch (Total estimate)	Employ-ees 1000s	*Turnover* mill ECU	Value-Added mill ECU
r1422	Mining of clays and kaolin	7.1	856	379
	Forestry and Logging	227.5		13086
	Sub total as % of Forest Cluster	*5%*		*8%*
	Mechanical Wood Sector			
46	Timber and Wooden furniture industries	428.3	9758	6820
r201	Sawmilling & planing of wood, impregnation of wood	131.4	17127	5521
r202	Manufacture of veneer sheets; plywood, laminboard, particle board, fibre board and other panels and boards	79.5	11039	3092
r203	Manufacture of builders' carpentry and joinery	206.5	17660	6086
r204	Manufacture of wooden containers	47.0	4123	1232
r205	Manufacture of other products of wood; of cork, etc	79.4	6074	2207
	Sub total as % of Forest Cluster	*23%*	*16%*	*15%*
	Pulp and Paper Sector			
r211	Manufacture of pulp, paper and paperboard	247.9	57021	16618
r212	Manufacture of articles of paper and paperboard	417.8	51090	16421
	Sub total as % of Forest Cluster	*16%*	*27%*	*21%*
47	Manufacture of paper & paper products; printing & pub.	423.9	17933	6162
	Printing and Publishing Sector			
r221	Publishing	389.3	52817	20609
r222	Printing and service activities related to printing	672.6	61478	27501
	Sub total as % of Forest Cluster	*25%*	*29%*	*30%*
	Machine building and Speciality Inputs			
r2412	Manufacture of dyes and pigments	27.4	5510	1595
r2821	Manufacture of tanks, reservoirs & containers of metal	30.4	2815	1074
r291	Manufacture of machinery for the production and use of mechanical power, exc aircraft, veh and cycle engines	473.0	52717	20589
r293	Manufacture of agricult and forestry machinery	47.2	5315	1633
r2955	Manufacture of machinery for paper & paperboard prod	32.1	3888	1546
	Sub total as % of Forest Cluster	*14%*	*18%*	*16%*
	Wood Furniture			
467	Manufacture of wooden furniture	91.4	4477	3027
r361	Manufacture of furniture (Includes all types)	611.9	56968	19747
	Wood Furniture Estimate (30% of totals)	183.6	17090	5924
	Sub total as % of Forest Cluster	*6%*	*5%*	*6%*
	Totals (using wood furniture only)	**4.2 Million**	**399 Bill ECU**	**161 Bill ECU**

Source: Eurostat.

ures are for manufacturing, and also include forestry. However, these figures do not include any of the related service activities within the cluster.

In percentage terms most of the value-added in manufacturing, 30%, is created in the printing and publishing end of the forest cluster. The pulp and paper element produces a further 21%, with the related machine building and speciality inputs adding another 16%. A further 15% is generated from the mechanical wood processing and wooden products sector, whilst an additional 8% and 5% is provided from forestry and the wooden furniture area. Percentages for turnover are of a similar magnitude.

Similarly for employment, printing and publishing provides about 25% of jobs, pulp and paper about 16%, whilst machine building and speciality inputs account for about 14%. However, the mechanical wood sector provides about 23%, whilst wooden furniture, and forestry employs another 6% and 5% respectively. One feature also worth mentioning is the number of enterprises indicated by the high percentage values for both printing and publishing and the mechanical wood sectors of the cluster. This indicates the nature of these types of firms which notoriously consist of Small and Medium Enterprises (SMEs), as does the wooden furniture industry.

At the country level the most significant forest cluster country is Germany Table 13.2. It delivers about 27% of total value-added, around 23% of the turnover and provides approximately 27% of the total employment. France is the next most significant country, providing 16% of total value-added, around 18% of the turnover and about 13% of the employment. Similarly, figures for the UK are 13% of value-added, around 16% of turnover but almost 19% of employment. Whilst for Italy, the values are less with 9% of value-added, around 11% of turnover and 12% of employment. With regard to both Italy and France it is also interesting to note the percentage shares of investments in machinery etc of around 23% each, whilst total investments were about 12% each, both of which were well above the average levels. Bearing in mind the rapid growth in forest cluster exports from these countries between 1989 and 1995, this is perhaps an indication of the shift in the centre of gravity within the forest cluster which has, and is currently, underway (closer to the customer).

Table 13.2 EU Forest Cluster - by country (as a % of total)

(Manufacturing and Forestry)	Employees - exc home workers	Turnover	Gross value-added (factor cost)
Austria	2.4	3.1	3.5
Belgium	4.0	4.6	4.9
Denmark	1.8	1.8	2.3
Finland	3.1	4.3	5.6
France	**12.5**	**17.9**	**15.8**
Germany	**26.5**	**22.5**	**27.3**
Greece	0.6	0.4	0.3
Ireland	0.6	0.4	0.5
Italy	**11.9**	**11.2**	**9.0**
Luxembourg	0.1	0.1	0.1
Netherlands	3.7	4.6	4.4
Portugal	3.5	1.5	1.7
Spain	6.5	5.1	4.4
Sweden	4.1	6.2	7.2
UK	**18.6**	**16.1**	**13.1**
Total EU15	100.0	100.0	100.0
(Total Figures)	(4.2 million)	(399 billion)	(161 billion)

Source: Eurostat, and ETLA estmates.

Based on this data, it is apparent that the so-called 'big forest industry countries' of Sweden, Finland and Austria, do not produce (at least not in their home country) nearly as much of the total value-added as the other major economies. In fact both Sweden and Finland deliver about 6-7% each of the value-added, between 4-6% of the turnover and around 3-4% of the employment. Austria's figures are even less, but both the Netherlands and Spain provide just as much as, Sweden or Finland. Therefore the main message here is that most of the other EU countries stand to gain much more from a more competitive forest cluster, in comparative terms, than the so called 'big' forest industry countries.

Furthermore, based on total manufacturing figures for 1994, as extracted from the Eurostat data, the significance of the forest cluster in each country has been calculated in percentage terms of manufacturing. As expected, forest cluster activity in Finland, Sweden and Austria accounted for high proportions of manufacturing. Finland's forest cluster accounted for 37% of the value-added, 34% of production value and about 34% of employment.

Similarly, the forest cluster in Sweden accounted for 25% of value-added, 22% of production value and 24% of employment. The same figures for Austria were, 17%, 16%, and 19%, respectively. Table 13.3.

Forest cluster activity in other EU countries, in terms of manufacturing, is also relatively high. In fact, in Denmark the importance of the forest cluster would appear to higher than in Austria, it's shares were 20% of value-added, 15% of production value and about 22% of employment. In the UK, the forest cluster accounted for about 16% of the value-added, 13% of production value and around 16% of employment in total manufacturing. In France, the cluster accounted for 13% of the value-added, 11% of production value and about 14% of employment. Figures for Italy were of a similar order at 11% of value-added, 11% of production value and 13% of employment. Total manufacturing figures for Germany, the Netherlands and Spain were not available.

Table 13.3 Significance of Forest Cluster in EU Countries in terms of manufacturing

All Figures expressed as a percentage of Total Manufacturing			
Country	Employees excluding home workers	Turnover	Gross value-added at factor cost
Austria	18.6	16.5	16.7
Denmark	21.7	15.3	19.9
Finland	33.7	33.7	37.1
France	13.6	10.6	13.0
Germany	NA	NA	NA
Greece	11.4	8.2	9.4
Ireland	11.4	5.1	6.1
Italy	12.9	11.0	10.8
Luxembourg	4.9	3.4	5.0
Netherlands	NA	NA	NA
Spain	NA	NA	NA
Sweden	24.4	21.5	24.7
UK	16.3	12.9	15.9

Source: Eurostat and ETLA estimates.

13.2 Significance of the forest cluster in the Economies of the EU

The importance of the forest cluster in terms of total manufacturing within each country is quite evident from the above enterprise survey data. However, how significant is the forest cluster within the various national economies of the European Union.

Selected details have been extracted from the national accounts, as produced by Eurostat, to examine just how significant the forest cluster is within the EU. Details for 1995 are reproduced below in table 13.4. Values of interest are those of Gross Domestic Product (GDP) and Value-Added. Individual country figures for total value-added as calculated from the Eurostat industrial statistics (1994) as

Table 13.4 National Accounts in ECUs 1995 (billions)

1995	Eur 15	Ger	Fra	Ital	Nld	UK	Ire	Dnk
Gross domestic product at market prices (GDPmp) (N1)	5685	1414	988	911	248	821	48	109
Forest Cluster **Value-Added** in Manuf #	161	43.87	25.32	14.38	6.98	20.99	0.75	3.66
Forest Cluster VA as a % of GDP	**2.83**	**3.1**	2.6	1.6	2.8	2.6	1.6	**3.4**
1995	Spa	Grc	Port	Aut	Bel-lx	Fin	Swe	
Gross domestic product at market prices (GDPmp) (N1)	417	69	59	139	174	103	186	
Forest Cluster **Value-Added** in Manuf #	7.13	0.56	2.71	5.60	7.98	9.02	11.52	
Forest Cluster VA as a % of GDP	1.7	0.8	**4.6**	**4.0**	**4,6**	**8.8**	**6.2**	

Estimated from 1994 Eurostat Enterprise Survey and SME databases (Gross Value-Added at factor cost in billions of ECUs).
Source: Eurostat and ETLA estimates.

also shown. From both sets of data the percentage shares of the forest cluster have been estimated for each country and for the EU in total, although this does place some degree of bias against value-added of the forest cluster value-added, due to the difference of reference year. Nevertheless, the comparison does provide some means by which to assess how significant the forest cluster is within the EU.

From this comparison, the first point to note is that forest clusters of Finland and Sweden, have the highest shares of GDP in each country. Finland's share of GDP was almost 8%, Sweden's was above 6%. However, both Portugal and Belgium/Lux had shares of 4.6%, whilst Austria's was 4%. Most of the remaining countries' shares of GDP ranged between 1% to 3.4%. However, overall the total value-added of the forest cluster, estimated at about 161 billion ECUs (1994), represented about 2.8% of the EU15's GDP, which in 1995 totalled some 5685 billion ECUs.

Putting this 2.8% of GDP, or 161 billion ECUs, into perspective, the total value-added of the EU forest cluster is greater than the GDP of Denmark, or Finland or even Austria. Needless to say, in terms of value-added, the EU forest cluster is large enough to individually support any one of the seven smallest member state economies of the European Union.

In addition, Eurostat also produces data showing the percentage shares of GDP for manufacturing industries of the EU15. These have also been extracted for 1989 and 1995 for industries included in the forest cluster. Total shares of GDP have been estimated from this data and whilst these data do show good correlation with the previous estimate, these figures also reveal that the total forest cluster share of the EU15's GDP could be even higher at around 3%.

13.3 Employment in the Forest Cluster

Employment in the EU forest cluster has been estimated at around 4.2 million in 1994 (including forestry), as detailed in the previous section. Comparing this figure with total employment within the EU, of around 147 million, then in percentage terms the forest cluster provides about 2.9% of the total employment in the EU. Although in percentage terms this might not seem substantial, 4.2 million jobs is greater than the total employment of Sweden or Belgium for example. Table 13.5.

Table 13.5 Total Employment (millions)

	1995	1994	1993	1992	1991
Employ in the EU Forest Cluster*		4.2			
Total Employ EU15#	148.2	147.2	147.8	149.9	152.3

*ETLA Estimate.
#Source: Eurostat Yearbook 1997 - Persons in Employment, page 296 (Nace clio).

In terms of total manufacturing in the EU, the manufacturing sector employs about 44.8 million workers. Therefore the forest cluster's percentage share of employment within manufacturing is greater than 9%. Moreover, within the EU the share of manufacturing in terms of total employment is declining. Between 1991 and 1996 it has declined by more than 12%. Table 13.6

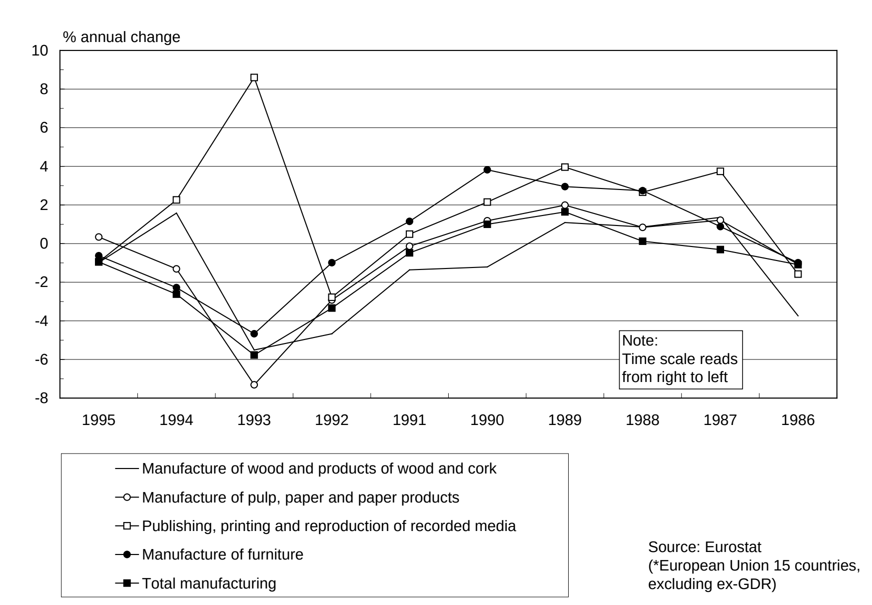
Table 13.6 Manufactured products Total employment within the EU (mill)

Naceclio	1995	1994	1993	1992	1991
EU15* (mill)	44.768	44.923	46.304	48.729	50.396

*Source: Eurostat Yearbook 1997 Employment in Industry, page 297.

However, over the period 1986 to 1995, the growth rate of employment in manufacturing has varied. In general, the growth rate in employment peaked around 1989, then declined until 1993. Since then however, there has been resurgence in employment growth. Within the forest cluster, most of the main activities have followed the same trends as in total manufacturing. However forest cluster activities have declined less between 1989 and 1993 and grown faster since 1993. One exception to this is manufacturing of wood and products of wood, which has declined more during the 1989-93 period and has seen both growth and decline since 1993. In 1995, employment in total manufacturing had a growth rate of -1%, whilst within the cluster, the change in employment was generally changing at the same rate or better in most cases. Over the period, most activities within the forest cluster evidently appear to have been less effected than total manufacturing in terms of employment growth. It is also likely that a good deal of restructuring has taken place, in most areas of the cluster since 1993. Table 13.7.

Table 13.7 Growth Rate of Manufacturing Employment (% annual change)



	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986
Manufacture of Wood and Products of Wood and Cork	-0.98	1.58	-5.51	-4.67	-1.36	-1.21	1.09	0.86	1.36	-3.74
Manufacture of Pulp, Paper and Paper Products	0.34	-1.31	-7.31	-2.92	-0.14	1.18	1.99	0.84	1.21	-1.07
Publishing, Printing and Reproduction of Recorded Media	-0.95	2.26	8.6	-2.78	0.49	2.15	3.96	2.66	3.74	-1.58
Manufacture of Furniture	-0.63	-2.28	-4.67	-0.99	1.15	3.82	2.95	2.74	0.88	-0.99
Total Manufacturing	-0.95	-2.62	-5.77	-3.34	-0.48	1	1.64	0.12	-0.31	-1.09

Source: Eurostat (*European Union 15 countries, excluding ex-GDR).

13.4 Significance of the Forest Cluster within the OECD

Based on aggregate level data extracted from Eurostat's NewCronos database, the EU forest cluster's share of value-added of the *OECD* is greater than 25%, whilst the EU15's share of total manufacturing is about 30%. In 1995, the shares of OECD value-added were as follows, manufacturing of wood and products of wood, 27%, manufacture of pulp, paper and paper products, about 27%, publishing and printing, around 24% and manufacture of furniture more than 37%. Furthermore, between 1989 and 1995, the percentage shares in all four of these aggregate branches grew faster than the EU's share of total manufacturing in the OECD. Table 13.8. In general, the EU forest cluster's share of value-added within the OECD is less than that of the EU's share of total manufacturing.

Table 13.8 EU's Share of OECD Value-Added # within Forest Cluster Branches (%)

NACE	Forest Cluster Branches of Industry (selection)	1989 *EU15 % Shares	1995 *EU15 % Shares	1989-95 *EU15 Growth
2000	MANUFACTURE OF WOOD AND PRODUCTS OF WOOD AND CORK, Excluding Furniture; Manufacture Of Articles Of Straw And Plaiting Materials	26.78	27.35	**0.57**
2100	MANUFACTURE OF PULP, PAPER AND PAPER PRODUCTS	25.06	26.83	**1.77**
2200	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	20.33	23.84	**3.51**
3610	Manufacture of furniture	33.52	37.2	**3.68**
9001	**Total manufacturing**	**29.59**	**30.05**	**0.46**

#Share of the value-added of the EU in the value-added of OECD in percentage terms.
*European Union (15 countries, excluding ex-GDR).

Forest cluster exports to the OECD have already been covered in a previous section of this report, were data indicated that the EU forest cluster appeared to be just about maintaining its share of OECD exports. Nevertheless, further data has been extracted from Eurostat to examine various elements of forest cluster exports to the OECD. According to this data, in 1989, the EU15's share of total manufacturing exports was around 59%, whilst exports from the majority of forest cluster activities (84% or more) held shares in access of this. Table 13.9.

By 1995, this had changed. The EU15's share of total manufacturing exports had fallen to about 58%, whilst as many as 79% of the forest cluster activities still had higher shares. Notwithstanding, the apparent status quo, when examining growth in the export shares of each individual forest cluster activity, it is very evident that overall the EU forest cluster is slowly losing its share of exports in the OECD. Between 1989 and 1995, the EU15's share of total manufacturing exports to the OECD had declined by 1.2%, whereas, as many as 44% of the forest cluster industries had experienced declines in excess of this value.

Despite the apparent drop in share of OECD exports, several areas of forest cluster activity experienced gains in export shares. Publishing of newspapers and journals and periodicals were some of the biggest gainers, with the UK one of the main gainers. Germany, France and Italy also gained in either one of these areas. The manufacturing of pulp, paper and paper products was another area of gain. However, the gains were mainly made in Germany, France and Italy and not in either of the other main producing countries of Finland and Sweden.

Another area of increased share of OECD exports was the manufacture of wood and products of wood, were both Sweden and Finland made substantial gains. Denmark, France, Italy and Bel/Lux also increased their shares in this area of exports.

In terms of manufacturing production, the EU15's share of total manufacturing in the OECD is about 35%. Within the forest cluster, the main activities of manufacturing of wood and products of wood, manufacture of pulp, paper and paper products, publishing and printing each have a share of about 31%, whilst manufacturing of furniture has more than 43%. Furthermore, between 1989 and 1995, the percentage shares of all four of these aggregate branches has grown faster than, or similar to, the EU's share of total manufacturing in the OECD. Table 13.10.

Table 13.9 EU's Share of OECD Exports (%)

NACE	Branches of Industry within the Forest Cluster *EU15	1989	1995	1989-95
1412	Quarrying of limestone, gypsum and chalk	63.66	62.79	-0.87
1422	Mining of clays and kaolin4	55.11	53.06	-2.05
2000	MANUFACTURE OF WOOD AND PRODUCTS OF WOOD AND CORK, excluding furniture; manufacture of articles of straw and plaiting materials	52.39	52.6	0.21
2010	Sawmilling and planing of wood, impregnation of wood	38.9	39.14	0.24
2020	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	68.21	62.67	-5.54
2030	Manufacture of builders' carpentry and joinery	72.56	76.43	3.87
2040	Manufacture of wooden containers	82.88	82.67	-0.21
2050	Manufacture of other products of wood; manuf articles of cork, straw and plaiting	79.19	75.87	-3.32
2051	Manufacture of other products of wood	69.59	66.39	-3.2
2052	Manufacture of articles of cork, straw and plaiting materials	92.52	91.72	-0.8
2100	MANUFACTURE OF PULP, PAPER AND PAPER PRODUCTS	59.81	60.12	0.31
2110	Manufacture of pulp, paper and paperboard	55.88	56.96	1.08
2111	Manufacture of pulp	33.69	29.04	-4.65
2112	Manufacture of paper and paperboard	64.66	65	0.34
2120	Manufacture of articles of paper and paperboard	78.81	71.88	-6.93
2121	Manufact of corrugated paper & paperboard and containers paper & paperboard	78.4	70.56	-7.84
2122	Manufacture of household and sanitary goods and of toilet requisites	81.51	75.39	-6.12
2123	Manufacture of paper stationery	81.63	69.61	-12.02
2124	Manufacture of wallpaper	81.2	76.49	-4.71
2125	Manufacture of other articles of paper and paperboard n.e.c.	72.46	69.05	-3.41
2200	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	67.23	61.25	-5.98
2210	Publishing	64.97	58	-6.97
2211	Publishing of books	67.87	67.22	-0.65
2212	Publishing of newspapers	92.23	94.16	1.93
2213	Publishing of journals and periodicals	64.44	70.6	6.16
2215	Other publishing	75.1	64.77	-10.33
2220	Printing and service activities related to printing	73.08	71.42	-1.66
2222	Printing n.e.c.	72.23	71.45	-0.78
2411	Manufacture of industrial gases	62.88	62.18	-0.7
2412	Manufacture of dyes and pigments	60.63	60.83	0.2
2821	Manufacture of tanks, reservoirs and containers of metal	74.32	69.47	-4.85
2911	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	42.92	42.69	-0.23
2912	Manufacture of pumps and compressors	59.77	59.09	-0.68
2913	Manufacture of taps and valves	70.63	65.56	-5.07
2914	Manufacture of bearings, gears, gearing and driving elements	62.26	58.74	-3.52
2932	Manufacture of other agricultural and forestry machinery	62.36	63.33	0.97

2955	Manufacture of machinery for paper and paperboard production	72.29	69.27	-3.02
2956	Manufacture of other special purpose machinery n.e.c.	58.74	50.28	-8.46
3610	Manufacture of furniture	84.13	75.19	-8.94
3611	Manufacture of chairs and seats	80.66	66.08	-14.58
3612	Manufacture of other office and shop furniture	75.73	73.13	-2.6
3613	Manufacture of other kitchen furniture	93.87	86.5	-7.37
3614	Manufacture of other furniture	87.11	81.25	-5.86
9001	**Total manufacturing**	**58.82**	**57.65**	**-1.17**

Source: Eurostat. *European Union (15 countries, excluding ex-GDR)
Note: Figures represent the % share of exports of a country in total OECD exports. For individual member states, world exports are used, whilst for the EU total, extra-EU exports are taken.

Table 13.10 Share of OECD Production # (%)

NACE	Branches of Industry within the Forest Cluster (Selection)	1989	1995	1989-95
		*EU15	*EU15	*EU15
2000	MANUFACTURE OF WOOD AND PRODUCTS OF WOOD AND CORK, excluding furniture; manufacture of articles of straw and plaiting materials	29.68	30.81	**1.13**
2100	MANUFACTURE OF PULP, PAPER AND PAPER PRODUCTS	31.13	31.53	**0.4**
2200	PUBLISHING, PRINTING AND REPRODUCTION OF RECORDED MEDIA	26.75	30.59	**3.84**
2930	Manufacture of agricultural and forestry machinery	42.5	38.47	-4.03
3610	Manufacture of furniture	39.82	43.47	**3.65**
9001	**Total manufacturing**	**34.65**	**35.32**	**0.67**

#Share of production in the production of the OECD, in percentage terms
*European Union (15 countries, excluding ex-GDR)
Source: Eurostat, Etlatieto.

At the domestic level, the EU forest cluster appears to have lost its ability to supply the domestic market somewhat in recent years. In 1989, total manufacturing in the EU accounted for about 90% of the EU's domestic market, and likewise most areas of industry within the forest cluster, held similar shares of around 90% or higher. Table 13.11. In 1995, whilst maintaining very high domestic shares at levels similar to 1989, the EU15 has actually experienced a decrease in domestic shares of between 1% and 4%. However, it must be stressed that these figures refer to the ability to supply the domestic market after accounting for exports, nevertheless this does have a reflection on the types of changes, which appear to have taken place within the cluster.

Table 13.11 Share of EU Domestic Market 1989-1995 (%)

Nace	Branches of Industry within the Forest cluster (Selection)	1989 *EU15	1995 *EU15	1989-95 *EU15
2000	MANUFACTURE OF WOOD AND PRODUCTS OF WOOD AND CORK, excluding furniture; manufacture of articles of straw and plaiting materials	86.54	86.16	-0.38
2010	Sawmilling and planing of wood, impregnation of wood	72.05	76.68	4.63
2020	Manufacture of veneer sheets; manufacture of plywood, laminboard, particle board, fibre board and other panels and boards	86.64	85.14	**-1.5**
2030	Manufacture of builders' carpentry and joinery	**97.85**	**94.78**	**-3.07**
2040	Manufacture of wooden containers	**97.94**	**94.36**	**-3.58**
2050	Manufact of other products of wood; manuf articles of cork, straw and plaiting	86.52	82.12	**-4.4**
2100	MANUFACTURE OF PULP, PAPER AND PAPER PRODUCTS	**91.55**	**90.73**	-0.82
2110	Manufacture of pulp, paper and paperboard	85.97	84.5	**-1.47**
2120	Manufacture of articles of paper and paperboard	**98.46**	**97.91**	-0.55
2200	PUBLISHING, PRINTING & REPRODUCTION OF RECORDED MEDIA	**97.92**	**97.86**	-0.06
2220	Printing and service activities related to printing	NA	**98.76**	NA
2910	Manufacture of machinery for the production and use of mechanical power, except aircraft, vehicle and cycle engines	**89.7**	87.74	**-1.96**
3610	Manufacture of furniture	**95.81**	**92.95**	**-2.86**
9001	**Total manufacturing**	**88.99**	**87.91**	**-1.08**

*European Union (15 countries, excluding ex-GDR
The share of domestic market is the ability to supply the domestic market, after accounting for exports. For individual member states, world exports are used, whilst for the EU, extra-EU exports are taken. (Q-X)/C*100, where: Q = production; X = exports; C = apparent consumption (Q+X-M); M = imports.
Source: Eurostat.

Summary Conclusions

- The EU forest cluster has been estimated to comprise of about 4.2 million employees; has a turnover of about 399 billion ECUs and yields approximately 161 billion ECUs in value-added
- In terms of value-added, turnover and employment, the most significant forest cluster countries in the EU are Germany, the UK, France and Italy
- The total value-added of the forest cluster, is estimated at about 161 billion ECUs (1994), about 2.8% of the EU15's GDP, and could be higher at around 3%
- The forest cluster provides 2.9% of total employment in the EU
- The forest cluster's percentage share of employment within manufacturing is greater than 9%
- The EU forest cluster's share of value-added in the OECD is greater than 25%
- The EU forest cluster's share of production of total manufacturing in the OECD is about 35%.

Chapter 14. Conclusions

The forest-based and related industries of the EU are widely distributed across Europe, and are not concentrated in any one region or country. Combined, the forest-based and related industries provide employment for over 4 million people, have a turnover of some 400 billion Euro, produce some 160 billion Euro in value-added, and also provide a trade surplus to the EU.

EU countries comprise a formidable amount of technological know-how and expertise in all areas of the forest cluster. The high levels of expertise contained within the related and supporting industries are demonstrated by the fact that a considerable proportion of machinery and equipment is exported by the EU forest cluster. This is significant, since it shows that many innovations continue to occur within the EU, and suggest that other elements of the forest cluster continue to be competitive. However, in the area of speciality inputs - such as pulp and paper chemicals, which is dominated by large multinationals – a considerable amount of inputs are imported from outside the EU. In this instance, the forest cluster may be losing its edge in some key inputs.

The EU forest cluster exists as a series of ‘industrial districts’, ‘clusters’ and ‘agglomerations’ found in many regions of Europe. These are found both localised in certain districts or regions and sometimes dispersed at the national level but the vast majority are comprised of SMEs. In many cases, they are linked to one another via multinational firms and networks of related and supporting industries. As such, key innovations developed in one competitive region may be transferred to another. However, there are many intangible assets, which may not be easily transferred. History also plays a key role in the development of these competitive regions, or districts, with companies and regions accumulating knowledge over centuries.

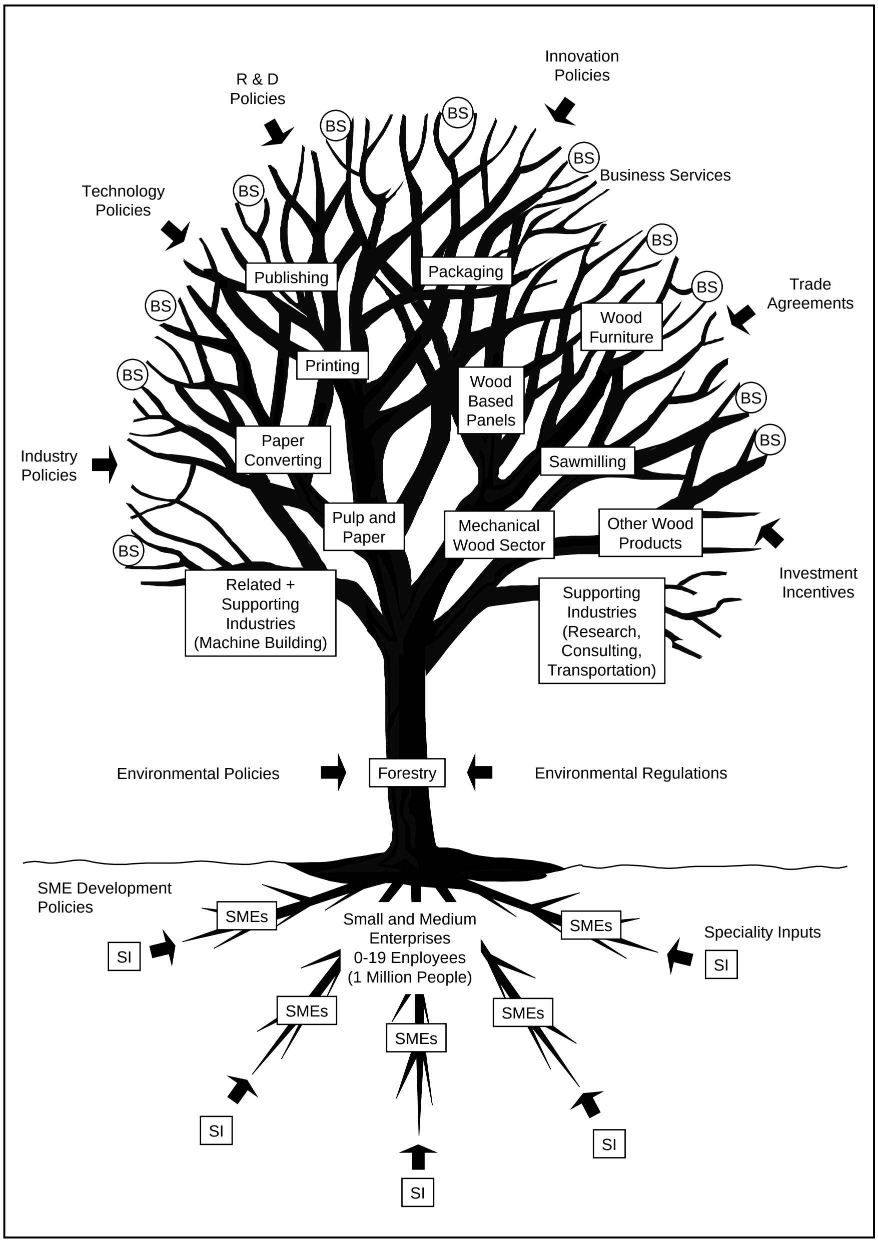
Due to the shear scope of research, it has only been possible to provide an overview of the EU forest cluster, its characteristics and some of its strengths and weaknesses. Nonetheless, it is evident that there are numerous examples of competitive industrial districts, clusters and agglomerations located in many regions of the EU. Therefore, to assist policy-makers, it would be highly desirable to conduct a series of cluster studies at the national level to obtain even more accurate information on the EU forest cluster.

Apart from strengths and weaknesses, we have also highlighted several opportunities and threats. Opportunities exist in the shape of new markets e.g. in Eastern Europe, which are anticipated to grow as living standards increase. Between 1989 and 1995, forest cluster exports to the Central and Eastern European countries have grown from 0.6 billion Euro to 3.5 billion Euro, faster than the forest cluster exports to Asia. Moreover, given the high levels of expertise contained within the EU, opportunities also exist to enhance collaboration in research and development, and co-operation throughout the value chain, and indeed, the cluster concept offers a good starting point in this respect.

Eastern European countries also provide potential threats. During the period 1989-1995, the share of forest cluster imports from the Eastern European countries and Russia has grown from 5 to 7 per cent and now stands at 6.5 billion Euro, the second largest importer after North America. Although not the focus of this research we have highlighted numerous examples demonstrating the expansion of Western companies into Eastern Europe. In many cases, subcontracting arrangements are being utilised to take advantage of lower wage production and even new production facilities are being established. In the short term, there may not appear to be any concerns arising from this phenomenon. However, even though it is claimed that most of the production being outsourced or transferred may be termed lower value-added, the trend still points to major structural change within the forest cluster. At the same time, the shift of lower stages of production process to some of the least regulated industries in Eastern Europe, also suggests that environmental problems are being encouraged to develop, unabated. It is therefore necessary, that these forest-based and related industries be the subject of detailed cluster studies at the country level to determine their status before entering into the EU.

In figure 14.1, we summarise the EU forest cluster, diagrammatically. The forestry sector provides the basis for most of the industry, that is, supply of raw materials. Essentially, these raw wood supplies flow to the mechanical wood-processing sector or pulp and paper industry for processing. These products are then further processed before being incorporated into various end products such as wood-based panels to the furniture industry; or paper products to the printing and publishing industry.

Figure 14.1 The EU Forest Cluster



However, the above industries do not act alone and are assisted by related and supporting industries such as machine building and speciality inputs, and also research, consulting and transportation industries. At the same time, the forest cluster is also a large and growing user of business services, contributing to the growth in business services. Hence, the fruit of forest cluster expansion can also be seen as growth in business services.

It has also been shown that Small- and Medium-sized Enterprises make up the vast majority of the forest cluster, but that SMEs of less than 20 persons are not represented in industrial statistics. Hence, although numbering about 1 million persons these firms are mostly ‘invisible’ and generally under-represented, yet they provide the foundations for the whole industry. Equally important are the suppliers of speciality inputs, such as bleaching chemicals for the pulp and paper industry, who are not normally considered part of the forest-based and related industries. Yet, in our research they have been shown to be central in the innovation process, feeding the development of the industry.

Furthermore, the forest cluster is also influenced by the institutional ’setting’ throughout the forestry-wood paper chain. Therefore, policy makers need to be aware that the complex interaction between each of the industrial branches of the forest cluster means that almost every policy decision has an impact right across the whole industry.

References

M. E. Porter, The Competitive Advantage of Nations, 1990.

Cluster Analysis and Cluster-based policy. New perspectives and rationale in innovation policy-making", OECD, Paris, 1999.

Ojainmaa, *International competitive Advantage of the Finnish Chemical Forest Industry,* 1994.

Lammi, *The Success Story of Paper, Machines and Know-how – The Competitive Advantage of the Forest Cluster*, in Finnish 1994.

OECD, Boosting Innovation – The Cluster Approach, OECD proceedings 1999.

Clusters, Industrial Policy and Firm Strategy: A Menu Approach. Danny Jacobs & Ard-Pieter De Man, in Technology Analysis & Strategic Management. Vol. 8. No. 4, 1996, pp 425-437.

Advantage Sweden – Sölvell, Zander and Porter, Norstedts, 1991.

Input-Output Supply & Use Balances, 1992-1996. UK Office for National Statistics, 1998.

Statistisches Bundesamt Physische Input-Output-Tabellen 1990 Beiträge zu den Umweltökonomischen Gesamtrechnungen, Band 1 Stuttgart, 1997.

Eurostat forestry statistics 1992-96.

NewCronos database, Eurostat, 1998.

OECD National Accounts, detailed tables Volume II, 1998.

Industrial Structure Statistics – Volume 1, 1998, OECD.

'Austria: Industrial Clusters' by Austrian Institute of Regional Studies and Spatial Planning, pp 159-166, in Networks of Enterprises and Local Development – competing and co-operating in local productive systems – OECD 1996.

The European Business Directory – EUROPAGES, 1999.

The Furniture Industry in the European Union, CSIL (Centro Studi Industria Leggera, 1999.

'External economies and value net strategies in Italian furniture districts' – Gabriella Lojacono and Mark Lorenzen, in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 71-91, Handleshojskolens Forlag, 1998.

'The evolution of a furniture industrial district' – Giacomo Bambi, in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 59-67, Handleshojskolens Forlag, 1998.

CTBA, the Technical Centre for Wood and Furniture, France, 1999.

'Industrial Development Through Small-Firm Co-operation – Theory and Practice', by Frank Pyke, pp 17, International Labour Office, Geneva, 1992.

'Development of a low technology industry in high-cost environments - The case of the wooden furniture industry in Denmark' in Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 71-91, Handleshojskolens Forlag, 1998.

'The furniture industry of the Lahti Region, Finland, at the turning point', by Mika Kautonen. In, Specialisation and Localised Learning – Six Studies on the European Furniture Industry, pp 95-121, Handleshojskolens Forlag, 1998.

'Specialisation and Localised Learning in the European Furniture Industry', pp 9-27, Handleshojskolens Forlag, 1998.

CEPI Annual Statistics 1998 (Confederation of European Paper Industries).

European Analyses & Forecast, by Mark Payne. Published by PPI (Pulp & Paper International), 1998.

IPPC – Draft Reference Document on best available techniques in the pulp and paper industry – 1998, by Institute for Prospective Technological Studies.

CEPIPRINT Demand – Supply report Newsprint and Magazine paper grades 1999-2001, Feb 1999.

Pulp & Paper International, 'PPI's Top 150 Companies', September 1999, Miller Freeman.

PPI, International Fact and Price Book, 1997, Miller Freeman.

Pulp & Paper International – As companies get bigger are profits getting fatter ?, pp 17-23, September 1999, Miller Freeman.

Pulp & Paper International – Viewpoint *Europe takes another crash course in consolidation pp 5, September 1999, Miller Freeman.

Pulp & Paper International – To restructure or to be restructured, pp 53, September 1999, Miller Freeman.

M. Lammi, 1994, 'The success story of paper, machines and know-how - the competitive advantage of the forest cluster,' The Research Institute of the Finnish Economy, ETLA B 99 (in Finnish with English summary).

'European Printing Industry and its Markets', by Richard Max-Lino and Camilla Kvam, published by Pira International, 1999.

'The Evolution of the European Graphic Industry 1996-1997', INTERGRAPH, 1998.

'Five year Technology Forecast of Printing and Publishing', by: John Berkenshaw, Roberto Minio and Sean Smyth, Pira International, 1999.

The Economist, pp 139-142, December 19th 1998.

'The Competitive Advantage of Nations – with new introduction'; pp 179-195, by Michael E. Porter. The Free Press, 1998.

Industrial Structure Statistics – Volume 1, 1998, OECD.

'Technology Developments in the Forest Industry: Past, Present and Future', J. Philippou, in Analysing Structural Changes in Roundwood and Forest Products Markets in Europe, pp 41-54, EFI Proceedings No. 26, 1998.

VDMA Fachverband Holzbearbeitungsmaschinen (The German Woodworking Machinery Manufacturers Association).

A history of presses – 'From the Fratelli Pagnoni company of 1848 to Pagnoni Impianti of 1998', by Francesco Mandressi, and Barbara Pagnoni, Pagnoni Impianti s.p.a 1998.

Cartiere Burgo Interim Report, six months ended 30th June 1999. – September 1999.

ABB web site: http://www.abb.com/automation.

The European chemical industry in a worldwide perspective – facts and figures, European Chemical Industry Council - CEFIC ,1998.

CEFIC webpages: http://www.cefic.org/product_families/).

Chemical Market Reporter – CBNB, USA, 8/3/1999.

Euro Chlor web site: http://www.cefic.org/product_families/.

Sveriges Stärkelseproducenter Annual Report 1997.

ECC International web site: http://www.ecci.co.uk/compinfo/ index.htm.

FEICA, the Fédération Européenne des Industries de Colles et Adhésifs, 1998.

Ahlström Corp. (1995-1997), Annual Reports.

Autio, E. - E. Dietrichs, - K. Fuhrer, - K. Smith (1997): Innova-tion Activities in Pulp, Paper and Paper Products in Europe.

Bourque, J. (1987): CIM and Flexible Package Conversion Equipment, in Proceedings of 1987 Tappi Conference on Polymers, Laminations and Coatings, Atlanta: Tappi Press.

CEPI (1995): The European Paper Industry: Competitive and Sustainable, Brussels: CEPI.

CEPI (1998): Activity Report.

Cowling (1990): A New Industrial Strategy, International Journal of Industrial Organization, North-Holland.

Enso Corp. (1995-1997), Annual Reports.

Eriksson, L. (1997): European R&D Resources in Pulp and Paper, Proceedings of the European Conference on Pulp and Paper Research, October 9-11, 1996 Sweden.

European Commission (1997): Second Report on S&T Indicators - Report, Brussels.

Hellström, E. & J. Palo (1995): European Forestry Research – Public and Private Involvement, Journal of Forest Economics 1:3 1995.

FFIF (1994): Research and Development Strategy for Finnish Forest Industry in Fourth Framework, Finnish Forest Industries Federation

FFIF (1995): Research and Technology Definition of Policy, Finnish Forest Industries Federation.

FIBRE (1997): Annual Report, Turun yliopsto, Turku.

Geroski, P. and A. Jacquemin (1985): Industrial Change, Barriers to mobility, and European Industrial Policy, Economic Policy, 1.

Goddard, R. (1997): Packaging 2005 – a strategic forecast for the European packaging industry, Pira International, UK.

Jaakko Pöyry Corp. (1997, 1998), Annual Reports and www-pages

Klevorick, A.- R. Levin, - R. Nelson, - S. Winter (1995): On the Sources of Significance of Inter Industry Differences in Technilogical Opportunities, Research Policy vol. 24.

Lefflner, N. (1993): Process Control: Today and Tomorrow in Proceedings of XXV Eucepa Conference, Vienna.

Levlin, J-E. (1997) The Pulp and Paper Industry Intesifies R&D, in High Technology in Finland 1997.

Lindström, T. (1996): Strategy and Tactics for the Pulp and Paper Industry's R&D, Proceedings of 6th International Conference on New Available Technologies and Current Trends, Stockholm.

Metsähallitus (1998): Environmental Guidelines to Practical Forest management, Helsinki.

Metsäliitto Corp. (1995-1997): Annual Reports.

Molkentin-Matilainen, P. (1998): European Union Fifth Framework Programme, mimeo.

Nurmi, K. - A. Heikkilä - P. Knuuttila (1998): New Records in Paper and Board Markets drive up Sales of Paper Chemicals, Kemia-Kemi Vol. 25.

OECD (1995): Industry and Technology - Scoreboard of Indicators, Organisation for Economic Co-operation and Development, Paris.

OECD (1998): Technology, Productivity and Job Creation - Best Policy Practises, Organisation for Economic Co-operation and Development, Paris.

Ojainmaa, K. (1994): International Competitive Advantage of the Finnish Chemical Forest Industry, Helsinki, ETLA C 66.

Partekforest Corp. (1998): www-pages and Annual Reports

PIRA (1992): Packaging and the Environment, United Kingdom.

PIRA (1993): Global Packaging Trends, United Kingdom.

Ponsse Corp. (1998): Annual Reports and www-pages

PPI (1998): Klass, C. New Grades Fill the Gap with Printing Technology, August.

Raisio Chemicals Corp. (1997, 1998) Annual Reports and www-pages

Rouvinen, P. (1993): Data-guide to OECD Exports. ETLA Discussion Papers 426.

Sund Defibrator Corp. (1999): Mechanical Pulping Technology

Sunds Defibrator Corp. (1999): An Investors Guide for Panelboard System

Timberjack Corp. (1997, 1998): Annual Reports and www-pages

UPM-Kymmene Corp. (1996-1997): Annual Reports

Valmet Corp. (1997, 1998): Annual Reports and www-pages

Voith Sulzer Corp. (1998), Annual Reports and www-pages

Vuori, S. and P. Vuorinen (eds.) (1993): Explaining Technical Change in a Small Country - the Finnish National Innovation System, Helsinki, ETLA B 84.

'What Determines the Economic Geography of Europe' – J.I. Haaland, H.J. Kind, K.H.M. Knarvik & J. Torstensson, CEPR (Centre for Economic Policy Research, London), Discussion Paper No. 2072, February 1999.

'Forest Related Resources, Industries, Services and Know-How, in the Border Regions of the European Union' – P. Hyttinen, A. Ottitsch, P. Pelli and A. Niskinen – European Forest Institute, 1998

'SME database' NewCronos, Eurostat.

'The Emergence of Industrial Districts in Spain: Industrial Restructuring and Diverging Regional Responses', by Lauren Benton; In 'Industrial Districts and Local Economic Regeneration', By Frank Pyke, Werner Sengenberger, International Labour Organisation, Geneva, 1992, pp 59-68.

'The success story of paper, machines and know-how – The competitive advantage of the forest cluster'. The Research Institute of the Finnish Economy, ETLA B 99.

OECD International Trade by Commodities Statistics (SITC REV3) database. 1998.

Eurostat NewCronos database, 'Daisie'.

Eurostat Yearbook 1997 - Persons in Employment.

Eurostat Yearbook 1997 Employment in Industry.

The Forestry Industry Handbook 1998 – The Forestry Industry Council of Great Britain.

UK Office for National Statistics-Sector Reviews, 1997.

Appendicies

Appendix A

OECD Database INTERNATIONAL TRADE BY COMMODITIES STATISTICS (SITC REV.3) *List of country codes included in Zones:*

Zone Europe =

ALB,AND,AUT,BEL,BGR,BIH,BVT,CHE,CSK,CYP,CZE,DEU,DNK,ESP,FIN,FRA,FRO,GBR,GIB,GRC,HRV,HUN,IRL,ISL,ITA,LIE,MCO,MKD,MLT,NFK,NLD,NOR,POL,PRT,ROM,SMR,SVK,SVN,SWE,TUR,VAT,XAA,XCA,YUG,SJM

Zone Africa =

AGO,BDI,BEN,BFA,BWA,CAF,CIV,CMR,COG,COM,CPV,DJI,DZA,EGY,ERI,ESH,ETH,GAB,GHA,GIN,GMB,GNB,GNQ,IOT,KEN,LBR,LBY,LSO,MAR,MDG.MLI,MOZ,MRT,MUS,MWI,MYT,NAM,NER,NGA,REU,RWA,SDN,SEN,SHN,SLE,SOM,STP,SWZ,SYC,TCD,TGO,TUN,TZA,UGA,XCB,ZAF,ZAR,ZMB,ZWE

Zone North America =

CAN,MEX,PRI,SPM,USA,XCC

Zone Asia =

AFG,ARE,ARM,AZE,BGD,BHR,BLR,BRN,BTN,BUR,CHN,EST,GEO,HKG,IDN,IND,IRN,IRQ,ISR,JOR,JPN,KAZ,KGZ,KHM,KOR,KWT,LAO,LBN,LKA,LTU,LVA,MAC,MDA,MDV,MMR,MNG,MYS,NPL,NTZ,OMN,PAK,PHL,PNG,PRK,QAT,RUS,SAU,SGP,SUN,SYR,THA,TJK,TKM,TMP,TWN,UKR,UZB,VNM,XAB,XAC,XBD,XCD,YEM

Zone Ocean =

ASM,ATF,AUS,CCK,COK,CXR,FJI,FSM,GUM,HMD,KIR,MHL,MNP,NCL,NIU,NRU,NZL,PCI,PCN,PLW,PYF,SLB,TKL,TON,TUV,UMI,VUT,WLF,WSM,XBA,XBB,XCE

Zone Central and South America =

ABW,AIA,ANT,ARG,ATG,BHS,BLZ,BMU,BOL,BRA,BRB,CHL,COL,CRI,CUB,CYM,DMA,DOM,ECU,FLK,GLP,GRD,GTM,GUF,GUY,HND,HTI,JAM,KNA,LCA,MSR,MTQ,NIC,PAN,PCZ,PER,PRY,SLV,SUR,TCA,TTO,URY,VCT,VEN,VGB,VIR,XAD,SGS

OECD International Trade database Notes:

1) The above Zones are compiled on a geographical classification basis and not an economical one.

2) The codes n.e.s where used in the old system which did not include codes like Holy See or small islands (BVT, SGS,) which are now declared as countries in the ISO codes.

3) Central and Eastern Europe include: Albania, Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovak Republic and Slovenia + OECD countries Hungary, Poland and Czech Republic.

4) List of OECD countries 29 members in 1998.

- In 1995, the OECD comprised:

Austria, Australia, Canada, Belgium-Luxembourg, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Mexico, Norway, the Netherlands, New- Zealand, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom and USA.

- Since 1996

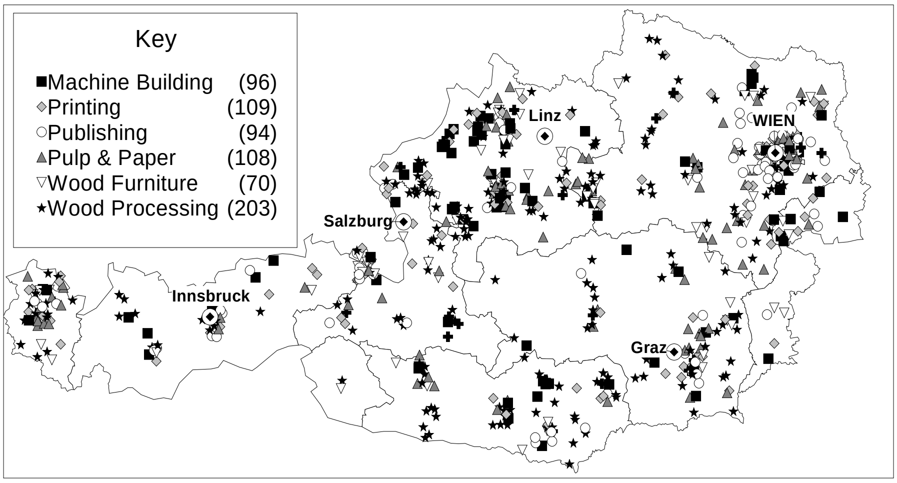
New members Korea, Poland and Hungary, are included.

5) All data are included in world estimates.

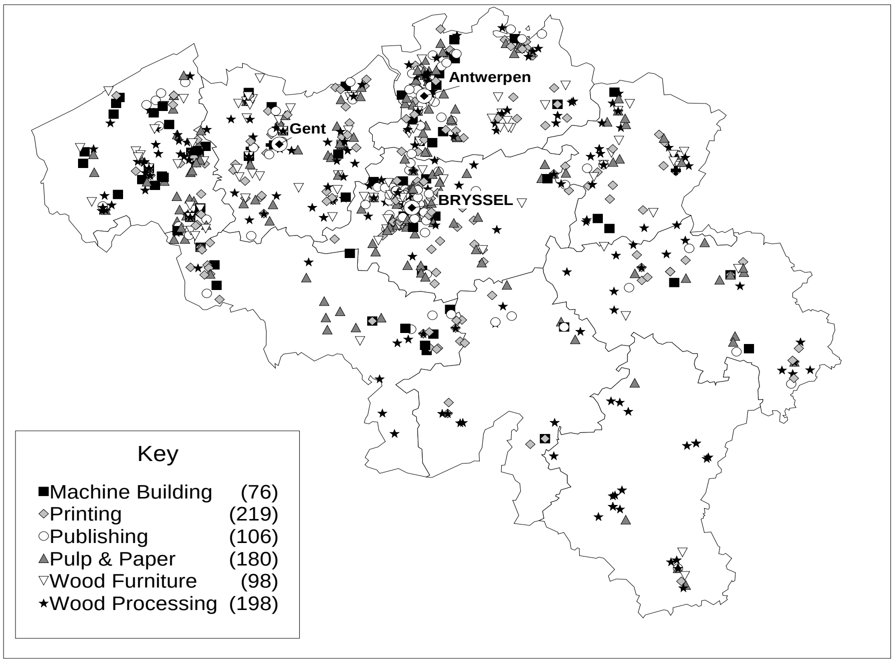
Appendix B

Location of forest-based and related industry companies in the EU

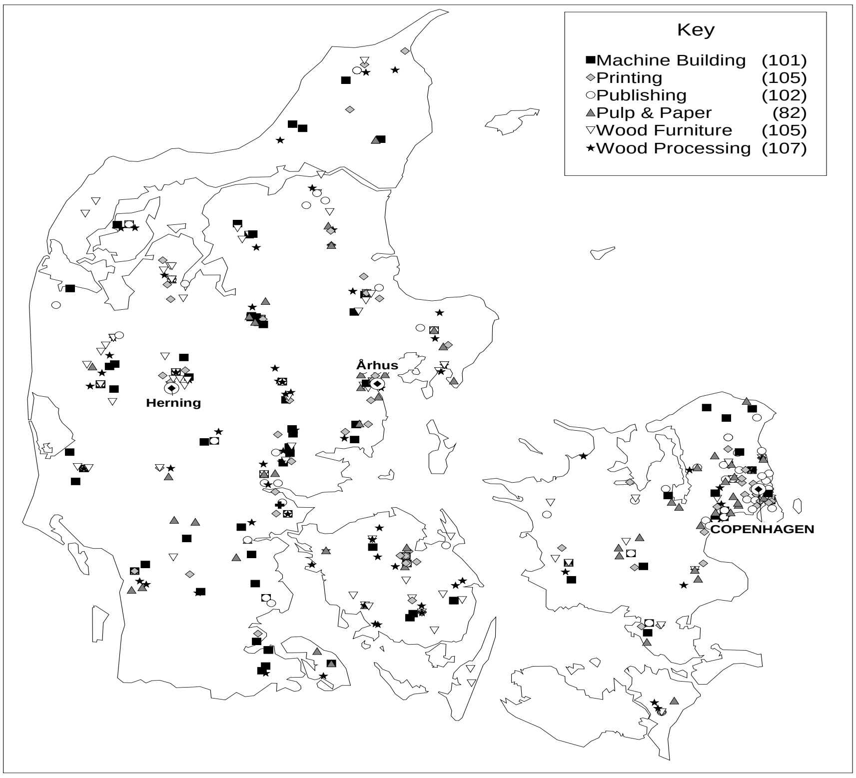
Austria



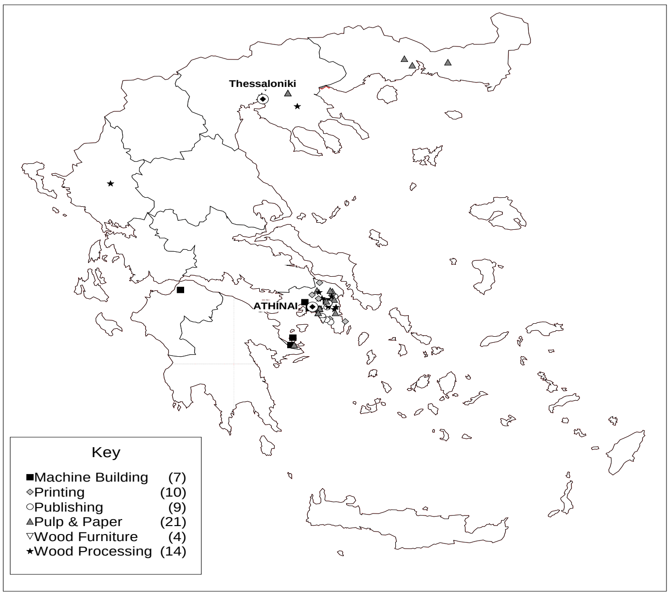
Belgium



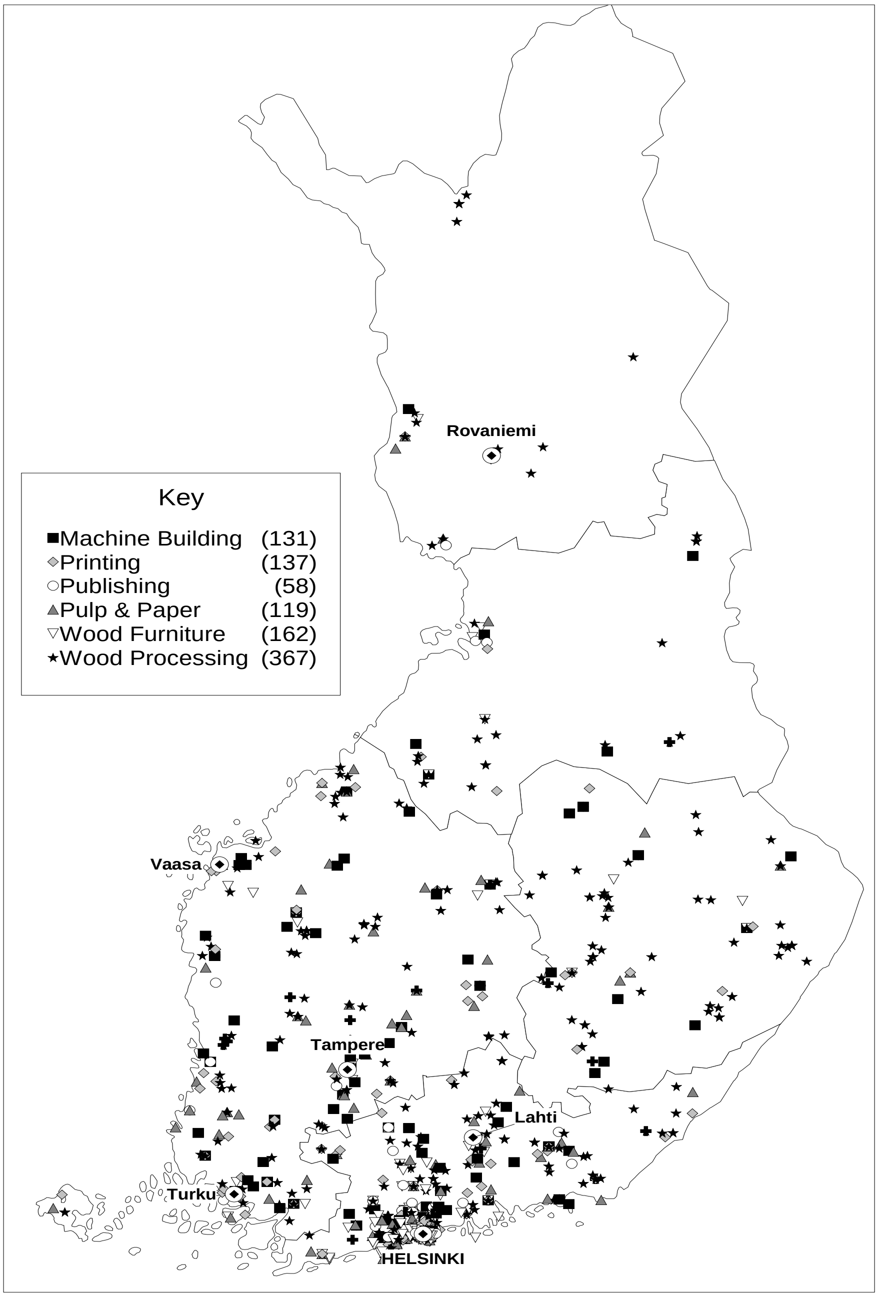
Denmark



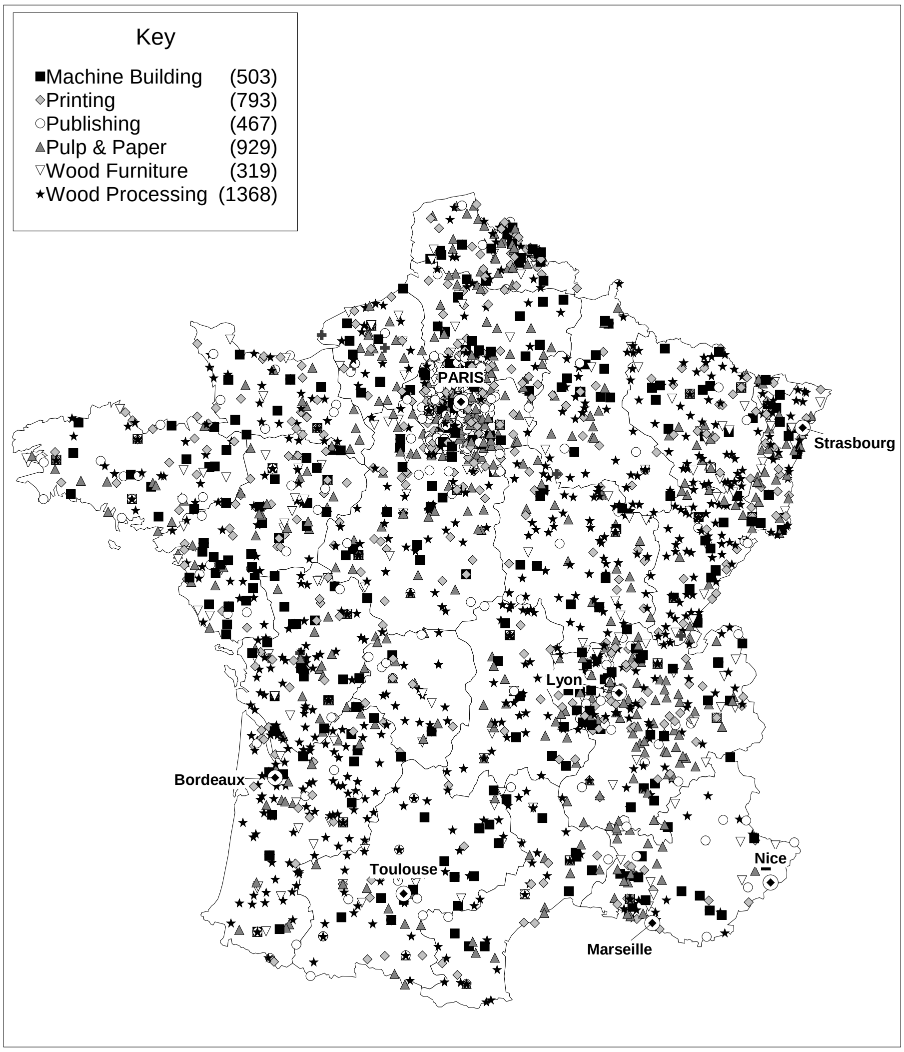
Greece



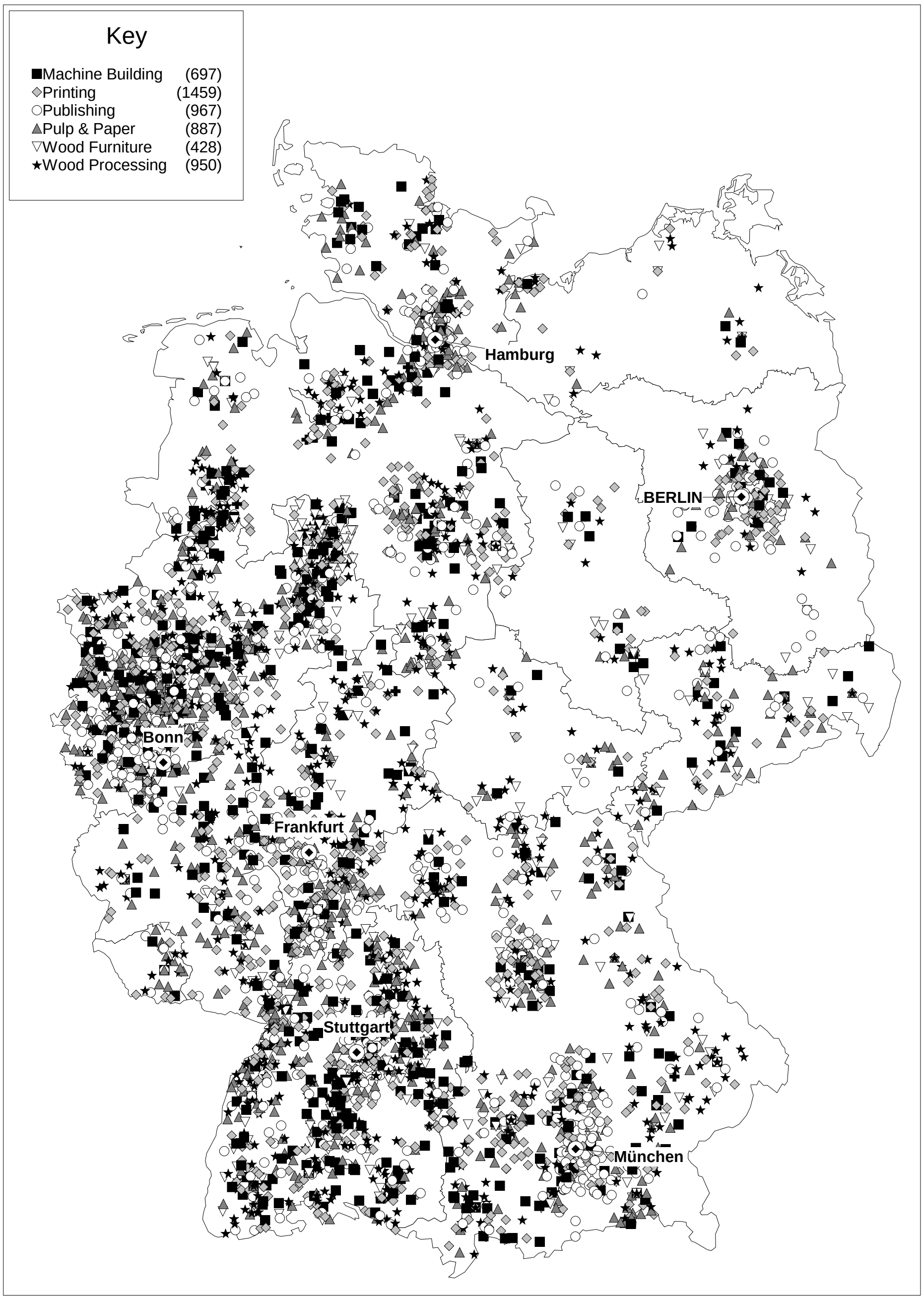
Finland


Rovaniemi
Key
Machine Building (131)
Printing (137)
Publishing (58)
Pulp & Paper (119)
Wood Furniture (162)
Wood Processing (367)
Vaasa
Tampere
Lahti
Turku
HELSINKI

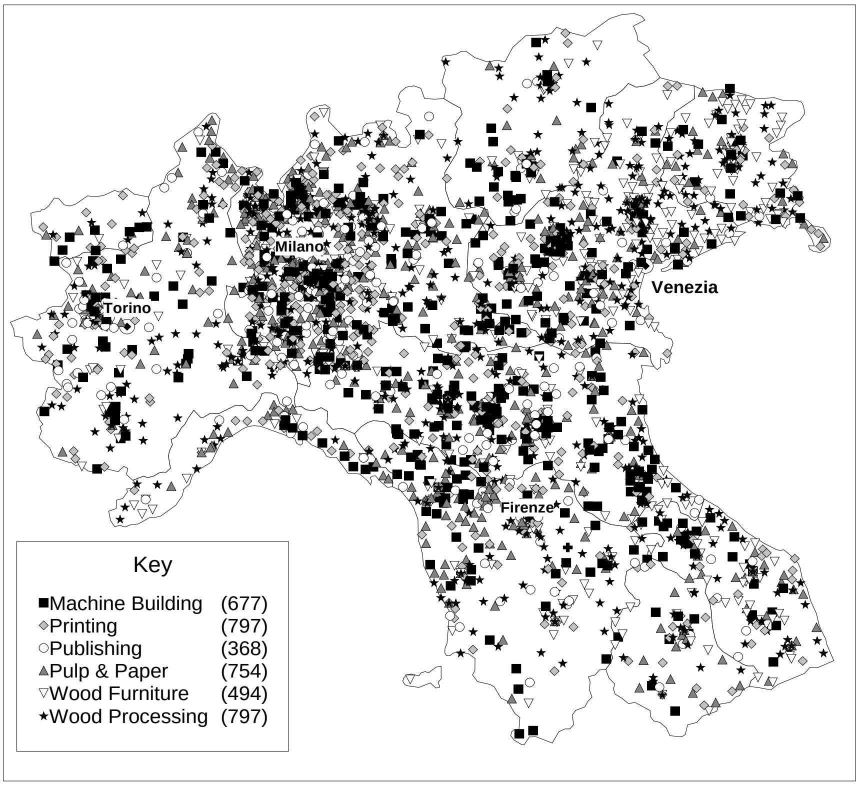
France

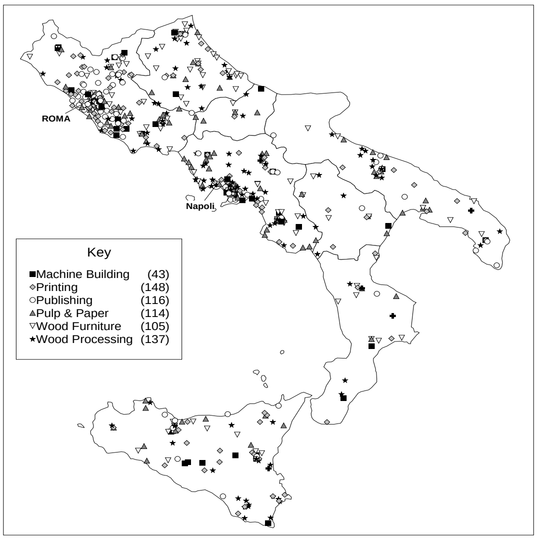

Key
■Machine Building (503)
◇Printing (793)
○Publishing (467)
▲Pulp & Paper (929)
▽Wood Furniture (319)
★Wood Processing (1368)
PARIS
Strasbourg
Lyon
Bordeaux
Toulouse
Nice
Marseille

Germany

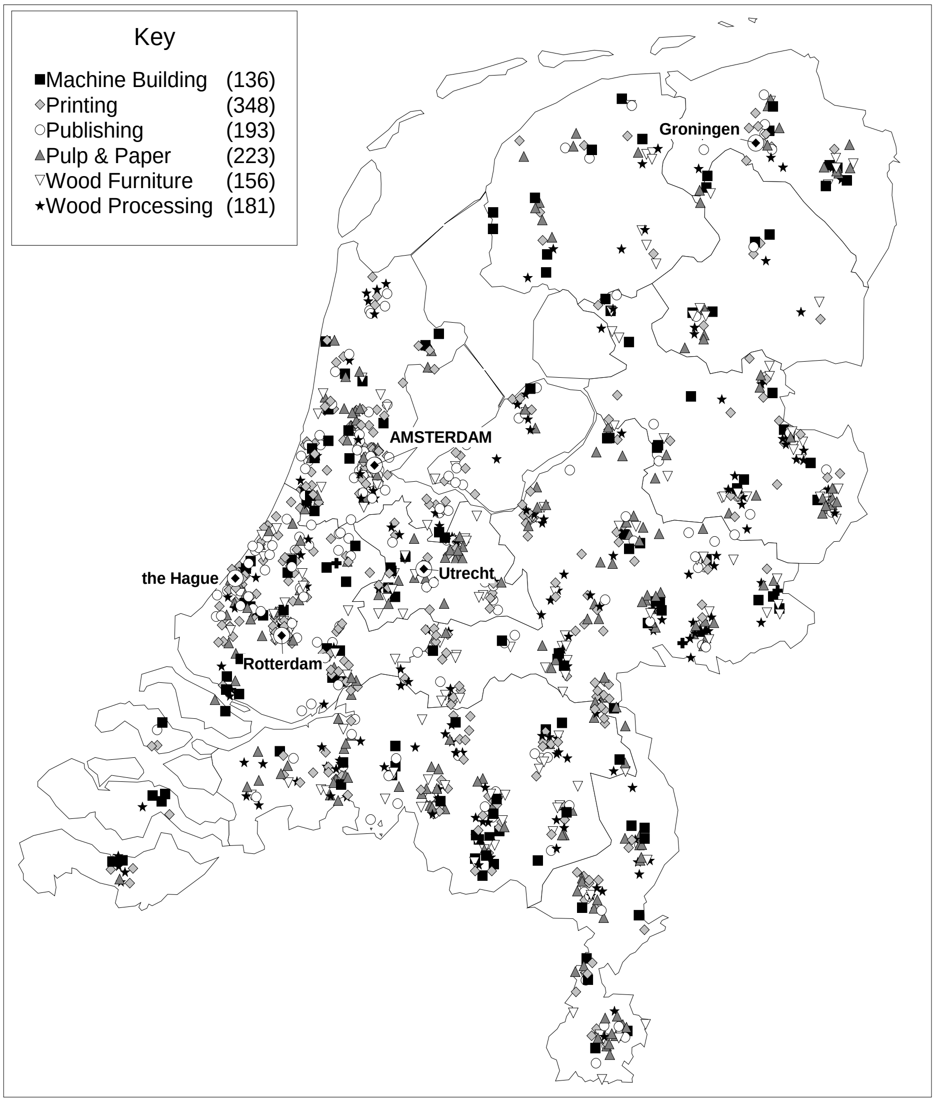

Key
Machine Building (697)
Printing (1459)
Publishing (967)
Pulp & Paper (887)
Wood Furniture (428)
Wood Processing (950)
Hamburg
BERLIN
Bonn
Frankfurt
Stuttgart
München

Italy

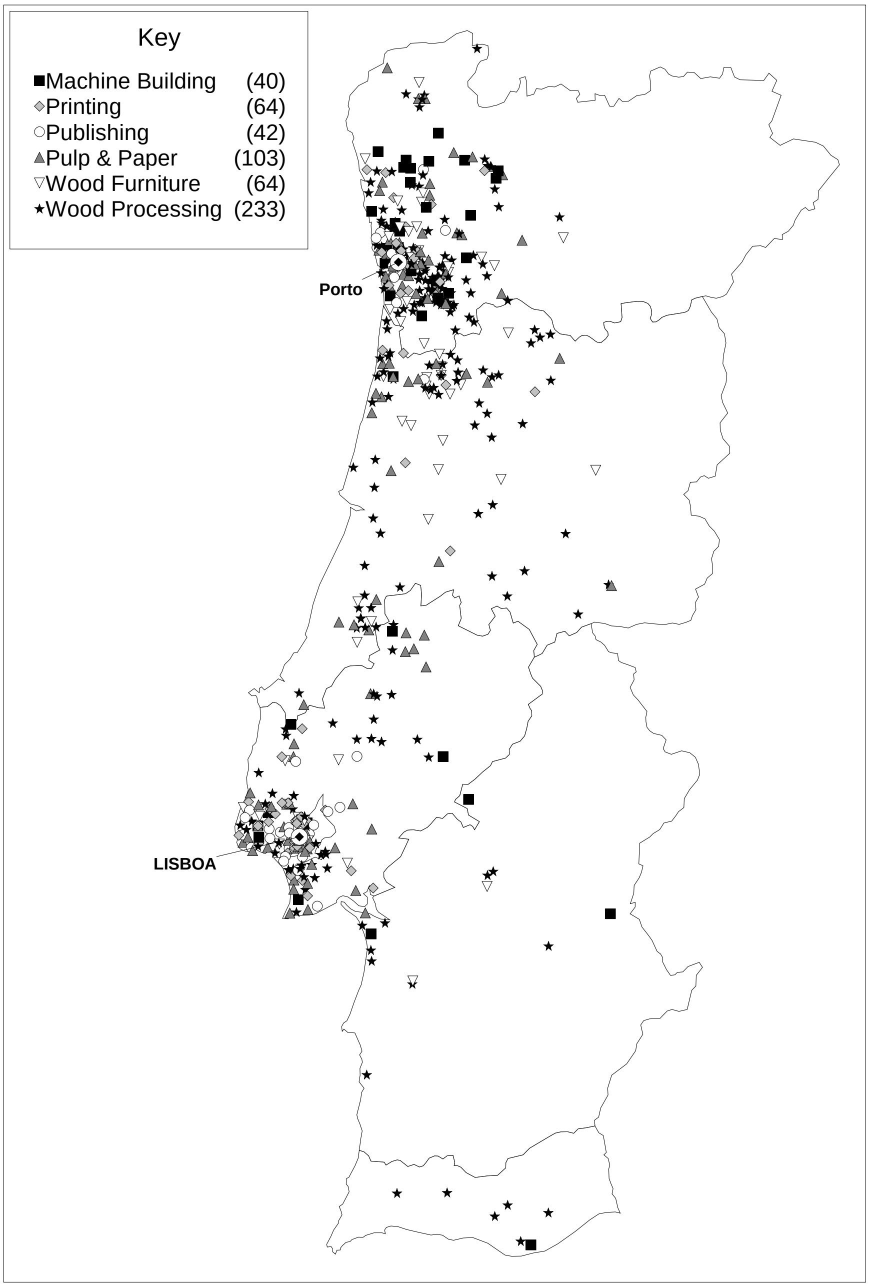

Milano
Torino
Venezia
Firenze
Key
Machine Building (677)
Printing (797)
Publishing (368)
Pulp & Paper (754)
Wood Furniture (494)
Wood Processing (797)


ROMA
Napoli
Key
Machine Building (43)
Printing (148)
Publishing (116)
Pulp & Paper (114)
Wood Furniture (105)
Wood Processing (137)

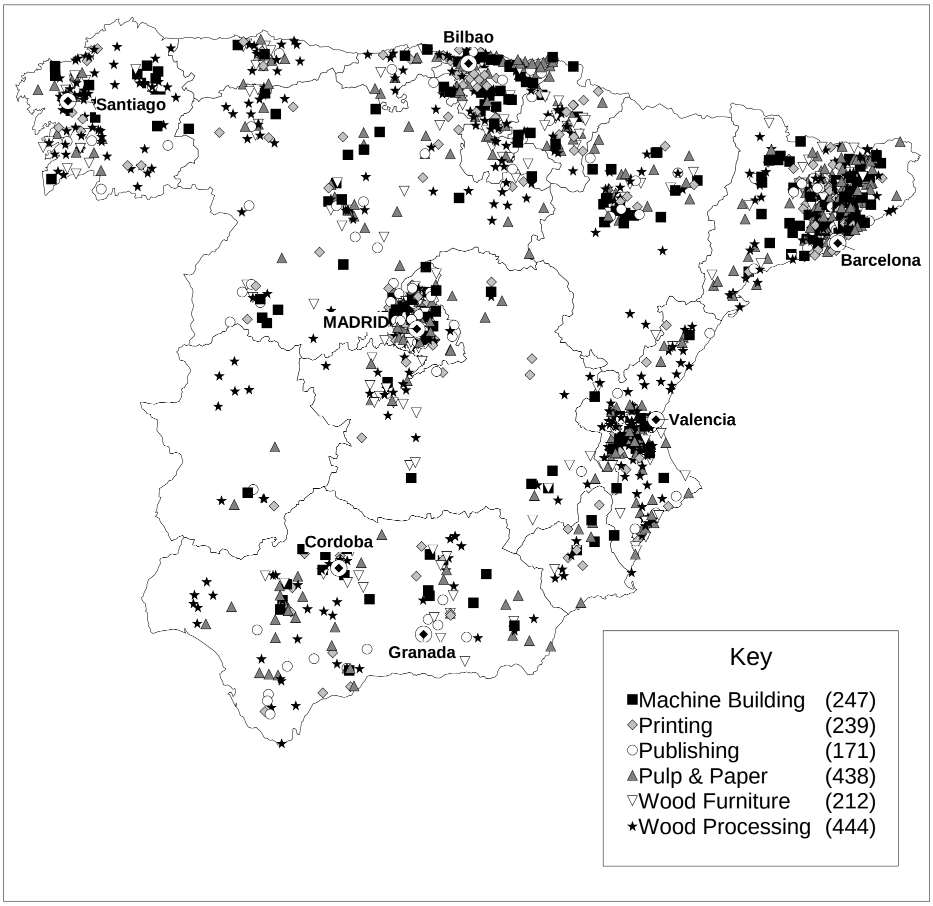
<u>Netherlands</u>



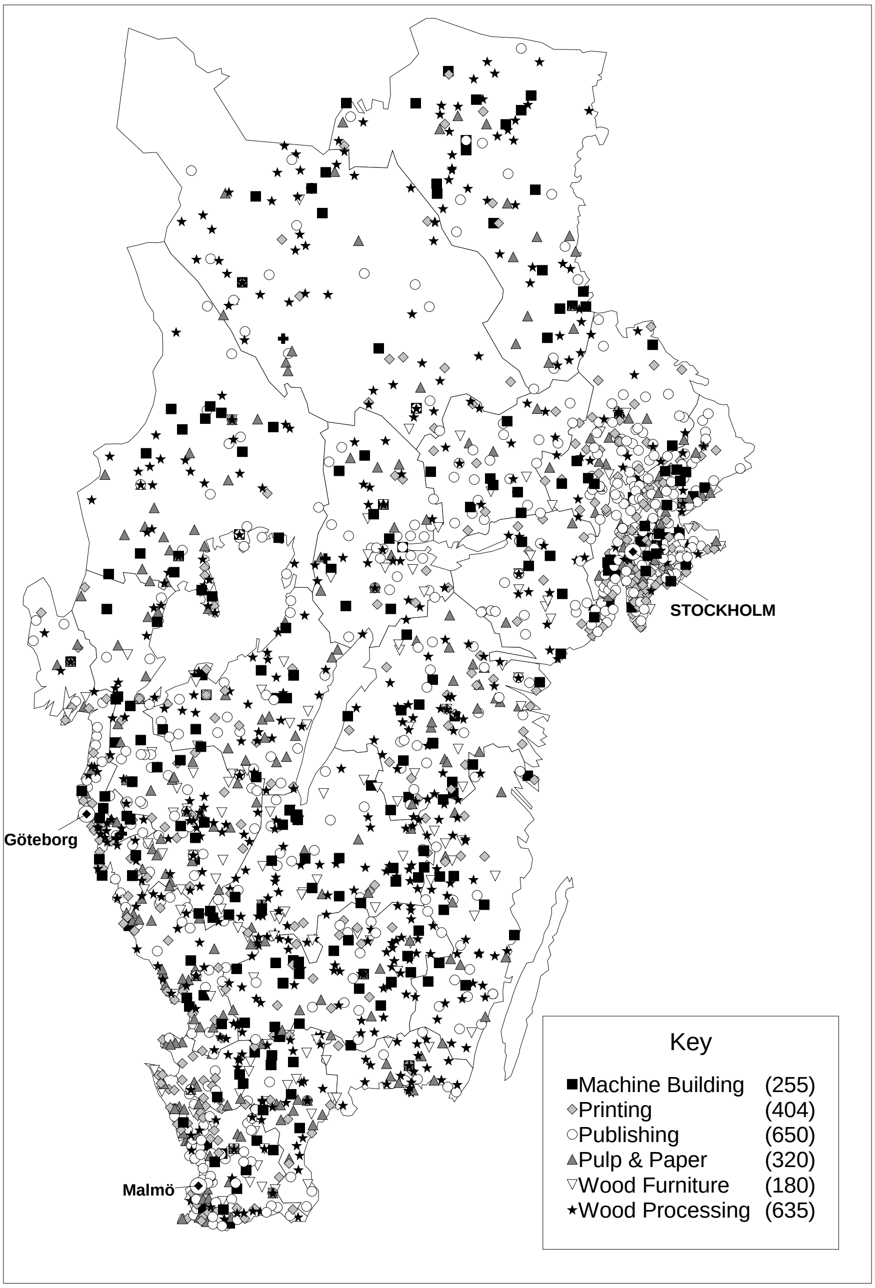
Portugal


Key
Machine Building (40)
Printing (64)
Publishing (42)
Pulp & Paper (103)
Wood Furniture (64)
Wood Processing (233)
Porto
LISBOA

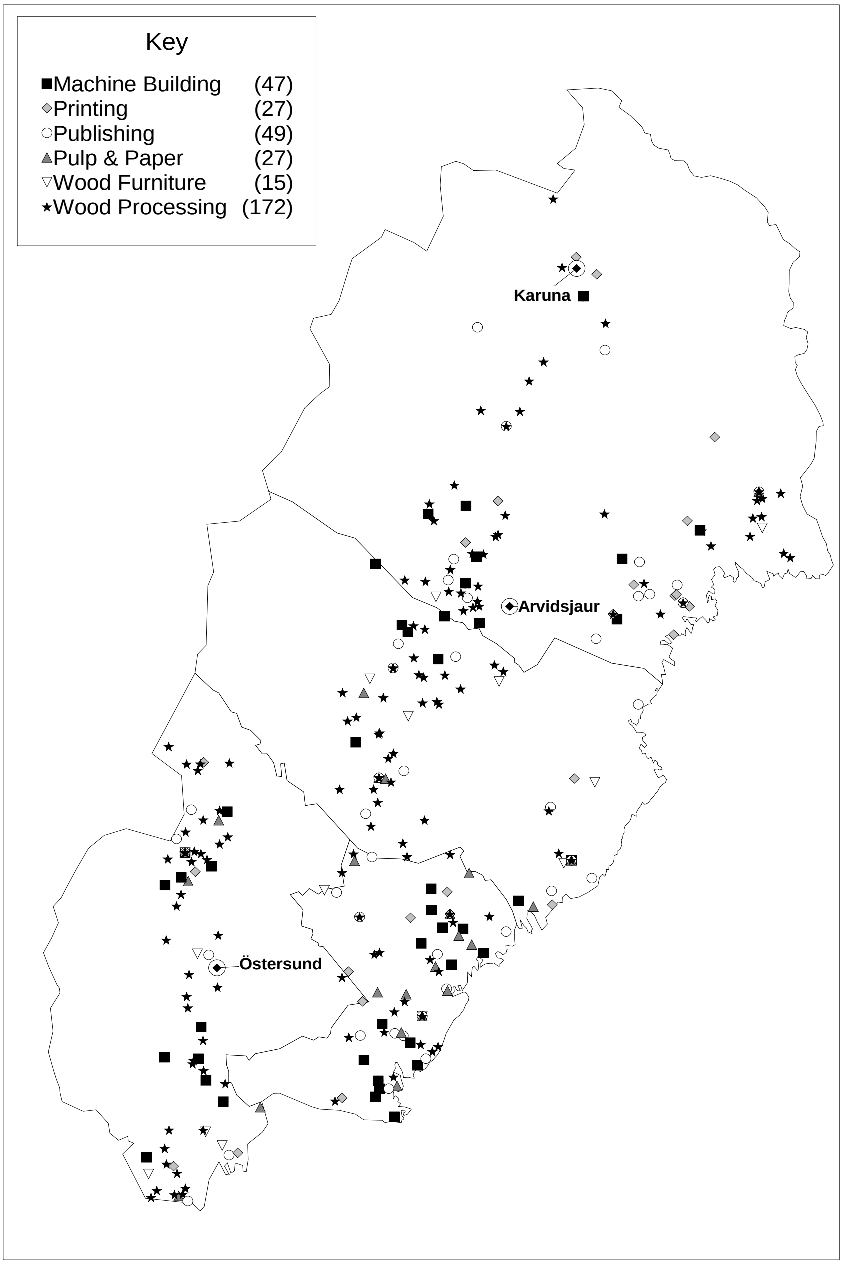
Spain


Bilbao
Santiago
Barcelona
MADRID
Valencia
Cordoba
Granada
Key
Machine Building (247)
Printing (239)
Publishing (171)
Pulp & Paper (438)
Wood Furniture (212)
Wood Processing (444)

Sweden (South)



Sweden (North)



UK and Ireland