ADVANTAGE FINLAND

The Future of Finnish Industries

The Research Institute of the Finnish Economy
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The Structure of the Study

Abstract

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ABSTRACT: The study looks at the competitiveness and future growth prospects of the Finnish industry on the basis of Michael E. Porter's theory of the competitive advantage of nations. The study identifies ten industrial clusters which are classified as strong (forest cluster), semi-strong (basic metals and energy technology), and potential or emerging (telecommunications, well-being, environment and chemical). Two of the clusters are characterized as defensive or latent (construction and foodstuffs). The study summarizes the results of some 60 reports on the development and prospects of the ten clusters. Many of the clusters have originally been factor-driven, but developed gradually into technology- or knowledge-driven clusters. The comparative advantage of Finnish industries has been moving from capital- and resource-intensive branches to those driven by know-how and technology. However, still close to two thirds of the export revenues are generated by the two traditionally strong clusters - the forest and basic metals clusters. The fastest growing industrial clusters are telecommunications, well-being and environment. All of them are knowledge-driven. The study foresees that by the year 2010 the size of these clusters is approximately as large as that of the two traditional clusters. It is the task of industrial policy to enhance the creation and growth of the advanced and specialized production factors as well as stimulate the emergence of strong industrial networks.

KEY WORDS: Industrial clusters, competitive advantage, structural change, industrial growth, externalities, industrial policies.

Foreword

This book summarizes the findings of *The Competitive Advantage of Finland* project and discusses industrial policy issues as well as some aspects of the alternative theories of competitiveness. The project was made financially possible by SITRA - The Finnish National Fund for Research and Development, The Research Institute of the Finnish Economy (ETLA), the Ministry of Trade and Industry, and major Finnish companies. Etlatieto (the project research and information services unit of ETLA) coordinated the activities of various research units involved.

The project had a supervisory board comprised of representatives of business firms, employers' and employees' organizations, the Ministry of Trade and Industry and the Prime Minister's Office. Methodological and theoretical issues were discussed in a scientific advisory group.

In the course of the three-year study over 60 sectoral analyses were made - many of them were conducted at the Helsinki School of Economics and Business Administration. This book is a synthesis of the results of separate cluster studies[1)] .

Although the project rests on M.E. Porter's competitiveness analysis, it differs from previous 'Porter studies' in three respects:

- It presents an explicit view of the future of the industrial clusters;

- it lays down the cornerstones of a new industrial policy - now to a great extent adopted in Finland;

- it has a methodological background wider than that of other 'Porter studies'.

We would like to thank all the researchers, interviewees, individuals, and organizations that have participated in this research project.

Helsinki, November 1995

Hannu Hernesniemi	Markku Lammi	Pekka Ylä-Anttila
Research Director	Research Director	Managing Director
Etlatieto	Etlatieto	Etlatieto

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1) See appendix 8. For further information about ETLA's research see its home page on the Internet (http://www.etla.fi/) or call +358-0-609 900.

A NOTE FROM THE EDITOR:

This is an English version of the original report titled *Kansallinen kilpailukyky ja teollinen tulevaisuus* (ETLA B 105). Laura Paija has provided the original manuscripts for sections 3.1.3 and 4.5. Markku Lammi has provided the manuscript for 4.9. Their cooperation throughout the translation process is gratefully acknowledged. Robert Duff has proofread and improved the language of the final draft. I would like to thank him for his corrections and suggestions.

Petri Rouvinen

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1. INTRODUCTION - WHY DO SOME NATIONS SUCCEED AND OTHERS FAIL?

Structural problems in the Western economies have inspired new interest in the old issues of industrial policy and international competitiveness, and raised the question *why do some nations, and the commercial enterprises in them, succeed and others fail in international competition?*

The traditional view of competitiveness argues that factor prices are the main determinant of industrial competitiveness. Therefore relative wages, capital costs, and the prices of other inputs have been the issues discussed. If this view were accepted, competitiveness could be fostered by merely taking measures to obtain key inputs at lower prices.

Later research does not argue that relative factor prices are irrelevant, but it has been shown that seemingly high factor prices can be compensated for by higher productivity and better production technology. In fact, it has been said that excessively favorable conditions, created through the implementation of protective policies and subsidies, can harm competitiveness in the long run since there are fewer incentives to adapt to changes in market conditions under extremely favorable circumstances.

While traditional research continues to seek answers, many alternative models have been suggested. One widely accepted new approach was introduced in Michael Porter's (1990a) book, *The Competitive Advantage of Nations*. Porter dealt with 10 leading industrial nations in his work, and since then country-specific studies have been composed in many other countries including Austria, Canada, Denmark, New Zealand, Norway, Sweden, and with this report, Finland.

Porter argued in his study that successful firms are seldom alone. Frequently a company's dominant market share and accelerated growth are supported by a unique combination of firms tied together by knowledge and production flows. Porter coined the term *cluster* to describe such a group. According to him, competitiveness originates from these unique combinations of firms - clusters or development blocks[1)]. Their typical features are numerous interconnections between firms, technological spillovers, and externalities. While many of the connections are of an economic nature, social and environmental benefits are important as well.

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1) This term was originally used by Dahmén (1950).

Defining formal boundaries for these development blocks may be cumbersome and even irrelevant; the main feature of a cluster is interaction and interplay among the participants.

Porter's thoughts were by no means new; he combined ideas introduced earlier in the history of economic thought in quite a unique way, however. One of the crucial ideas behind a cluster's endogenous growth is the existence of externalities. Alfred Marshall was the first author who explicitly distinguished internal and external economies of scale in his *Principles of Economics* (1890).

Walras and Cournot advanced the competition and general equilibrium models greatly, but these results often relied heavily on simplified, though unrealistic, assumptions. Joseph Schumpeter criticized this 'mechanical' neoclassical approach, and emphasized the role of dynamic innovations and entrepreneurship. Schumpeter's (1911) view of economic development is dynamic and holistic in much the same way as Porter's. Dahmén (1950) applied Schumpeterian views in his studies of Swedish industries. Later, Raumolin (1988) used Dahmén's approach to analyze major Finnish industries in a fairly 'Porterian' manner. A French economist, Perroux (1950), modeled the dynamics of innovation under monopolistic competition. This is one of the goals Porter seems to have with his diamond model. Perroux (1958) discussed propulsive industries, which can be interpreted as vigorous clusters generating new commercial activity in nearby sectors. Hirschman (1958) studied the role of backward and forward linkages in the context of an investment decision - Porter uses the value chain method in a broader context. According to Porter, intelligent properties of the labor force and other actors in an economy are the main sources of unique and long lasting competitive advantages. In mainstream economics this view was popularized by Romer (1986) in the form of new growth theory. One of its main messages is that the stock of human capital determines the long-term growth rate. Thus economic growth can be spurred by investing in education and research.

Porter's study was quite well-received and it has inspired a wide range of research in nearly all of the industrialized countries. Besides these, many regional and cross-country sectoral studies have been made[1)].

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1) Reve and Mathiesen (1994) have composed one such study concerning the industrial competitiveness of the European Union.

Regardless of Porter's research, or maybe partly owing to it, industrial policy has attracted increased attention during recent years. In the 1970s and 1980s many industrialized countries practiced defensive industrial policies. In practice this often meant heavy government subsidies and import protection for declining industries. These policies proved to be unsuccessful; they made firms less adaptive to market changes and brought about inflexibilities. Gradually the focus evolved to emphasize the importance of a stable macroeconomic environment, and to improve the functioning of the competitive market. Protective industrial policies came to be regarded as inefficient. In less than a decade some countries shifted from one extreme to another. In the 1990s, however, active industrial policy seems to be gaining ground again. The approach, however, is quite different. The new paradigm focuses on creating an attractive milieu for industrial activity. Government interferes with the competitive market directly only when it is obvious that the free market is not functioning appropriately; this is often true in the case of research and education[1)]. Porter's thoughts are well in line with the ideas of this new policy approach.

1.1. The principle of competitive advantage reborn

A firm is the basic competing unit in international trade. Porter defines 'micro-level' competitive advantage as a company's ability to stay alive and make a profit in fiercely competitive international markets. *National competitive advantage* is brought about by the number (and size) of competitive firms a nation has. Inherited endowments and factor conditions have secondary importance in sustaining competitive strength; national prosperity has to be continuously created by developing more advanced factors of production. Thus natural resources, an unskilled labor force, and interest (or exchange) rates do not have long lasting effects on national competitiveness. In the long run, *"...competitiveness [of a country] depends on the capacity of its industry to innovate and upgrade"* (Porter 1990b, p. 73). The fundamental forces behind this ongoing improvement process are domestic demand and fierce rivalry between producers.

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1) It has been shown that research and education have positive effects on national well-being. Both activities have externalities that a private business enterprise can not internalize due, for instance, to 'unwanted' technological spillover and mobility of labor. Thus a free market produces less than a Pareto optimal quantity of these activities. On the macroeconomic level microeconomic externalities are internal, and thus national wealth can be increased by public investments on education and research.

An internationally competitive country can offer a high and rising standard of living to its citizens. The collective national goal ought to be a high relative wage level in the home country and premium prices for domestically produced commodities in the international markets. Key factors in achieving this are continuous improvements in productivity, and specialization into products in which the country has a comparative advantage. Porter notes that in many industries internationally competitive firms are often located in only a few countries. He concludes that, as far as international competitiveness in concerned, it seems to be more important *where* and *how* the factors of production are used rather than the factors themselves.

1.2. Reasons to study the future of Finnish industries

Finland fell into the most severe economic crisis of its peacetime history during the late 1980s and the early 1990s. While worldwide cyclical fluctuations were abnormally strong at the time, it became apparent that maintaining the old economic structure of Finland had become impossible. The country found itself in a totally new situation, since Finnish postwar economic growth had been brisk even by international standards, second only to Japan and Taiwan. In Finland, as in many of the established market economies, long term economic growth culminated in recession, and the recovery from that recession has been painfully slow.

Growth can be explained by increased productivity. This in turn is made possible by technological progress and structural change. A profit maximizing enterprise always pursues the most cost efficient method to organize its activities, and at the macroeconomic level resources are naturally allocated to the industries boosting higher levels of productivity than others. Recent technological development has been extremely rapid. Many European countries have been expecting positive effects from the European Union. Nevertheless, Finland, like many other industrialized countries, has vast problems with unemployment and with the financing of the public sector. In the long run, substantial structural changes are needed in order to reach a more sustainable external balance.

Manufacturing industries[1)], being the engine of growth throughout the century, play an important role in solving these problems. Central

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1) One should consider manufacturing industries in a broad sense - including all the direct and indirect services that are part of the final product.

questions are: Can industrial growth and restructuring solve the unemployment problem? What kind of industrial structure is needed to achieve and maintain external balance? What are the effects of new technologies and production paradigms in the Finnish context? What are the effects of integration and globalization on the industrial and firm structure? What is the role of the public sector and industrial policy in accelerating and maintaining economic growth? And finally, Should we support existing competitive economic structures or pursue new growth industries? These were the fundamental issues underlying the *Competitive Advantage of Finland* project.

In the early 1990's the open sector (which generates export revenues) in the Finnish economy proved to be too small to support the previous standard of living and its continuous growth. Finland simply had too few successful firms and industries. Policies used earlier to promote industrial activity were inappropriate in the new, more global, and less restricted environment. Therefore it was necessary to study competitiveness and its origins, to predict future industrial structure, and to redefine the role of industrial policy.

Finnish industries were studied using Porter's cluster approach. The objectives of the *Competitive Advantage of Finland* project were as follows:

- to identify Finnish products that have been successful in international markets; based on this information, to define the underlying clusters;

- to explain the birth of the clusters, and to discover the factors behind their success;

- to uncover the success factors in the Finnish manufacturing industry and service sector in the 1990s and to foresee future industrial structure;

- to provide supporting material for redefining the role of industrial policy, and to outline national industrial strategy.

1.3. Structure of the study

Chapter two puts forth the theoretical framework by outlining Porter's diamond model. The main features of the Finnish economy are provided in chapter three. Chapter four identifies the main clusters of the Finnish economy and includes brief summaries of individual cluster studies. Dynamic developments of Finnish clusters are discussed in chapter five. Chapter six considers Finland's current and future position in international competition. Chapter seven sketches Finland's future industrial structure, predicts developments of the identified clusters, and sets down the principles for a new industrial policy.

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2. THEORETICAL BACKGROUND - A CRITICAL VIEW OF PORTER'S DIAMOND MODEL

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, according to Porter is simply a question of how competitive its firms are.

National competitive advantage is not inherited - it has to be created. An abundance of traditional factors of production is not enough to guarantee long term success; it is continuous innovation and improvement in productivity that are crucial.

A systematic approach is needed to study competitiveness in the firm, the industry, and finally, on the national level. the *Competitive Advantage of Finland* project adapted Michael Porter's (1990a) so-called 'diamond model' as the main theoretical framework.

2.1. Definition of a cluster

The concept of a cluster can help us 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 and industries. 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 specialization. Geographical proximity is typical of clusters - although it is not absolutely necessary. The agglomeration of many participants creates positive externalities: specialized factors of production are more readily available, new innovations are easier to come by due to active interaction, and 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 starting point of a cluster analysis is the identification of network relations. Among these are relationships with competing producers, R&D cooperation, and user-producer connections. After identifying these key relationships an agglomeration can be found, where interaction is particularly intense. This concentration is taken as a starting point for a cluster

analysis. Potential clusters identified, they are studied using Porter's diamond model. If clear internal synergies are found within this concentration, it is indeed justified to refer to the group as a cluster.

2.2. The industrial diamond - Porter's model of competitive advantage

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."* (Porter 1990a, p. 67). Institutional structure, domestic factor pools, and macroeconomic conditions are some of the factors defining the setting where national industries operate.

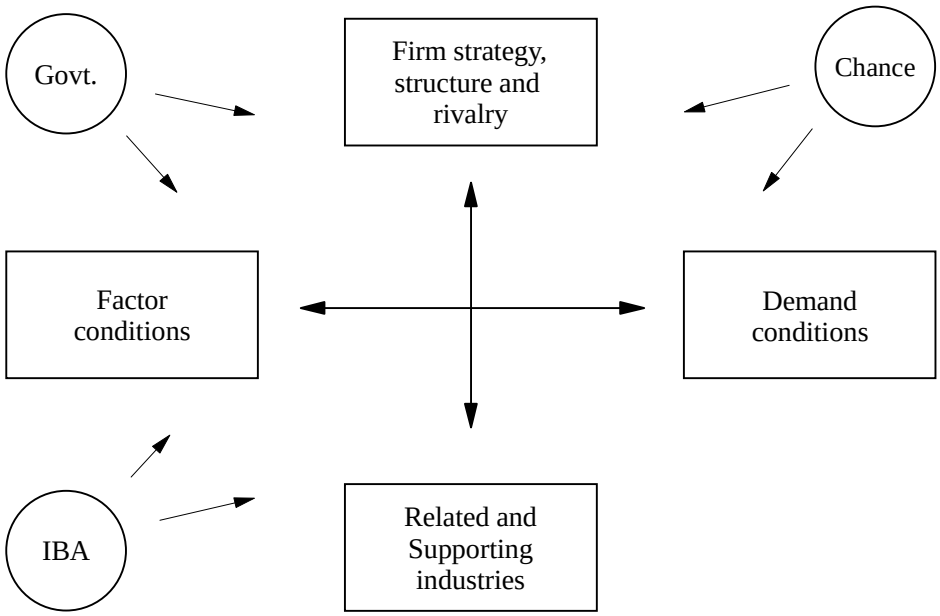
The diamond model incorporates forces influencing the firm's ability to sustain and upgrade its competitive advantage. The four main determinants of the diamond are: (1) factor conditions, (2) demand conditions, (3) related and supporting industries, and (4) firm strategy, structure and rivalry. Besides these there are three outside forces shaping the operating environment namely (5) government, (6) chance, and (7) international business activities (IBA). The diamond model is illustrated in figure 2.1.

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

2.2.1. 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

Figure 2.1 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).

government have to invest continuously. It is through these often highly specialized and industry specific factors of production that the most significant competitive advantages can be gained.

Box 2.1 Factor conditions - advanced medical research sprouts industrial activity

In the health care equipment industry advanced medical research is often the initial impetus behind founding a new company. One example it the case of radio isotopical research, in which Finland has been a pioneer. The first commercial application was made in 1950, when professor Jorma Wallasvaara founded *Wallac* to develop equipment based on the usage of gamma and beta rays. In the 1960s *Palomex* launched a range of X-ray apparatus based on the research of professor Paatero. Later *Instrumentarium Imaging*, *Sorodex*, and *Planmeca* took advantage of the same technology.

2.2.2. Demand conditions

Porter argues that globalization 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.

Box 2.2 Demand conditions - CEO Krister Ahlström's letter to his friend Bertil Hakulin

Loviisa's (a town in southeastern Finland) nuclear power plant was built between 1973 and 1978. At the time I was with *Wärtsilä* being responsible for the shipments to the power plant under construction. It is my firm belief that the extremely strict standards set forth by *Finnatom* (the construction firm that built the reactor) radically heightened the quality level of all the suppliers involved, and that this was one of the fundamental factors behind the Finnish export success in the 1980s...

I think that the example of Loviisa illustrates the role of a large national project in the diffusion of new ideas. I guess it would be fair to say that this was little Finland's version of the Apollo project or MITI. For the boiler industry it meant that 'quality assurance' became common, and for *Imatran Voima* (a state owned power company) and *Teollisuuden Voima* (an industry owned power company) that they acquired a narrow but high-level knowledge of nuclear power.

2.2.3. 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 sophisticated demand they are facing. While a cluster's companies compete fiercely in the market place, they might cooperate, 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.

Box 2.3 Related and supporting industries - the forest industry has brought about a wealth of related industries

The Finnish forest industry has a 500-year history. It started with the burning of wood tar and sawing of timber. Today, magazine paper is the main export product. Especially during the postwar years the forest industry companies and metal workshops have been in close cooperation developing new machinery. This interaction has been the most apparent between paper mills and their machinery suppliers. Through the years Finland has grown from an importer of forest industry machinery to a clear technological leader and major exporter. The close connections have been a source of innovation to both parties.

2.2.4. Firm strategy, structure and rivalry

Porter acknowledges that national characteristics partly determine how companies in a country are founded, organized 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.

Box 2.4 Firm strategy, structure and rivalry - competition in power generation

In most industrialized countries power generation and transmission has been a national or regional monopoly due to high initial capital costs and nature of the industry. This sector has also been considered strategically important, and therefore domestic equipment manufacturing has been protected.

In Finland, however, the competition has been fairly open. Although the state owned *Imatran Voima* has a dominant role in power generation and transmission, it has been unable to take advantage of its market position due to competing utility companies, municipal power plants, and industries own (and rather large) capacity. The imports of equipment have been unrestricted. Driven by the competition, the energy sector has been dynamic; energy prices have been low and building of the Finnish energy system has sprouted technologically advanced equipment suppliers.

2.2.5. The role of government

While Porter gives the government a minor role in his analysis, the bulk of his recommendations are related to public policies. He is for *laissez faire* in the sense that government should not be directly involved in business life. The government has, however, a significant role in a number of ways: it ought to (1) guarantee a sufficient supply of resources needed for growth - especially in the case of advanced factors, (2) create forces for upgrading and innovation (strict environmental restrictions, rigorous safety standards, etc.), (3) limit direct cooperation between competition and ensure the functioning of the market system, and (4) promote development of human capital.

Box 2.5 The role of government - strict standards boost innovation

Mobile communications were initiated by operations in the public sector in 1963, when the Finnish Army ordered a prototype for a small radio telephone. As the Army did not redeem the innovation, the industry started to launch radio telephones to civil markets.

In 1966, the responsibility for the planning and construction of the first mobile phone system was granted to public *Posts and Telecommunications*. Technical specifications were prescribed public, so that mobile terminal production and distribution were free from the outset. Three manufacturers developed the first equipment to the market. The final breakthrough in the mobile phone industry was the Nordic joint venture in the development of the NMT (Nordic Mobile Telephone) standard. It created a market that was sufficiently large to the Nordic manufacturers, but not attractive enough to the multinational companies. Eventually Swedish *Ericsson* and Finnish *Nokia* became leading manufacturers in the field.

2.2.6. 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.

Box 2.6 The role of chance - *Rapala* owes to *Marilyn*

Lauri Rapala founded a company in 1936 to manufacture fishing gear. It internationalized quickly, but its final breakthrough was eased by a coincidence; *Rapala* was featured in *Life* magazine in 1962 - the same edition that told about the death of *Marilyn Monroe*. The magazine was the most sold *Life* in its history and certainly the one that was kept. Rapala's reputation spread, and nowadays it has a 40 per cent global market share in lures.

2.2.7. International business activities

International business activities were not part of Porter's original diamond. They have been added later thanks to discussion initiated by Dunning, in particular.

According to Porter, multinational corporations are extensions of national diamonds. He assumes that the structure of global companies is meaningless when competitive advantages are created. Whether this view is justified or not depends greatly on the branch of industry in question. 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.

Box 2.7 International business activities

Strömberg was founded in 1889 to manufacture electrical equipment. The company expanded rapidly during and after the Second World War. Especially during the 1960s the technological level improved considerably and electronics became a major part of their products. Since the 1960s Strömberg has expanded its exports.

Although the products were advanced and production was fairly efficient, the costs of maintaining an international distribution network were too high for a relatively small company. Strömberg was in constant financial trouble. The company merged with *Kymi* (forest industry) and later with Swedish *ASEA*. In the late 1980s *ASEA* merged with Swiss *BBC* and *ABB* (Asea Brown Boveri) was born.

Since being part of the *ABB*, *Strömberg* has been quite profitable. By being part of a multinational corporation it has access to a global distribution network, and it has been able to concentrate to the thing it does best - advanced electrical equipment.

2.3. Porter critique

As the popularity of Porter's approach has grown criticism has increased as well; nowadays there is a whole subsection of economic literature under the topic of 'Porter critique.'

Penttinen (1994)[1)] divided the critique into nine categories:

1. Where the competitive advantage is actually created - competitiveness is not necessary found in clusters; there are many successful 'lone stars' (see Reinert 1993),

2. The diamond model does not properly take into account foreign direct investments and multinational enterprises (see Dunning 1993, Rugman 1992),

3. This model might not be suited to small open economies (see Bellak and Weiss 1993),

4. Perhaps it is only applicable to resource based industries (see Yetton, Graig, Davis, and Hilmer 1992),

5. Differences in national cultures should have had greater emphasis in the model (see Van den Bosch and van Prooijen 1992),

1) Penttinen prepared an extensive and thorough summary of Porter critique for this project. See Penttinen 1994, *Summary of the Critique on Porter's Diamond Model. Porter's Diamond Model Modified to Suit the Finnish Paper and Board Machinery Industry*, ETLA Discussion Papers No. 462.

6. The methodology as a whole might not be valid; Porter's ideas may be too loose and only seemingly theoretical; did he only rewrap old ideas (see Cartwright 1993),

7. The role of macroeconomic variables in Porter's model is unclear (see Daly 1993),

8. It is unclear, whether the model is really dynamic or static (see Narula 1993), and

9. The studies might not be conducted rigorously (see Grant 1991).

Dealing with Porter's critique in depth is not in the scope of this publication, but it should be noted that all the issues listed above have some truth in them. In our increasingly globalized world it is clear that the number of companies without clear national identity will increase - one example is the ABB corporation. Obviously the basic diamond model does not lay enough emphasis on international activities. In fact many of the later Porter studies (including this one) incorporate this element as a third outside force of the diamond. It has also been shown that many countries have been able to create and sustain competitive advantages in resource-based industries - this can be seen in the cases of Australia, Canada, Finland, and New Zealand.

The most serious limitation of the model, however, is that it is essentially backward-looking[1)]. The model explains the birth and growth of the existing clusters but is unable to forecast how they will develop in the future, and what will be the yet-unborn centers of excellence. Nevertheless Porter is one of the most prominent authors of the 1990s. While his ideas are not original, he packaged them in a unique way, and he has inspired many new thoughts among academics and business people. Thanks to Porter, current research is looking for more holistic micro-level approaches to explain competitiveness and international trade patterns.

Researchers in the *Competitive Advantage of Finland* project have been able to circumvent some of the limitations mentioned, while a few remain even in their approach.

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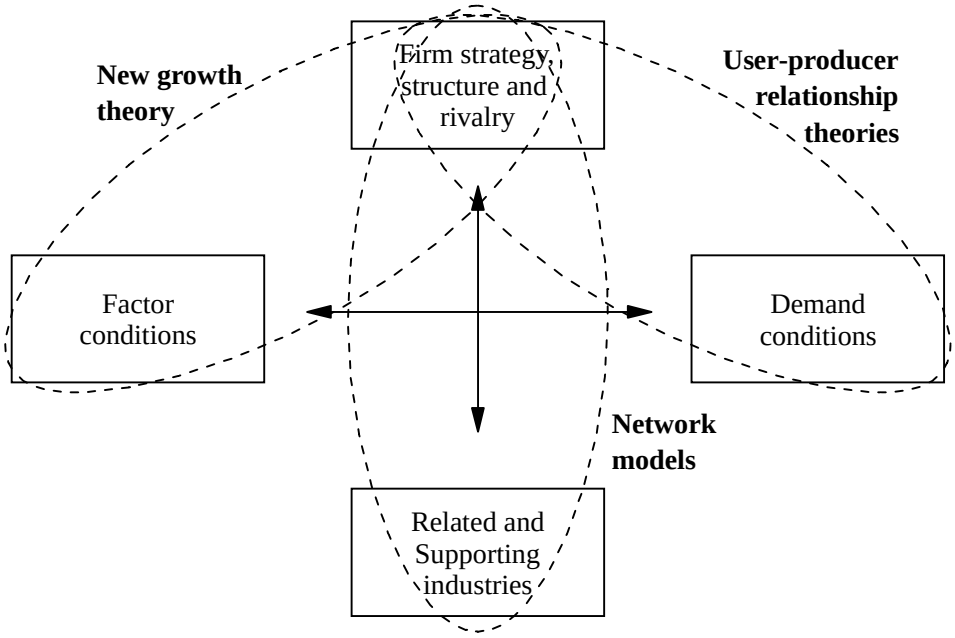
1) The *Competitive Advantage of Finland* project has laid a lot of emphasis on predicting future developments. See chapters 5, 6, and 7 for discussion.

2.4. Comparing Porter's diamond and other economic models

It can easily be seen that Porter's approach incorporates many well-known economic models. Apparently Porter has been influenced by new growth theory, network models, and ideas of user-producer relationships. This is illustrated in figure 2.2.

Figure 2.2 The diamond and its connections to other economic models



Porter's greatest achievement may be the unique way he combines different approaches; he forms a model that is fairly comprehensive, unlike many older models. While this causes some analytical problems and he is forced to be less specific in his formulation, he captures the segments of economic and social research that have been in the spotlight during recent years.

2.4.1. Porter and new growth theory

In the neoclassical approach, economic growth is thought to have certain boundaries defined by productivity improvement and external factors,

such as population growth. According to new growth theory (Romer 1986), growth can be accelerated by investing in education and research.

Porter argues that national well-being is supported by successful business enterprises in a country. He tries to explain why a country is successful in certain industries, and why some companies are superior to others. He agrees with new growth theory in the sense that in his approach there is no 'natural growth paths'. By making the right choices a nation can control its own growth prospects; developing necessary human capital is one of the key factors to long-term success.

2.4.2. Porter and user-producer relationships

Most of the mainstream economic models are founded on the idea of a perfectly competitive market, where the market price transfers necessary signals between users and producers. User-producer theories argue that there is a need for more active communication among market participants; a frictionless relationship between producer and users can be an important source of new innovations and competitive edge.

Porter thinks that demanding customers are one of the ultimate sources of competitive advantage. Preferably their demand should anticipate the changes in international market trends. By active cooperation with 'key' customers a firm is able to develop new products to emerging markets.

2.4.3. Porter and network models

Basic economic theory treats each firm as a single entity and possible externalities or synergies are not considered. According to network theories the competitiveness of an enterprise could be increased, if it joined forces with other companies in the same or related fields.

Porter's (1985 and 1990a) discussion of value chains is closely related to network models. The concept of a value chain is not identical to cluster, although it is in a central role. A dynamic cluster includes numerous value chains. Participation in a value chain is a learning process to everyone involved. As separate entities get more and more integrated, they rationalize their interaction and gain mutual benefits.

3. FINLAND - A NORDIC WELFARE STATE

3.1. Main features of the Finnish economy [1)]

3.1.1. General background of Finland

Finland is the second most northern country in the world, located between Sweden and Russia in northern Europe. In territorial terms it is about the size of Germany or the state of New Mexico (USA); yet, with 5 million inhabitants, the population density is only 16.6 persons per km^2.

Finland has a fairly short history as an independent nation. From 13th century until 1809 Swedes ruled the country, and after that Finland was an independent grand duchy of Imperial Russia for about 100 years. Finland became independent in 1917. While Finland lost the war against the Soviet Union during World War II, the country was never occupied. Nowadays Finland is one of the advanced western democracies, and it has been the member of the European Union since the beginning of 1995.

The primary language of Finland is Finnish, while 6% of the population speak Swedish, the second official language, as their mother tongue. The major religion is Lutheranism (90%).

3.1.2. Economic history in brief [2)]

The Finnish economy entered the industrialization phase in the mid-1800s - much later than the leading nations of the Industrial Revolution but yet quite early, if all the countries in the world are considered. Many of the economic institutions were founded in the mid-1800s as well, although Finland was still part of Imperial Russia. In the latter half of the century great advances were seen in the central government, in the banking system, as well as in the transportation (railroad and water ways), and communication infrastructure (telegraph). Finland also got its own currency, the Finnish *Markka*.

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1) In cooperation with L. Paija.

2) Based on Vartia and Ylä-Anttila 1993.

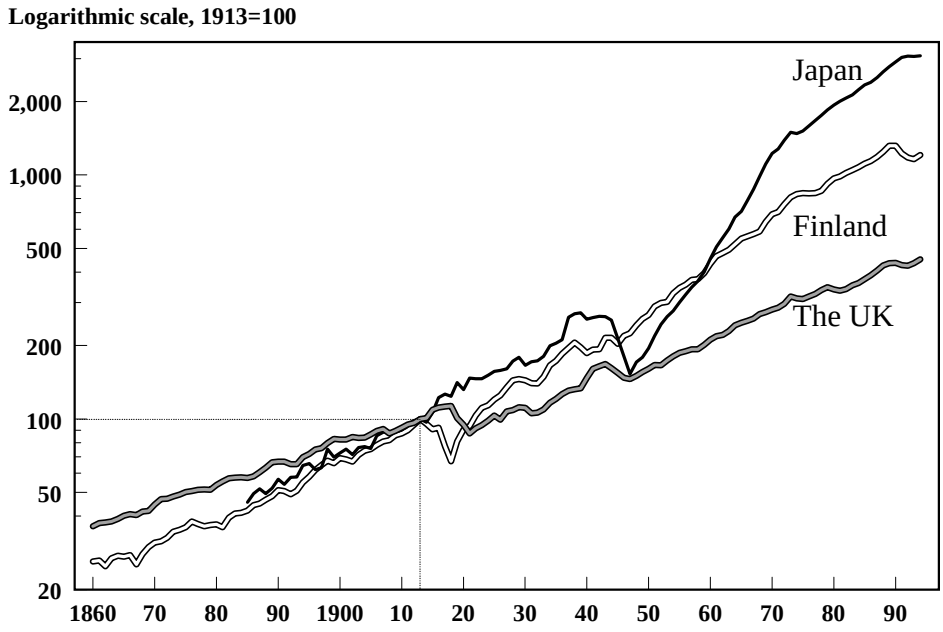
More liberal ideas took the place of mercantilism in the mid-1850s, and many earlier restrictions to commercial activities were removed. This marked the way towards economic growth. The role of government remained important on many branches and later increased in some cases.

Industrial growth was rapid starting from the 1850s. The textile industry developed considerably from 1840 to 1870. The Finnish metal industries expanded since the 1860s too, even though domestic ore deposits were modest besides some copper resources. Despite advanced industries - the country being one of the most forested countries in the world (57% of the territory) - the forest industry formed the backbone of the economy. Steam, and later hydro-powered, sawmills offered a competitive edge in production, and exports of the logging industry expanded threefold during the 1860s. The discovery of new paper manufacturing methods had great influence on Finland's economic future. Germans invented wood grinding method of paper production and the first factories were build in Finland in the 1860s, about 15 years afterward. The first chemical pulp factory started in 1880. Russia was the main export market; since Finland was part of the same empire import duties could be avoided. The Russian paper industry was still using rags as raw material, and the technological advantage in the most important market area was held for decades.

The economic growth rate picked up as industries developed. Finland remained, however, fairly agricultural. When Finland was about to gain its independence in the early 20th century, per capita gross domestic product (GDP) was 2.5 times what it was in the mid-1800s. The logging and paper industries were the engines of growth. During the independence (from 1917 to the early 1990s) aggregate production has grown 1200%, averaging over 3% annually. The GDP is 7.5 times higher than at the birth of the nation. Internationally compared growth has been swift. Figure 3.1 shows the development of GDP volume since 1860.

Finland fell into the most serious economic crisis of its peacetime history during the late 1980s and the early 1990s. During the same period, the collapse of the Soviet Union caused a significant downfall in the bilateral trade that had played a significant role in the Finnish foreign trade. This gap needed to be compensated in other markets in times when the global economy as a whole was suffering from slack demand. Even when considering these severe hits, Finnish economic performance has been impressive; only few countries (Japan and Taiwan) have grown faster during this century.

Figure 3.1 Volume of GDP in Finland, Japan, and the United Kingdom (1913=100)



Source: ETLA Database

Naturally the Second World War is the most peculiar period in Finland's economic development. While the terror of the war can hardly be exaggerated, Finland was lucky in some respects: much of the physical capital was untouched, economic and social institutions functioned during and after the war, and huge war reparations to the Soviet Union boosted industrialization.

As late as 1950 nearly one-half of the population was engaged in primary production, and only about a quarter each in manufacturing and services. Today less than one-tenth of the labor force is in primary production, almost 30% is in manufacturing, and over 60% in services. Industrialization, and by the same token urbanization, has been rapid.

3.1.3. The current economic performance of Finland [1)]

The structure of the economy. Of the total value-added in industry, metal and engineering accounts for 40% and the forest industry for 20%. The chemical and food industries represent both some 10%.

After the dismal beginning of the 1990s, manufacturing has been picking up, reaching a growth rate of 12% in 1994. Behind this sudden upturn lie reviving exports of forest and metal products[2)]. International competitiveness, that was improved by disciplined wage development, devaluating currency, and enhanced productivity during the recession, may be in danger to deteriorate due to impatient wage negotiations. The flourishing industries are also facing capacity constraints, which dampen the growth potential in some industries.

As a small, open economy Finland is fairly dependent on foreign trade. Nearly three-fourths of the current exports go to Europe. It has been estimated that exports will be 40% of the Finnish GDP by the end of the century. The importance of the forest industry and metals and engineering exports (both some 40% of the total) have kept the economy sensitive to variations in global markets. The role of the more knowledge-intensive electronic and electrical industry, however, is on the rise, which could balance the effects of global fluctuations on the national economy in the future.

Standard of living. Finland is one of the richest countries in the world, as measured by GDP per capita, and was improving its OECD-ranking quite steadily until the slump of the early 1990s.

Inflation. Although Finland has a history of relatively high inflation, it has stayed below the EU average since 1991 due to sluggish economic activity. In 1995, the inflation rate is expected to stay at 2%, whereas in 1996 the ongoing strong recovery is expected to induce higher inflation, depending heavily on wage claims. In 1994, the Finnish price level exceeded the EU average[3)] by 10%, whereas in 1989-1990 the difference was as much as 40%.

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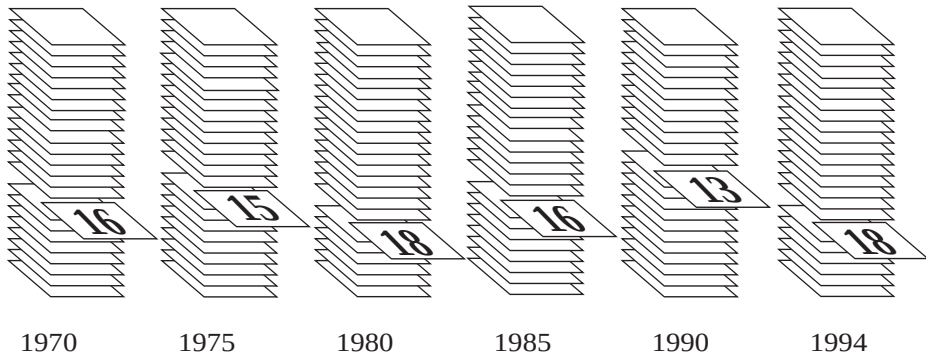
1) See ETLA's quarterly forecast publication *The Finnish Economy* (ETLA - The Research Institute of the Finnish Economy) for latest developments.

2) The growth rate in the forest industry was 10% and in the metal industry 25% in 1994. The future prospects are promising, but less impressive.

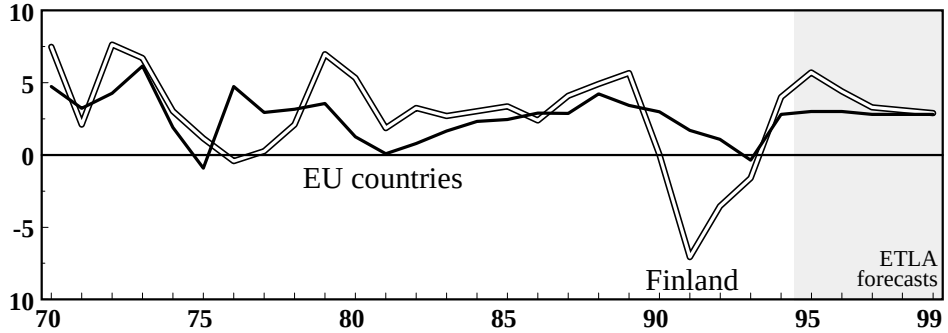
3) Measured in purchasing power parity.

Figure 3.2 Finland's OECD-ranking in a GDP per capita comparison (US$, current prices and PPP exchange rates)



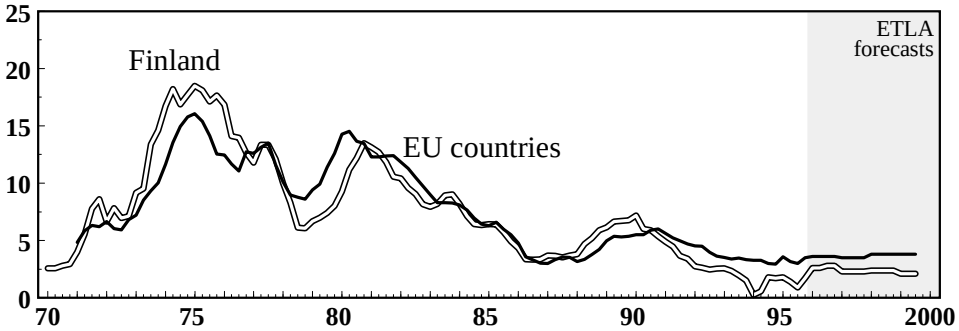
Source: OECD National Accounts 1960-1993: ETLA Database

Figure 3.3 Volume changes of GDP in Finland and in the EU



Source: OECD National Accounts 1960-1993: ETLA Database, forecasts: ETLA - *The Finnish Economy*

Figure 3.4 Inflation rate in Finland and in the EU



Source: Central Statistical Office of Finland: ETLA Database, forecasts: ETLA - *The Finnish Economy*

Unemployment. Finland enjoyed a low level of unemployment, averaging 5% throughout the 1980s. But in the first part of the next decade it witnessed a surge in unemployment, the rate hitting close to 20% in 1994. To date, the ongoing economic recovery has ameliorated the situation somewhat, and unemployment is expected to remain steady at 12% until 1999.

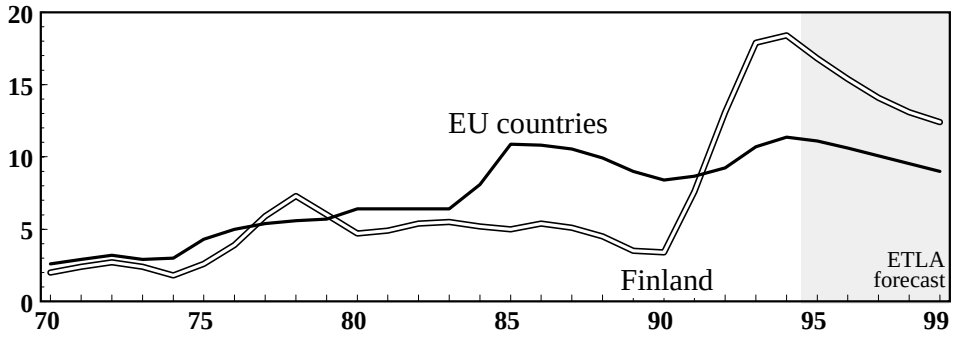
Balance of payments. The current account deficit plunged at the beginning of the 1990's, representing 5.5% of the GDP in 1991. In 1994, the current account deficit turned to a surplus in spite of reviving imports. The strong terms of trade that were lost in the early 1990s are being gradually regained, partly reflecting the world-wide price recovery of the forest industry's products.

Public debt. The recession has also hit government finances hard. Harsh unemployment reduced tax revenues and simultaneously required increasing social transfers. With a history of moderate relative indebtedness, public borrowing exploded after the turn of the decade. The gross public debt, mainly issued by the government, exceeds 60% of the GDP, up from less than 20% in the late 1980s.

Not surprisingly, budget consolidation is the main focus of fiscal policy, and indeed, remarkable budget cuts and revenue increases have been implemented, owing to widespread political consensus on the need for national debt reduction. Government consumption has been in decline for four consecutive years since 1992, and the trend is expected to continue.

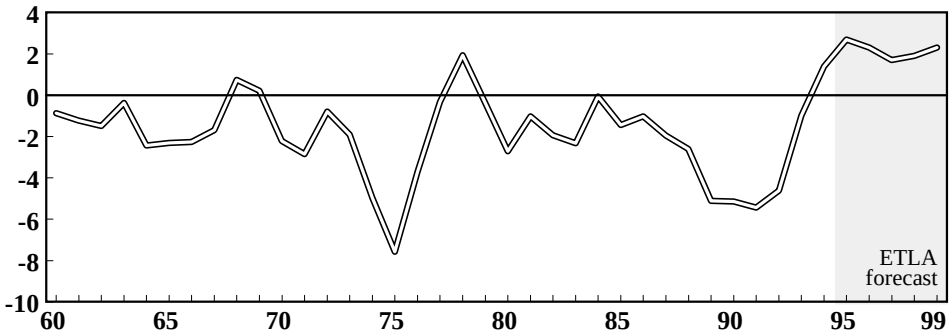
National currency. The history of the Finnish Markka is a cycle of strong currency policy (overvaluation of the Markka) and devaluation. In 1991, the Markka became subject to international speculation that led to the decision to let Markka float in 1992. Since then, monetary conditions have progressively eased, and by the early 1995, the Markka had rebounded back to its pre-floating level. There have been occasional central bank interventions to relieve excessive pressure on appreciation, and the main objective of the Bank of Finland today is to assure convergence at the targeted 2% inflation level.

Figure 3.5 Unemployment rate in Finland and in the EU



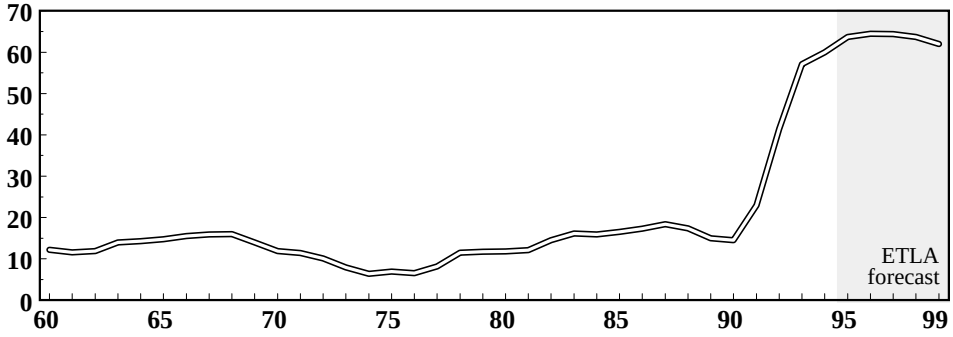
Source: ETLA database, forecasts: ETLA - *The Finnish Economy*

Figure 3.6 Finland's current account surplus as % of GDP



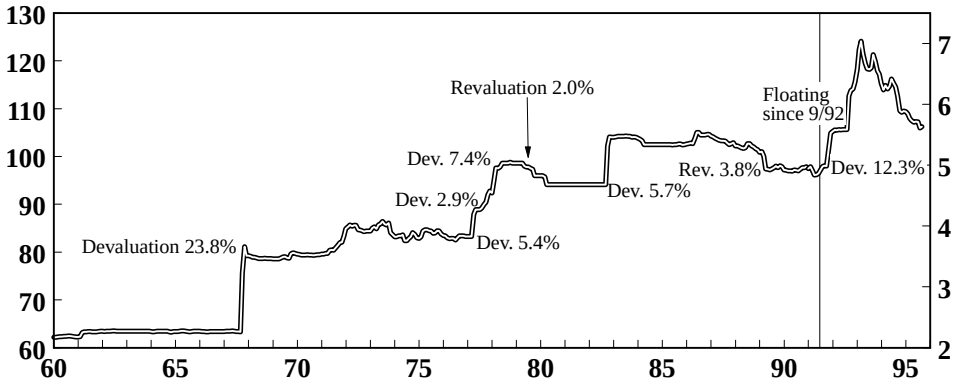
Source: ETLA database, forecasts: ETLA - *The Finnish Economy* 1995

Figure 3.7 Finnish public gross debt relative to GDP (%)



Source: ETLA database, forecasts: ETLA - *The Finnish Economy* 1995

Figure 3.8 External value of the Finnish Markka [1)]
(Bank of Finland currency index until May 1991, left-hand scale. Since June 1991 Markka's exchange rate against the ECU, right-hand scale.)



Source: The Bank of Finland: ETLA database

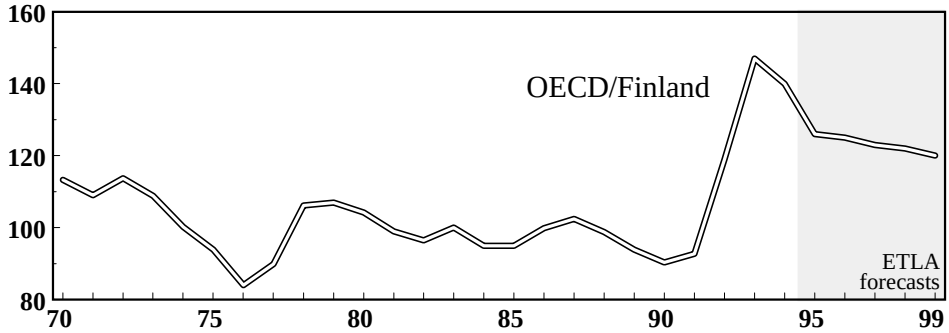
Labor productivity and compensation level. A striking characteristic of the Finnish labor market is the high level of centralization of the wage bargaining process, covering some 80% of the work force. The central agreement stipulates a framework for compensation levels for the following year or two, but it is not legally binding. Actually, industry and enterprise-level 'wage drifts' account for a notable portion of the total wage adjustment. The central negotiations also serve to establish minimum wages by type of activity and other compensations for special working conditions that are applied to non-organized employees and organizations as well.

Unlike in the past, wage increases at the beginning of the decade were low, reflecting the necessity to cut labor costs in companies. In international comparison, only Japan had a lower rate of labor cost increase. But, now that the economy is picking up, demands for higher compensations are strengthening.

Growth of labor productivity has declined since the mid-1970s, but much less than in other industrialized countries on average. The reasons for this are found in the structural development of the economy, rate of technical progress, and the Eastern trade. The low level employment with recuperated industrial activity has further enhanced labor productivity. This phenomenon will normalize, however, as the demand for labor grows.

[1)] Appendix 4 (p. 201: currency conversion) has average annual exchange rates between the Finnish Markka and major currencies.

Figure 3.9 Relative unit labor costs of Finnish industry
(Finland's unit labor costs are adjusted for exchange rate movements in relation to those in 14 OECD countries; average 1971-1990 = 100. Higher index indicates better price competitiveness of Finnish labor)



Source: ETLA Database, forecasts: ETLA - *The Finnish Economy* 1995

Foreign direct investments. Finnish companies have internationalized quickly but rather late. The mid- to the late 1980s were an active period in direct net investment abroad.

The sharp fall in consumer demand and high indebtedness, followed by the loose monetary conditions of the late 1980s, took a heavy toll on the business sector in the 1990s. Nevertheless, with the economic recovery in sight, high expectations have been placed on small and medium-size companies to enhance the dismal employment situation.

Financial markets[1)]. Until the early 1980s, the money market was tightly regulated. High inflation, together with the low and regulated interest rates, made demand for credit excessive. Additionally, tight central bank regulation over foreign exchange movements was justified by the fixed exchange rate policy. Negative real interest rates and the undeveloped securities market made the business sector heavily indebted to banks. At the end of the 1980s, the Bank of Finland started gradual and full liberalization of the financial markets, but it was only in the early 1990s when short-term non-trade capital movements, as well as households' foreign borrowing, were allowed.

As a result of the economic growth and financial liberalization of the 1980s, the stock market experienced a rapid expansion which was further stimulated by improved non-bank finance and relatively low capital

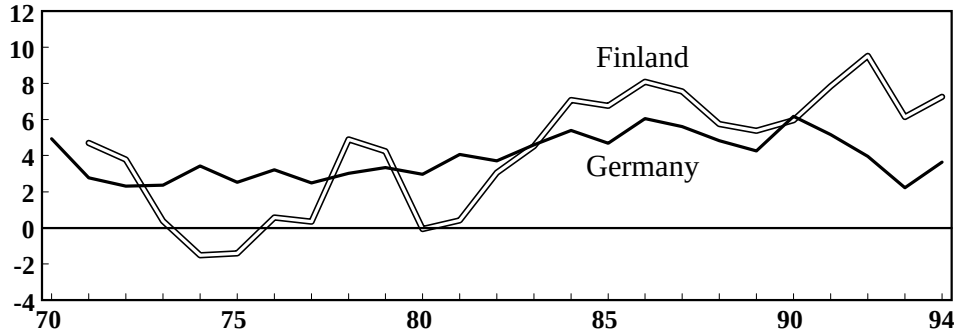
1) See ETLA's monthly report *Finnish Financial Markets* (ETLA - The Research Institute of the Finnish Economy) for latest developments.

income taxation. Competition for market shares and inexperience in unregulated conditions caused banks to neglect proper evaluation of collateral, while borrowers misjudged the risks. Borrowing by households and companies soared, and high stock and real estate values made debt-asset ratios look deceptively low.

There were practically no fiscal or monetary policy measures taken to moderate the expansionary effects of liberalization or the economic boom; nor was there tightening of banking supervision. Finally in 1989, a tighter monetary policy was introduced, but it only led to greater foreign borrowing as the widely-publicized fixed exchange rate policy blurred its risks. The economy was fast overheating and accelerating labor costs further eroded competitiveness. Together with the collapsed Soviet trade, Finland was suddenly facing external balance problems.

Tight monetary conditions with a heavy debt service burden lowered domestic demand, in particular for real estate. Asset values and profits plummeted, bankruptcies - and consequently unemployment - soared to record levels. Speculation against the Markka kept interest rates very high, distressing Markka borrowers, while the later decision to float the national currency depressed foreign currency debtors.

Figure 3.10 Real interest rates on Finnish and German capital markets



Source: ETLA database, forecasts: ETLA - *The Finnish Economy*

Finally, the lion's share of responsibility fell into the arms of the banks who had, to a large extent, financed the 'party.' Credit and guarantee losses grew eleven-fold between 1989 and 1992. Together with lost new lending and diminishing marginal interest[1)] the banking sector has been

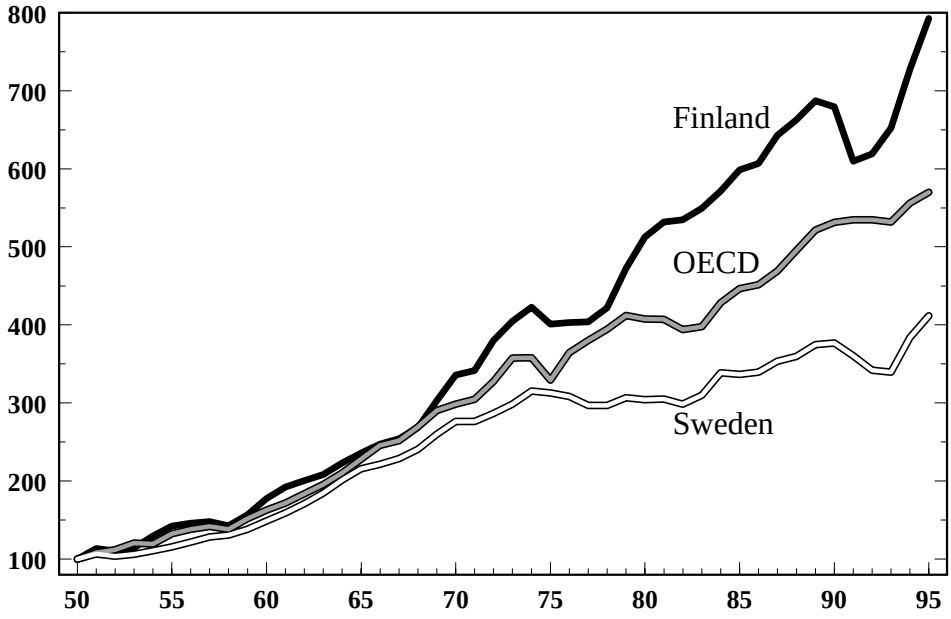
1) Half of the loans were linked to the regulated and low Bank of Finland's base rate,

suffering huge yearly losses since 1991. The banking crisis culminated when one major bank ran into a liquidity crisis and the Bank of Finland was obliged to take over control. Since then, many other banks have required public support totaling some FIM 45 billion (mid-1995).

3.2. Economic development and structural changes [1)]

The manufacturing industries have been the engine of growth in the Finnish economy. During the 20th century, industrial production has grown 1.5 times faster than aggregate output, being considerably faster than the postwar average growth in the industrialized countries (see figure 3.11).

Figure 3.11 Volume of industrial production (1950 = 100), the OECD-district, Finland, and Sweden



Source: OECD National accounts: ETLA Database

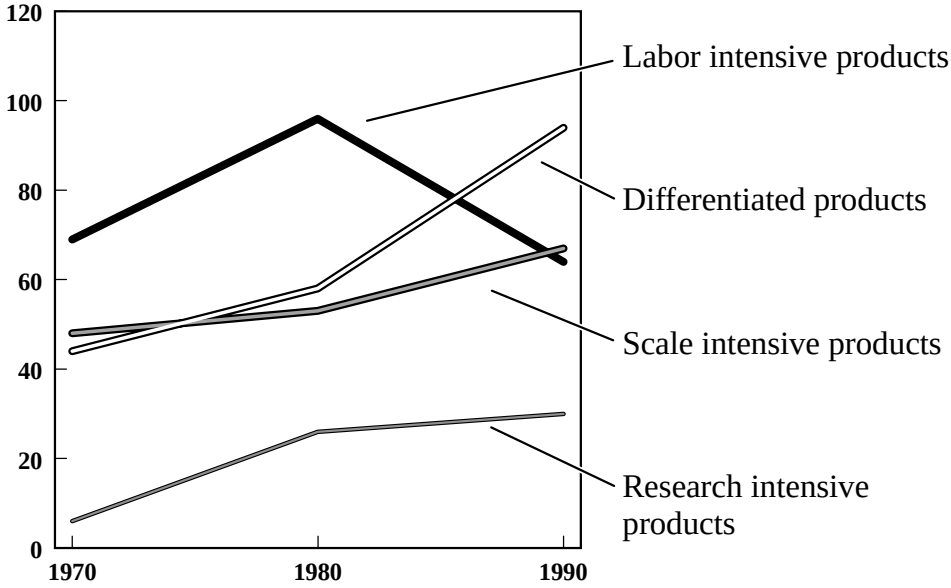
while a tax reform shifted deposits into higher-yielding taxable accounts.

[1)] Appendix 7 (p. 207) summarizes the developments in major industries (food, textile, wood, paper and pulp, chemical, non-metallic minerals, basic metal, metal products & machinery., electrical products, transport equipment and construction). See ETLA's semiannual *Profitability by Branch in Finland* (ETLA - The Research Institute of the Finnish Economy) for latest developments.

Finnish industrial structure is somewhat one-sided; the forest and metal industries are dominant. On the other hand, traditional mass production of consumer goods never became as important as in many other industrialized countries.

A number of structural changes took place in the 1970s and 1980s: technological development was swift, and gradually the composition of production and exports changed towards more knowledge-based industries (see figure 3.12). Private enterprises expanded their international activities considerably (see table 3.1). At this point Finland should have made a progressive transition, and the depression could have been avoided. In 1990, however, the country was struck by a severe structural crisis that hit other industrial countries 10 to 15 years earlier; from 1990 to 1994 the industrial employment decreased by one-fourth.

Figure 3.12 The specialization of industrial exports (RCA-index)



Source: OECD 1992

While investments in new technology have been considerable, to the extent that it has been questioned whether the latest technology has been the end rather than the mean, their profitability has not been remarkable. Many investments have been neither economic nor commercial successes (see Eloranta, Ranta and Ollus 1994; Pohjola 1994).

Table 3.1 Internationalization of Finnish industrial enterprises[1)]

Company	1983			1994		
	Total personnel	**Personnel abroad**	**%**	**Total personnel**	**Personnel abroad**	**%**
Repola	18512	1300	7	27378	15879	58
Nokia	23651	4146	18	28043	13059	47
Kone	13137	8700	66	21553	19611	91
Kymmene	16087	2426	15	17061	4128	24
Outokumpu	10089	141	1	14959	7270	49
Valmet	15371	1969	13	12146	3797	31
Enso	15315	1500	10	14747	2422	16
Metsäliitto	7891	590	8	13331	2960	22
Ahlström	12472	1796	14	13479	7555	56
Neste	7076	1489	21	8195	2608	32
Kemira	8159	200	3	11156	5015	45
Huhtamäki	4698	311	7	11145	8215	74
Partek	6200	531	9	8128	5800	71
Rautaruukki	7712	120	2	9068	1999	22
Asko	3800	1227	32	8700	4409	51
Amer	2102	454	22	6199	4205	68
Cultor	4397	200	5	4857	1710	35
Orion	4106	290	7	5092	415	8
Tampella	7611	613	8	4447	2252	51
Fazer	4211	432	10	6992	1838	26
Total	192597	28435	15	246676	115147	47
Share of total manufacturing industry	36 %	78 %	6	66 %	83 %	37

Source: Financial statements and Key Figures of Top 500 Corporations in Finland by Talouselämä, Company Reports

3.3. Finnish national growth strategy

Accelerated economic growth has been a goal of Finnish national policy for the past 50 years. It is fair to say that is has been a national mission. Its typical features have been: economic policies that shore up investments and support industrial activity; a dominant role for the government and publicly owned companies; an effort to exploit domestic resources as

[1)] Appendix 5 (p. 202) gives basic statistics of 70 biggest commercial enterprises in Finland. For further information consult ETLA's *Financial statements and Key Figures of Top 500 Corporations in Finland* database (Compiled by business magazine 'Talouselämä'. Includes over 100 variables per firm.).

efficiently as possible; finally, a shared opinion that growth is indeed important. There were also signs of protectionism (Pohjola 1994a and 1994b, Vartia and Ylä-Anttila 1992). The decades of a rather planned economy created many inflexibilities and a whole jungle of regulations, many of which have been demolished during the recent economic slump.

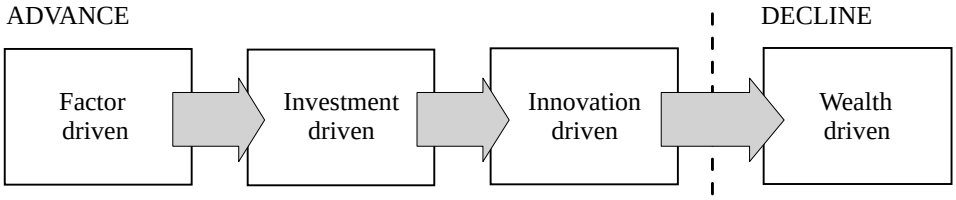
Devaluation of the Finnish Markka has been used to boost competitiveness in the past. Since internal flexibility has been limited, policy makers have been forced to adjust external variables instead. It has been shown that Finland is fairly sensitive to changes in international market trends (Kotilainen, Alho, and Erkkilä 1994).

As consequence of the policies discussed above, the Finnish economy is dominated by a few large companies; the share of small and mid-size companies is modest (see Heum and Ylä-Anttila 1993 and 1994). Developing new industrial activity and entrepreneurial culture to replace the old regime is an arduous task.

3.4. Stages of industrial evolution [1)]

Porter recognized four major stages a developing country's industry passes through. Stages may be overlapping, and a nation may move to either direction in its progress. The first three stages, (1) factor, (2) investment, and (3) innovation-driven, are successive improvements in national prosperity whereas in the fourth stage, (4) wealth-driven industrialization, national competitiveness will decline.

Figure 3.13 Four stages of national competitive development



Source: Porter 1990a, p. 546

If a nation is in the factor-driven stage, its internationally successful industries take advantage of abundant basic factors of production such as

1) Based on Vartia and Ylä-Anttila 1993.

favorable climate or cheap labor. In the investment driven stage national competitiveness in based on willingness to postpone consumption and to invest in efficient large scale production facilities. In the innovation-driven stage the national diamond is fully developed and interaction between the determinants is frictionless. In the wealth-driven stage the economy has reached a state, where accumulated wealth weakens the motivation to invest and innovate. These four stages of economic development can be found in the case of Finland.

3.4.1. Features of the factor-driven stage - as applied to the initial industrialization of Finland

In this stage competitive advantages are based on low wages and input prices. Domestic production of investment goods is almost nonexistent. Firms apply imported and well-known technologies. Internal research and development is limited. Firms often lack direct connections to the end users. The economy is very sensitive to the fluctuations in the world commodity markets. While a fairly high standard of living can be achieved, maintaining it in the long run is unlikely.

This description fits well to the initial phase of Finnish industrialization from the mid-1800s to the earlier 20th century; paper and harvested Finnish 'green gold' were the main impetuses behind growth. The main innovations in paper manufacturing were made in Germany and they were applied in Sweden at an early point; Finland was lucky enough to be culturally and economically close to both of these countries. Not only the technology, but also managerial skill were imported. This stage of national development was dominant until the 1930s, and still exists to some extent. The majority of internationally successful Finnish products still relate to the forest industry in some way.

3.4.2. Features of the investment-driven stage - as applied to post-war economic development in Finland

National competitive advantage is characterized by the willingness and ability of domestic firms to invest aggressively. Companies try to acquire the best technology available on the global market, and they often aim to create competitive advantages based on economies of scale. Upon applying foreign technologies they are also enhanced to suit local conditions. Since production technology is bought rather than invented, domestic

producers are nevertheless in the second tier as far as technological advances are concerned. The majority of successful companies make fairly standardized products.

The role of industrial and economic policies is substantial in this stage. The public sector can fine-tune economic performance by channeling capital to specific industries, by offering temporary protection for infant industries, and by establishing collective risk-sharing schemes. Since investments are favored over current consumption, strong national consensus is needed to defer immediate consumption in favor of long-term growth.

This description suits postwar Finland well up to the 1980s. At the same time, however, the next stage, the innovation-driven phase, has been under development. The 40 years after the Second World War were characterized by a high investment ratio, further growth of forest and mining sectors, and public policies favoring investment. This route has come to an end, and Finland seeks to find another route to national well-being.

3.4.3. Features of the innovation-driven stage - Finland since the late 1970s

In the innovation-driven stage a country should have a wide range of internationally competitive industries. While successful enterprises have strong linkages to the traditional sectors, fitting the national environment and history, brisk innovative activity has created many subsectors. Domestic research and development has increased competitiveness in traditional branches and spin-offs have generated seeds for new industries. Domestic rivalry is fierce, and linkages to customers are an important source of new ideas. Firms do not only adapt innovations made elsewhere, but also innovate themselves. Competitive strength is founded on specialized and advanced factors; highly skilled labor and firm-specific knowledge are crucial. Firms compete in global markets with differentiated products. The service content of manufactured products is high. In this stage the economy is less sensitive to cyclical fluctuations.

The role of public policy differs from the previous stage. Policies should be geared toward enhancing innovativeness through creating and sustaining advanced factors; education and research policies as well as sophistication of public demand are important.

The Finnish economy moved towards this stage in the late 1970s and in the 1980s. Many of the Finnish knowledge-intensive firms are closely related to the forest and metal industries. The electronic industry has expanded rapidly in the areas of automation, process control, and telecommunication. As the economy prospered, signs of the wealth-driven stage became more apparent.

3.4.3. Features of the wealth-driven stage - the overheating of the Finnish economy in the late 1980s

In this stage the economy enjoys the fruits of accumulated wealth. Firms try to improve their competitive position by mergers and acquisitions rather than by investing in new capacity. As a high level of income is reached, eagerness for a change diminishes; everyone tries to maintain the status quo and dynamism is lost. Productivity growth is sluggish, and there is chronic underinvestment in the economy. The wealth-driven stage is the beginning of a decline.

Many advanced industrial countries, e.g. Sweden and the United Kingdom, have reached this stage. The Finnish economy moved to some extent into the wealth-driven stage during the 1980s. Wealth proved to be an illusion for the most part; sectors of the economy expanded spending based on false expectations and foreign debt soared. This, however, is a fairly narrow view of the period in question. The late 1980s and the early 1990s was also a period of the emergence of an information society, a service society, or a post-industrial society: the service sector grew more rapidly than the rest of the economy, the service content of manufactured products increased, and knowledge became an end-product in itself.

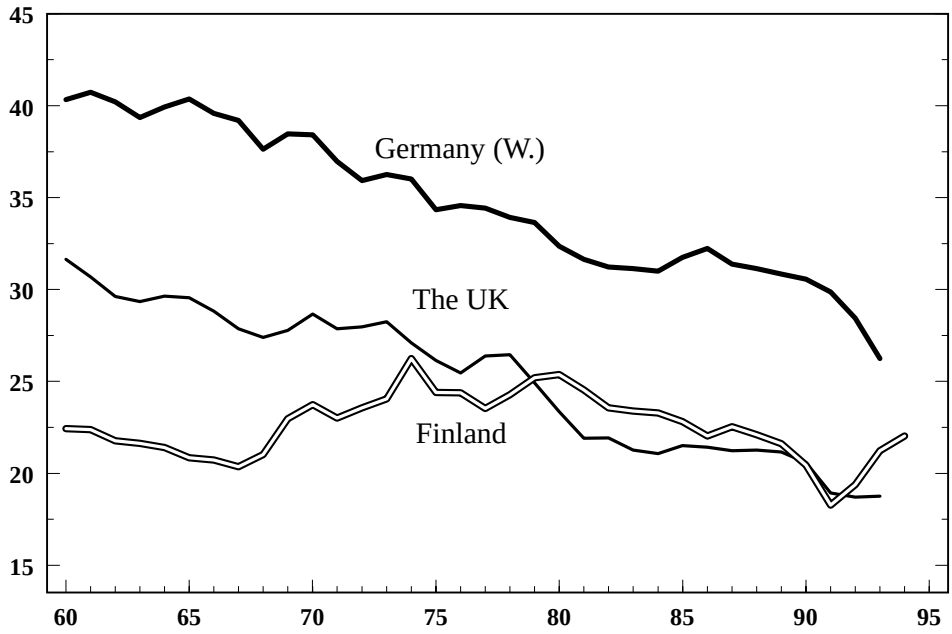
3.5. Conclusion: the Finnish heritage and new preconditions for a high standard of living

The scenarios of a post-industrial society, emphasizing the role of services and increasing importance of information, are no doubt correct for the most part. Some of these visions were realized in Finland during the last decade (see figure 3.14). Yet, paradoxically, the shrinking of traditional industries caused Finland most of its problems during recent years. Sweden and the United States were caught in the same cycle about ten years earlier. Clearly, services and manufacturing can not be seen as substitutes

but rather as complements; post-industrial society should still be industrial - only the nature of dominant branches is altered.

The economic slump of the early 1990s revealed the weaknesses of the Finnish economy. Currently the country is in search of an economic structure that would allow it to maintain external balance, and to guarantee a high standard of living to its citizens. In practice this means that the economy should be in the innovation-driven stage, for the most part.

Figure 3.14 Manufacturing production as a percentage of GDP



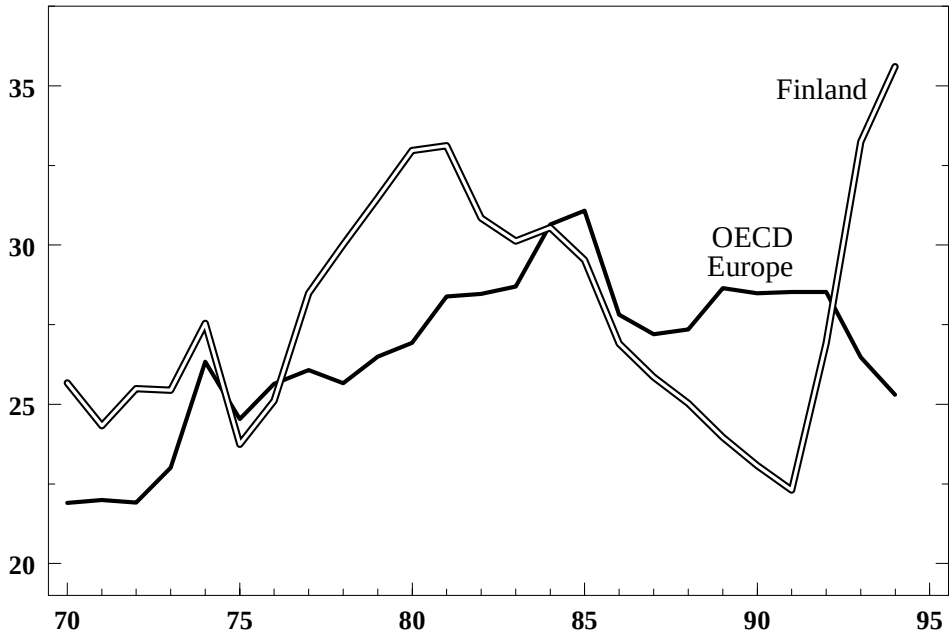
Source: OECD, ETLA Database

Reasons for the crisis are not hard to come by. Structural distortions were exaggerated during the years of rather controlled economy. Some errors in economic policies even magnified the effects of the unavoidable economic downturn.

New economic structures should be created with the requirements of open markets in mind. Strangely enough, while firms compete, cooperation in activities outside the traditional marketplace are increasingly important. Companies form networks that will be key sources of competitive advantage. Large global corporations integrate into the world economy, and the role of the national state eventually diminishes.

Finland has made most of the necessary investments to build its economy; now it is time to increase the productivity of the existing capital stock. A devaluation of the currency is no longer an option for policy makers. Global integration and increased openness have altered the role of the public sector; direct involvement is not desirable. In order to maintain the standard of living Finns have experienced during the past decade, the export sector has had to be further expanded. Finnish price competitiveness has improved considerably in the early 1990s, but complete recovery will take years.

Figure 3.15 Exports as a percentage of GDP



Source: OECD, ETLA Database

A study of European industrial competitiveness and structural problems (Reve and Mathiesen 1994) has a simple conclusion: if a country has an insufficient number of competitive firms and industries, unemployment follows. This is also the problem in the case of Finland.

4. INDUSTRIAL CLUSTERS OF FINLAND

4.1. What are the competitive branches of Finnish industry?

4.1.1. How were the internationally competitive clusters identified?

Clusters were identified according to Porter's (1990a) methodology. The primary source was *OECD foreign trade database*. Other sources included Finnish data on foreign direct investments and service trade, the Central Statistical Office of Finland, the Board of Customs, the ETLA database, and field interviews. Clusters were chosen based on statistical information and expert opinions[18]. The competitive clusters of the Finnish economy were defined in four stages:

1. The OECD foreign trade database was used to identify all the industries in which Finland had achieved international success. Industries were defined as narrowly as possible; i.e. *uncoated paper: weight 40-150 g/m^2* was used rather than a broader sector, such as the *paper industry*[19]. International competitiveness was defined as a presence of significant exports and/or foreign direct investment drawing on advantages created in the home country (in contrast to portfolio investments). Practical criteria in constructing the lists of successful industries were: (a) Finland's share of world market exports in the commodity in question exceeded the average Finnish share of the world trade, (b) industries where the trade balance was negative were eliminated, and (c) if a commodity was traded almost exclusively with neighboring nations, the industry was excluded.

2. After the successful products were found, the firms producing them were recognized. Companies and their products were grouped according to their functional connections. Upon sketching these connections,

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18) It should be noted that parts of a traditional branch of industry can be included in a number of clusters. For example products of the chemical industry are included in the forest, 'well-being', environment, construction, foodstuffs, and telecommunication clusters.

19) In practice the United Nations' SITC (Standard International Trade Classification) revision 2 and revision 3 five-digit (or four-digit when five-digit level was not available) data was used.

skeletons of clusters were formed. In practice, clusters were often found around certain key products. A cluster includes domestic competitors in the market for that product, manufacturers of needed machinery and equipment, related and supporting industries, as well as specialized factors of production.

3. Experts evaluated whether the suggested clusters indeed formed tight entities, and some changes were made. The list of tentative clusters (Hernesniemi 1993) was presented to the board of advisors. The list got their approval. It was suggested, however, that a separate study of the success stories outside identified clusters should be conducted as well (see chapter 4.12).

4. After this preliminary work was done, actual cluster studies were started. Virtually all of the major academic and economic institutions in Finland were involved in some way. Hundreds of company interviews were carried out. Upon completing the studies, many of the clusters were reformed as more information was gathered. For example, in the forest cluster *related machinery* proved to be a particularly competitive industry having rather impressive market shares.

4.1.2. Internationally successful products and industries

The top of the table 4.1 shows the commodities earning the highest export incomes for Finland in 1994. The products where the Finnish shares of the total OECD exports are the largest are presented in the bottom half of the table. The role of the forest industry is very important as far as export income is concerned, although telecommunication products are climbing up the ranks at a fast pace. Market shares are large in many of the basic metal products. According to the guidelines mentioned above, some products, such as passenger vehicles, were excluded. The list of major export products includes some, e.g. raw furskins of fox, that do not currently have a supporting cluster behind them.

The mining industry in particular (including related machinery) has been active in foreign direct investment. It has supported the basic metal cluster and helped to reach a minimum efficient scale. The forest industry has mainly acquired foreign machinery manufacturers.[18)]

[18)] Appendix 6 (p. 204) gives further information about foreign subsidiaries.

Table 4.1 The main export products of Finland in 1994

Top 20 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 Mobile phones	5.7	4481	2.91	61
5 Newsprint	7.0	2899	1.88	0
6 Folding box board	25.8	2783	1.81	7
7 Uncoated fine paper, 40-150g/m^2	13.6	2650	1.72	2
8 Coated fine paper, less than 150g/m^2	12.2	2595	1.68	29
9 Gasoline	4.9	1976	1.28	30
10 Passenger cars	0.1	1927	1.25	0
11 Bleached softwood pulp	5.0	1859	1.21	7
12 Birch plywood	41.1	1791	1.16	1
13 Cellular and fixed network systems	6.7	1767	1.15	34
14 Digital processing units	1.3	1737	1.13	69
15 ADP input and output units	1.3	1709	1.11	33
16 Passenger cruisers, ferry-boats	18.5	1624	1.05	1
17 Bleached hardwood pulp	11.0	1600	1.04	-1
18 Diesel generators	10.6	1450	0.94	55
19 Graphic paper in sheets	15.6	1437	0.93	21
20 Parts for cellular telecom equipment	1.5	1413	0.92	24
Top 20 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 Fox furskins	50.8	842	0.55	36
2 Fructose	48.8	125	0.08	24
3 Unroasted iron pyrites	47.9	45	0.03	3
4 Machinery for making pulp	44.5	764	0.50	29
5 Wallpaper base	42.5	362	0.23	5
6 Birch plywood	41.1	1791	1.16	1
7 Cobalt oxides and hydroxides	40.3	291	0.19	44
8 Pitch and similar rosin preparations	36.5	44	0.03	44
9 Coated mechanical paper (e.g. LWC)	32.6	7683	4.98	11
10 Uncoated kraft paperboard, >225g/m^2	31.8	825	0.54	16
11 Unbleached hardwood pulp	31.1	18	0.01	-13
12 Viscose fibre waste	30.8	39	0.03	9
13 Uncoated mechanical paper (e.g. SC)	30.2	5153	3.34	3
14 Bituminized paper	30.1	13	0.01	-6
15 Folding boxboard	25.8	2783	1.81	7
16 Fluting	25.5	692	0.45	7
17 Uncoated kraft paperboard	25.2	329	0.21	11
18 Luxury cruisers	25.2	184	0.12	-4
19 Alloy steel sheets,over 600 mm wide	22.8	86	0.06	7
20 Oats	22.0	240	0.16	10

Source: OECD foreign trade database, Board of Customs, Central Statistical Office

4.1.3. Strong, semi-strong, potential, and latent (or defensive) clusters

The final composition of the Finnish clusters differed somewhat from Porter's original definition. His theory was developed for large economies having considerable domestic consumer markets. The researchers thought that slight modifications had to be made before applying Porter's approach to a small open economy such as Finland. Finns are typically specialized into business-to-business trade, and well-known consumer brands are rare. Contradicting Porter, it was thought that a cluster could be defined around a shared resource base.

Porter's approach was supplemented by a classification of clusters according to their relative strength. Clusters were thought to be either *strong, semi-strong, potential,* or *latent (defensive).* In order to define a cluster as strong, all parts of the clusters diamond should be strong and well in balance, competition among domestic firms should be fierce, Finnish R&D should be significant even in the global scale, and there should be a considerable network of supporting and related industries and organizations. In the case of semi-strong cluster all the conditions above are fulfilled, but to a somewhat lesser extent. Potential clusters are still fragile and their industrial diamonds are incomplete, but there are many positive factors supporting their growth. Defensive clusters have some cluster structures, but their development trends have been negative.

The clusters of the *Competitive Advantage of Finland* project are classified in table 4.2. The forest cluster is clearly a strong one. The base metal and energy clusters were considered semi-strong. The telecommunications, environment, and well-being clusters have significant growth potential. As a comparison group, two defensive clusters, construction and foodstuffs, were considered.

During the 1980s the telecommunication cluster has increased its production almost 11% annually; the second fastest-growing has been the well-being cluster - 10% annually. The energy cluster has expanded approximately 5% a year. Exports of these clusters, however, remain small compared to the strong forest cluster.

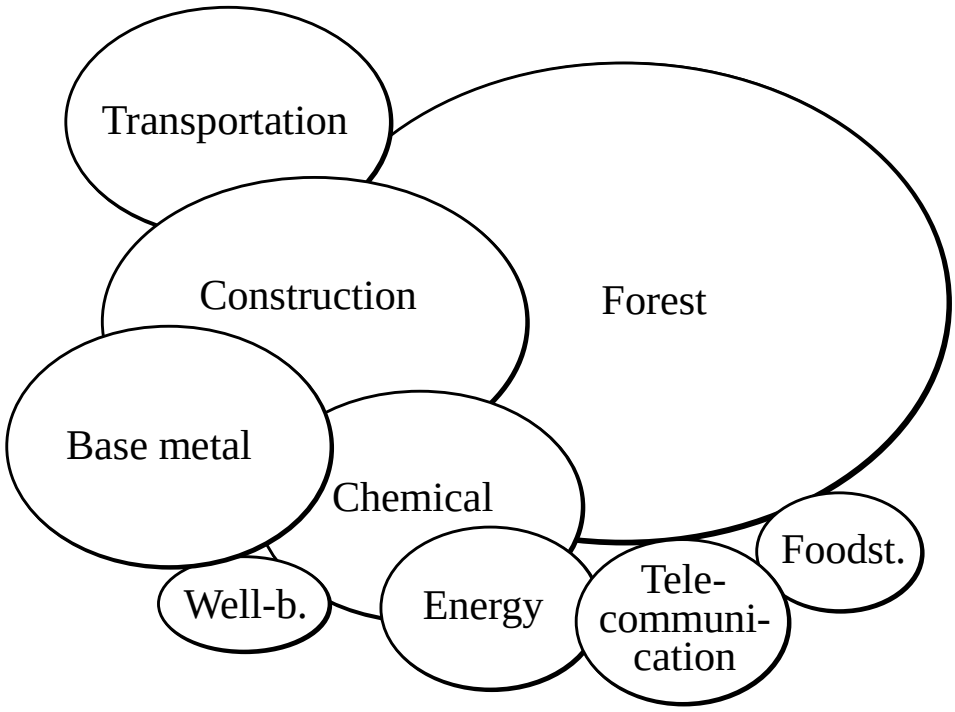
Table 4.2 The industrial clusters of Finland

Type	Nature	Cluster
Strong clusters	Complete cluster structure, fierce competition, dynamic relations between participants create advantages, many interconnections between firms via product and knowledge flows	Forest cluster
Semi-strong clusters	Stable but incomplete cluster structure, positive cluster relations	Base metal cluster Energy cluster
Potential clusters	Cluster structures are still fragile but strengthening, positive development	Telecommunication cluster Environmental cluster Well-being cluster Transportation cluster Chemical cluster
Latent (defensive) clusters	Some cluster structures exist, negative aspects in cluster relations, under-utilization of capacity	Construction cluster Foodstuffs cluster

While the perspective in this project has been distinctly Finnish, there is no reason why clusters should respect national borders. For instance, two of the largest Finnish clusters, forest and metal, are increasingly regional (they have numerous connections to Sweden and to other countries around the Baltic sea) and even partly international. It seems that currently some firms in certain industries are trying to form multinational clusters; increased competition in the fields of telecommunication and power generation has forced companies to search for global alliances.

Although the role of clusters has been emphasized above, it should be kept in mind that there are many successful enterprises without a supporting network around them (this issue is discussed in chapter 4.12). This report only argues that the likelihood of success is higher within the existing knowledge concentrations.

Figure 4.1 The industrial clusters of Finland in terms of the estimated exports share, at the beginning on the 1990s



Environmental technology is included in many of the clusters above.

4.2. The forest cluster - 500 and still swinging [18)]

The 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, specialty input producers, chemical firms, as well as service providers. Universities and research organizations are also an important part of the industrial network. Tight interplay among the participants has made the forest cluster a prosperous one (see figure 4.2).

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 out of it. Fiber processing machines make pulp either by mechanically grinding the wood or chemically, by 'cooking' it. Stock preparating machines wash and bleach the pulp in the next stage before it is fed to a paper machine. Finally paper is coated, calentered and/or cut to size in finishing machines.

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.

4.2.1. The forest cluster has expanded into new areas

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.

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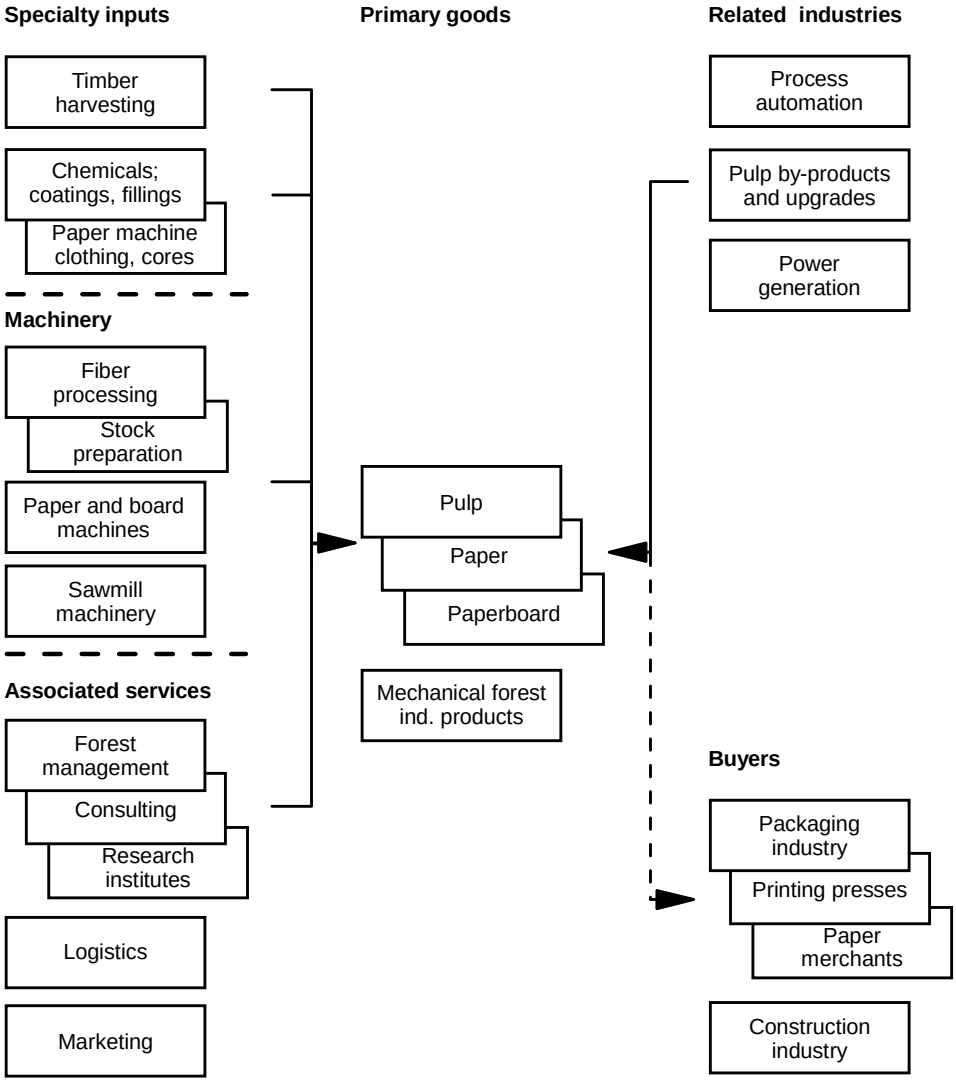
18) Follows mainly M. Lammi, 1994, *The success story of paper, machines and know-how - the competitive advantage of the forest cluster*, The Research Institute of the Finnish Economy, ETLA B 99 (in Finnish with English summary).

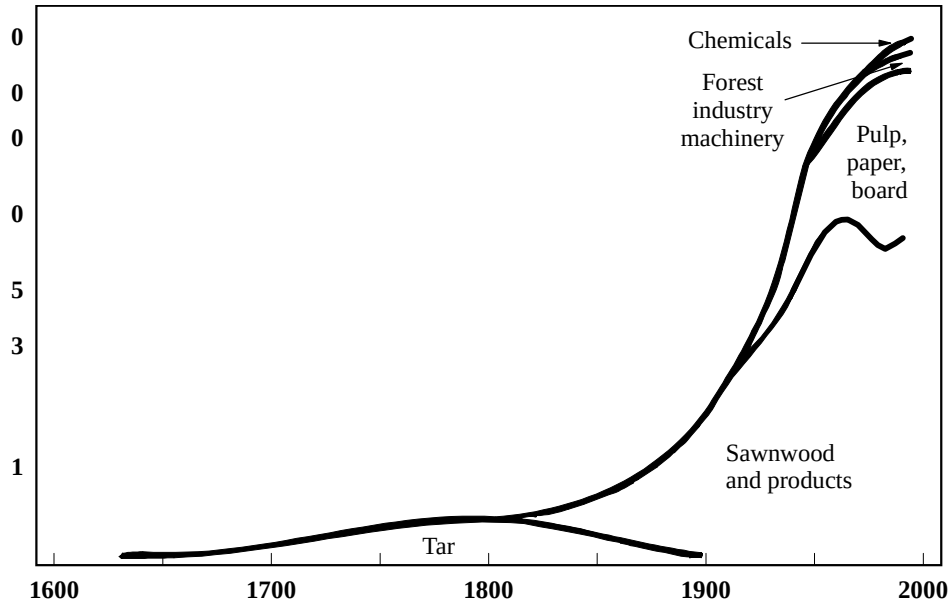
Figure 4.2 The Finnish forest cluster



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. The workshops flourished. In the 1980s Ahlstrom gave up most of the traditional wood refining business and concentrated on achieving excellence in engineering.

Figure 4.3 Export value of the branch since the dawn of the forest cluster



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.

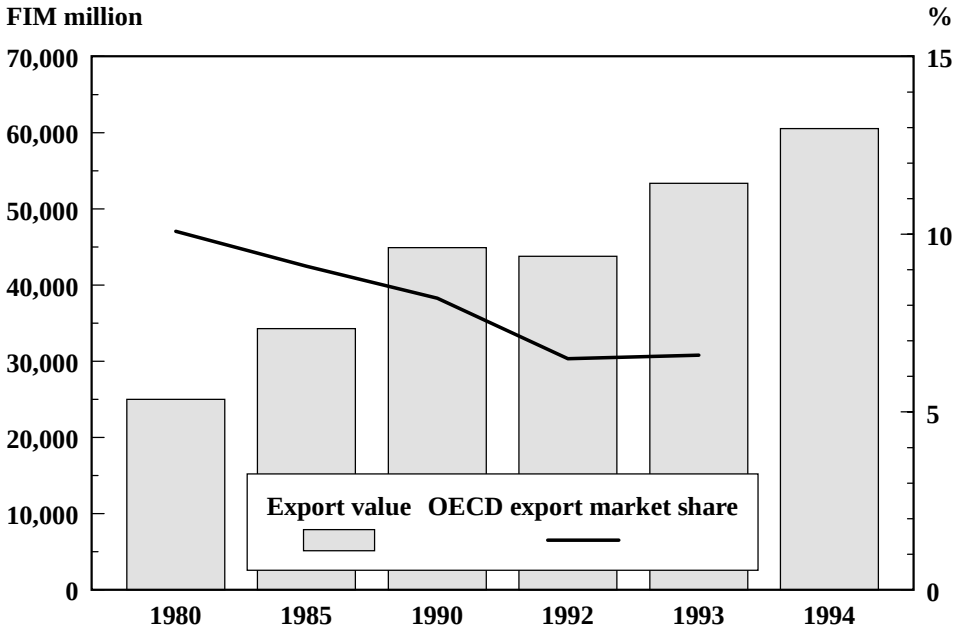
Box 4.1 Links between the Finnish forest and metal clusters - the case of Valmet

Valmet's history differs from that of the other engineering workshops in the forest cluster. In 1938 the state started to manufacture artillery cannons in Rautpohja. Valmet was established on these foundations in 1946 from the state's war material industry. It began to produce manufactures used to pay the war reparations to the Soviet Union. At the end of the decade Valmet expanded its product range with paper machines. In 1953 the first two paper machines were sold to Poland. By 1960 paper machines were the main products of Valmet's factory in Rautpohja. While domestic competition was fierce for decades, over the years Ahlstrom's (forestry & engineering), Tampella's (forestry & engineering), and Wärtsilä's (ship building & engineering) production of paper and paperboard machines were merged with Valmet. Currently Valmet produces over 30% of the of new machines in the world.

4.2.2. Europe is the main market

In 1994 the export value of the forest cluster was FIM 61 billion (see figure 4.4). 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.

Figure 4.4 Exports of the Finnish forest cluster and its OECD export market share



Source: OECD, Board of Customs, ETLA

Different types of high quality papers top the list of most important export products (on the top of table 4.3): 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 4.3). As the bottom of table 4.3 illustrates (and taking into account the export orientation of the country) it is fair to say that Finland is the most forest dependent country in the world.

Table 4.3 The main export products of the forest cluster

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

The chemical forest industry (pulp, paper, paperboard, etc.) accounted 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%. The typical features of each of the subsectors are summarized in table 4.4.

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-calantered coated (SC) paper, and Kymmene is the dominant company in the light-weight coated (LWC) paper, both of which are used in magazines. Metsä-Serla is also an important provider of paperboard for some highly specialized industries, such as cosmetics and tobacco. There are also some somewhat smaller firms. UPM and Kymmene merge in 1996 and the new UPM-Kymmene is the largest forest firm in Europe and No 5 in the world. Enso-Gutzeit and a medium-sized Finnish forest firm *Veitsiluoto* also merge 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, harming 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 fiber 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 4.5.

Table 4.4 Structural features of some submarkets of the forest cluster

PRODUCT	SELLER CONCENTRATION	BUYER CONCENTRATION	ENTRY BARRIERS
Sawnwood	Low concentration: numerous small and medium size suppliers. In the Nordic countries many large companies.	Low concentration.	Access to wood raw material.
Bleached pulp	About 50 suppliers.	Low concentration: 400-500 buyers.	High investment needs, access to wood raw material.
Newsprint	Scandinavian suppliers have 50% of the market. Enso over 10%.	Largest publishers control significant share of demand.	Significant investment needs, at least partial access to wood raw material.
Printing and writing papers	Low concentration except UPM-Kymmene: 25-30% of the market. Variable degree of concentration in individual submarkets.	Largest publishers control significant shares of the demands for magazine and book papers. Low concentration for other grades: independent merchants play an important role.	Significant investment needs, product differentiation in some grades.
Industrial papers and paperboards	Low overall concentration. Moderate to high concentration in individual markets.	Very low concentration: hundreds of converting firms and industrial users.	Nature and intensity of barriers vary by grade.
Household and sanitary papers	*U.S. Scott Paper* (USA) holds 20% of the market. A few EU suppliers are significant.	Consumer products: sold through supermarkets and other retailers.	Product differentiation through advertising and access to distribution channels.
Paper products	Very low concentration: hundreds of suppliers. In some specialized products a high degree of concentration.	Very low concentration: mainly used in packing.	Production of specialized products requires good command of technology.
Fiber processing machinery	Varies from product to product: fair high / extremely high degree of concentration.	Less than 40 significant buyers in Europe.	Rather significant investment needs, high know-how requirements.
Paper and paperboard machinery	*Valmet*, *Beloit*, and *Voith* dominate the market. In some markets only one potential provider.	Less than 40 significant buyers in Europe.	Significant investments and a high level of know-how is required.
Printed matter	Low concentration: large publishers	Low concentration: publishers are also	Rather low barriers of entry.

Source: partly Zavatta (1993)

Table 4.5 Some of the 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

4.2.3. 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 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 centralized 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 fiber, 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 'centers of excellence' in each subsector could be created. Also, greater cooperation between different units could increase productivity.

Labor costs have accounted for one-fourth of the expenses in the forest industry. Since the 1980s labor 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 labor costs. This process has increased competitiveness indirectly.

Efficient logistics could compensate for the unfavorable 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.

Box 4.2 The role of recycled fiber

The usage of recycled fiber is supported by:

Costs. The collection of community waste paper is often publicly supported. This makes recycled fiber a price competitive alternative to virgin fiber - provided that transportation costs are reasonable. Savings in newspaper grades can be considerable whereas in magazine grades savings are less significant. As new technologies are developed, more recycled material can be used also in SC, LWC, and copier papers.

Consumer opinions and legislation. Consumers favor environmentally friendly products. Many countries (Germany and the United States among others) have legislation concerning the use of recycled material.

The usage of recycled fiber is hindered by:

Costs. As the recycling ratio rises over 60% of paper consumption, costs are increased considerably. Some types of paper can not be recycled. As paper contains more recycled fibers, the price of high quality paper waste will increase.

Legislation. The German recycling requirement has caused a flood of recycled material in the neighboring countries. Currently the European Union is considering measures to restrict recycling.

The alternative usage in energy production. Particularly low quality paper waste could be used in energy production.

Recycled paper and the Finnish forest industry

Due to the trend towards recycled paper new paper mills may be built near densely populated areas. The increased raw material base will also decrease the price of timber. All of the recycled material will not be used in the newspaper grade. SC papers and later even LWC papers will contain a significant portion of reused fibers.

Domestic usage of recycled papers will increase because of growing consumer preference. Currently 100,000 tons of recycled material is imported. The figure could easily multiply fivefold. In such case, the share of recycled fibers would be 10% of the total Finnish consumption.

4.2.4. Stable growth of demand

The demand for the primary forest industry products is expected to follow general economic growth paths in the future as well. The fast-growing Asian economies, China and India in particular, will increase their per capita consumption of forest products considerably. The changes in the former communist bloc will spur demand in Eastern Europe during the coming decade. The traditional markets, Western Europe and North America, will grow modestly.

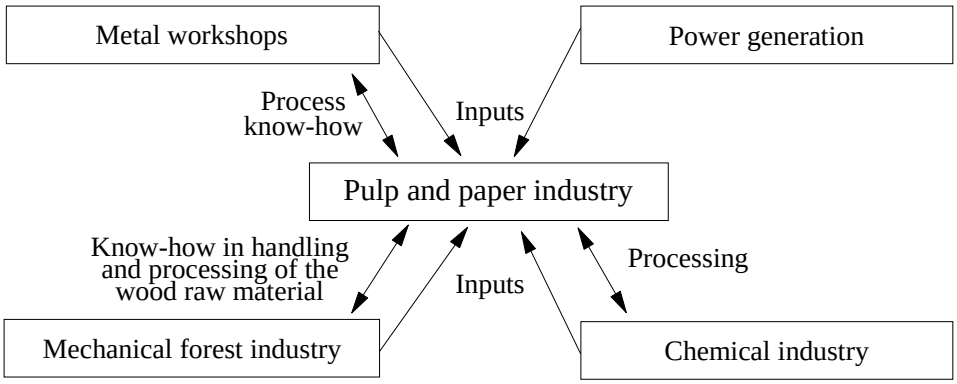
It is expected that the consumption of paper and paperboard will increase on average by over 3% annually during the next 10 years. The growth in sawnwood will be about the same.

Demand for related machinery and equipment closely follows the trends in the parent industry. Usage of chemicals in turn will grow disproportionately compared to the demand for paper.

4.2.5. Wood and iron: hand in hand

The forest cluster has strong related and supporting industries. In no other country has forest given birth to such a range of equipment, chemicals, and services. Figure 4.5 shows the most important supporting industries.

Figure 4.5 Related and supporting industries : pulp and paper production



Source: Huolman 1992

Metal workshops are the main source of competitive advantage as far as related and supporting industries are concerned. In cooperation, companies on both sides have been 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 the ones mentioned, there are a countless number of small companies in virtually all the subsectors of the forest cluster.

4.2.6. Refocusing on the customer rather than on the production

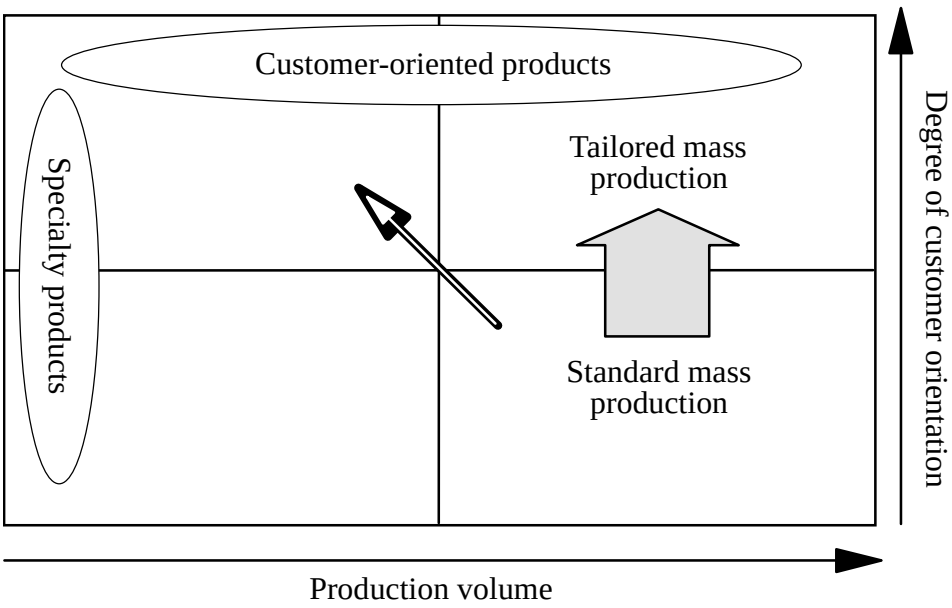
The competitive situation in the sawnwood market is intense. While the big sawmills dominate, smaller companies are numerous. Most of the products offered are rather standardized, emphasizing the role of cost competitiveness.

Since there are only a few domestic producers in the forest chemical industry they have been able to cooperate in research and development. Internationally-oriented cooperation is active on other fronts as well, maybe the most concrete form being export cooperatives 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 specialty products (see figure 4.6).

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.

Figure 4.6 Customer-focused production strategies in the forest industry



4.2.7. Finland as a home base for the forest cluster

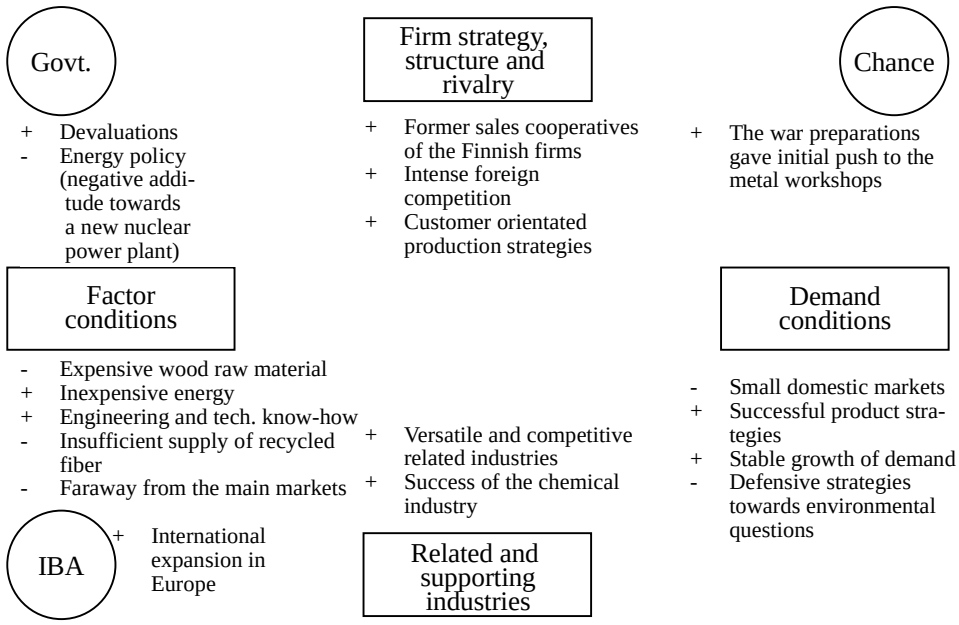
The forest cluster has been export-oriented all along; early this century 90% of production was exported. Compared to other Finnish industries, the history of internationalization has been long. *Kymmene* bought the first foreign paper mill, the English *Star Paper*, in 1930. The 1960s and 1970s were decades of foreign direct investments, and in the 1980s many sizable acquisitions were made. Already in 1980 app. 10% of Finnish paper and paperboard were produced abroad - today over one-fourth. Foreign investments will continue. Finland, however, remains the favored 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 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.

4.2.8. Conclusion: the success story of paper, machines, and know-how

Figure 4.7 summarizes the main features of the cluster. Industry-specific human capital and versatile related and supporting industries are the main sources of competitive edge.

Figure 4.7 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, at least as far as market growth is concerned. 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 fiber may reshape the competitive arena. Cost

competitiveness of the Finnish SC and LWC paper producers can be upgraded 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.

Box 4.3 Visions for the future: the Finnish forest cluster in an integrating Europe

After the European Monetary Union (EMU) materializes, the exchange rate is out of the national control. The profitability of the forest industry can no longer be adjusted externally. Input prices (labor and timber) have to be more elastic. The efficient utilization 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. (see Kotilainen, Alho, and Erkkilä 1994)

Recycled fiber 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. Specialization 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 an obvious 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.

4.3. The base metal cluster - processing knowledge[18)]

The Finnish base metal cluster is a versatile and internationalized group of industrial enterprises, whose success is largely based on Finnish technological knowledge. Key products of the cluster are base metals and steel. The structure of the cluster can be seen in the diagram below (see figure 4.8). The base metal cluster is clearly the second most significant one in the Finnish industrial history, next to only the forest cluster.

Today the basic raw materials, ore and scrap, are mostly imported. There are five Finnish companies manufacturing the key products, base metals and steel. Suppliers of machinery and equipment are more abundant; most of these are in the fields of mining technology and metallurgy. Finnish process-control devices and automation systems are also manufactured. Transportation knowledge, field-specific consulting, energy production, and logistics are the main related and supporting activities. Construction is the biggest client industry. In addition to this, automobile and electronics industries are significant customers. The cluster is quite export-oriented.

Many of the machines are imported. For example, steel production machinery is of foreign origin. The reasons for this are, among other things, the capital intensity of the machine production, and the relatively short history of the Finnish steel industry. In non-ferrous metals the situation is different, although the knowledge is developed mainly within one company, *Outokumpu*.

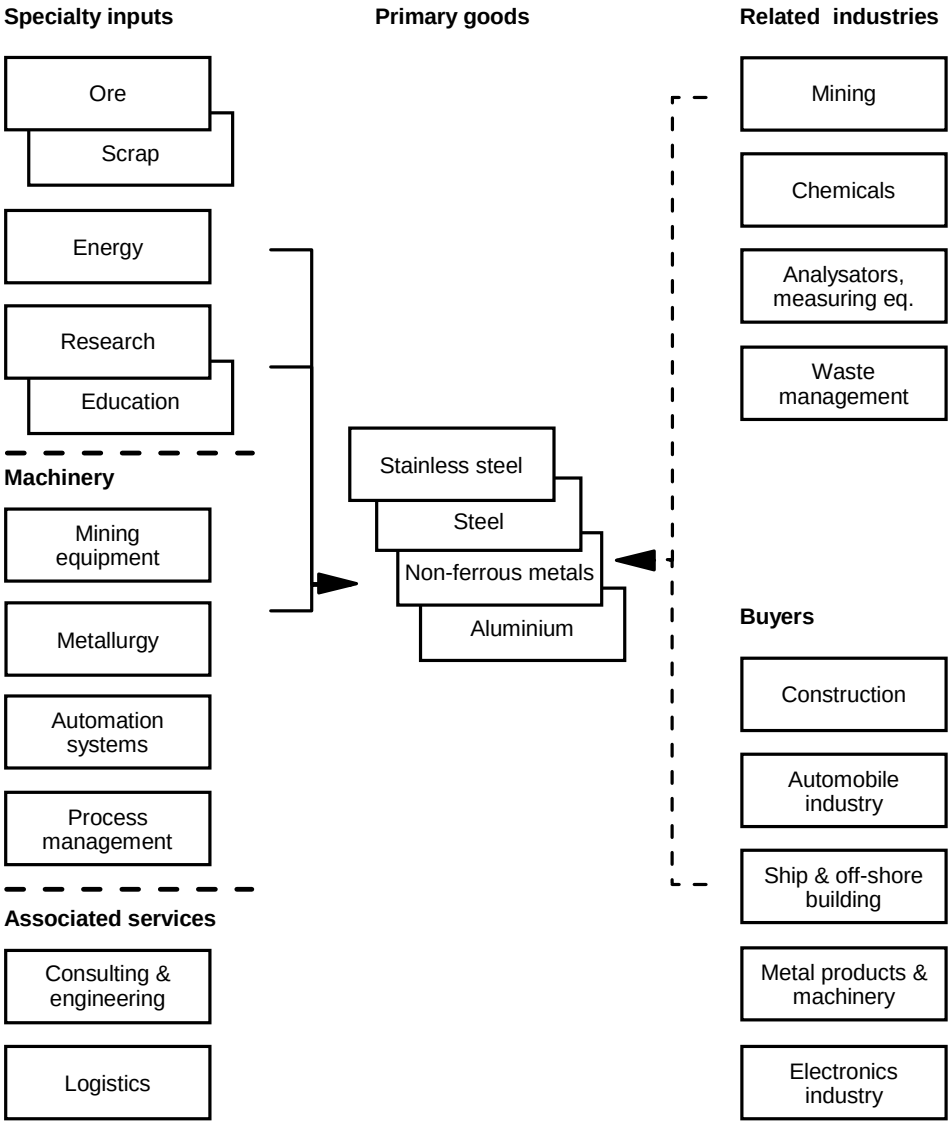
4.3.1. A historical background of the current innovation-driven growth

The finding of Outokumpu copper deposit in 1910 had a big impact on the development of the Finnish metal industry. During the Second World War imported mining equipment was in short supply, and domestic manufacturing started. After the war, investments were made to create sufficient capacity. Variety also increased significantly. Due to reconstruction and the war reparations, metals were in high demand. In the 1950s *Outokumpu* started to refine zinc and nickel. In the 1960s *Rautaruukki* was founded, and soon it evolved to semi-processed products. Outokumpu began to

18) Follows mainly A. Leiponen, 1994, *Competitiveness of base metals cluster*, The Research Institute of the Finnish Economy, ETLA B 98 (in Finnish with English summary).

manufacture specialty steels. The 1960s was a decade of expansion in the steel industry. In the 1970s Finnish companies moved on to semi-finished products. The 1980s was a period of internationalization.

Figure 4.8 The Finnish base metal cluster



4.3.2. Downward price trends and a steady market growth

Metals have well-functioning, international markets. The volume of the global metal trade is considerable; the annual value of the steel trade alone is as large as that of oil. The (real) price trend of iron ore has been downward since the 1950s. The price of copper has typically undergone great cyclical fluctuations; nevertheless, the price has decreased since 1965. From 1970 to 1986 the trend in nickel was downwards but then the price tripled in 1988 only to crash in 1990. The zinc market has been fairly stable.

The demand for low-technology, volume products, like those used in construction, will continue to be rather smooth due to the fundamental nature of these commodities. Supplying them for locally well covered markets will be profitable also in the future. Demand in the Baltic states in particular may grow. In volume products, customer-specific services and applications are needed. This creates the possibility to increase the value added. Due to significant logistics costs, regional production units have to be established if global coverage is desired. Finnish process know-how could be further exploited in joint ventures.

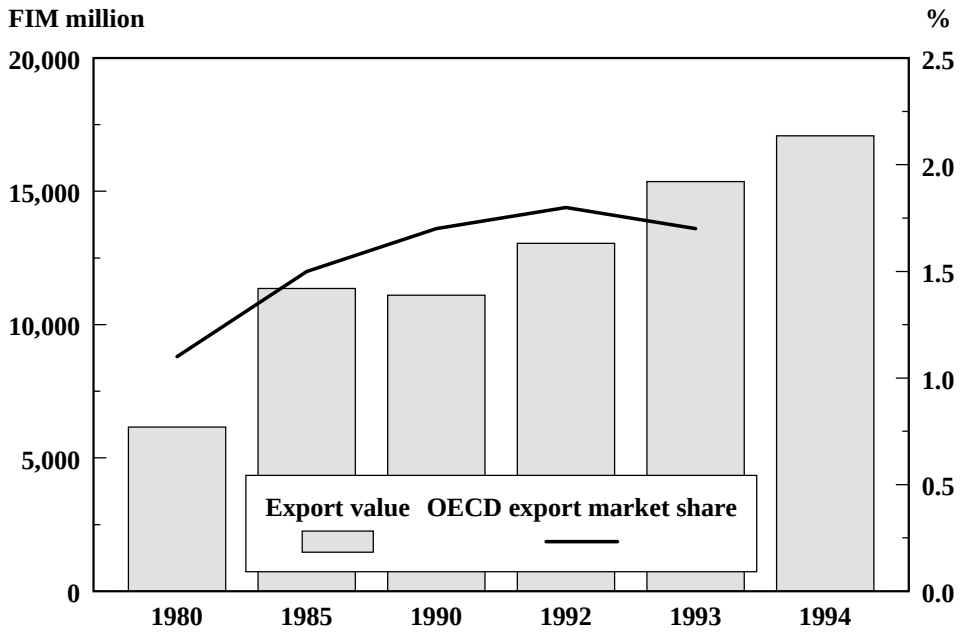
The high-end market is somewhat different. The success in specialty products, such as off-shore steel, radiator strip, and oxygen-free copper, depends on relatively high R&D investments. Since even the biggest Finnish producers are small or medium-sized by international standards, they have to focus their efforts.

The markets for machinery and equipment are global; segments are so narrow that R&D costs can not be covered otherwise. In order to compete on the market place, manufacturers have to be able to predict market changes.

4.3.3. Many products have only one Finnish manufacturer

As the exports of metals, related machinery and equipment grew, Finnish firms realigned their focus towards international markets. In 1994 the total exports of the base metal cluster were FIM 17 billion (see figure 4.9), representing app. 11% of the total Finnish exports. Steel and non-ferrous metals alone were about 9% of the Finnish exports; mining and refining equipment, 1%. The Finnish OECD export market share has grown steadily.

Figure 4.9 Exports of the Finnish base metal cluster and its OECD export market share



Source: OECD, Board of Customs, ETLA

The most important single products are listed in table 4.6. OECD-wide comparison shows, that the Finns are relatively specialized in the production of non-ferrous metals. On the machinery side, the Finnish cluster is active in grinding and crushing equipment, rock drilling, and screening apparatii.

The Finnish steel manufacturers are *Rautaruukki*, *Imatra Steel*, *Fundia*, and *Outokumpu Steel*. Rautaruukki and Outokumpu are listed companies; the Republic of Finland owns respectively 70% and 40% of the shares. Fundia is partly owned by a Norwegian *Norsk Jernverk*. Imatra steel is a subsidiary of the *Metra* conglomerate. None of the Finnish steel companies are completely dedicated to the mass markets - they have specialized in various high-grade steels.

Outokumpu Metals & Resources is the only Finnish producer of non-ferrous metals. Production has progressed to the point that semi-finished products such as seamless copper tubes are now made.

Table 4.6 The main export products of the base metal cluster

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 Stainless steel sheets, 1-2.99 mm	15.1	1299	0.84	26
2 Unalloyed zinc	7.4	685	0.44	-4
3 Copper tubes and pipes	5.5	547	0.35	4
4 Stainless steel sheets, 0.5-0.99 mm	7.0	527	0.34	40
5 Coated steel sheets, > 600 mm wide	3.1	516	0.33	30
6 Lifting machinery, excl. lifts	4.0	510	0.33	5
7 Plates and strip of refined copper	12.2	493	0.32	8
8 Non-circular welded steel tubes	5.9	440	0.29	20
9 Uncoated hot-rolled unalloyed steel	4.7	418	0.27	2
10 Welded steel tubes of circular	2.8	398	0.26	12
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 Unroasted iron pyrites	47.9	45	0.03	3
2 Cobalt oxides and hydroxides	40.3	291	0.19	44
3 Alloy steel sheets, over 600 mm wide	22.8	86	0.06	7
4 Unrefined copper & copper anodes	21.3	329	0.21	4
5 Stainless steel sheets, > 600mm wide	18.9	323	0.21	13
6 Ferro-chromium	18.7	268	0.17	9
7 Coal cutters and tunneling machinery	16.4	351	0.23	54
8 Uncoated & unalloyed steel sheets	15.9	120	0.08	12
9 Stainless steel sheets, 1-2.99	15.1	1299	0.84	26
10 Steatite and talc	13.5	154	0.10	19
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of ex-ports in OECD**	
1 Turkey	14.4		1.4	
2 Finland	11.3		1.7	
3 Australia	10.4		2.0	
4 Austria	9.3		2.4	
5 Belgium	8.9		6.5	
6 Sweden	7.9		2.4	
7 Germany	7.6		17.9	
8 Spain	7.6		2.9	
9 Great Britain	7.3		0.4	
10 Japan	7.0		16.1	

Source: OECD, Board of Customs, ETLA

Suppliers of mining, refining, and metallurgy technologies are normally much smaller than metal companies in terms of net sales, but they are numerous. Most of these firms are relatively young, and from the very beginning they had to compete with well-established Swedish and German competitors. *Roxon* was founded in the 1960s to manufacture crushing and screening equipment. *Tamrock*, a hard rock drill producer, has internationalized through acquisitions. Many smaller companies, such as *Larox* (pressurized filters), have gained world-wide foothold on narrow segments (see table 4.7).

Table 4.7 Some of the companies in the Finnish base metal cluster

Company	Products and services	Net sales, MFIM	Personnel	Foreign net sales, %
Outokumpu	Copper products, stainless steel, mining, smelting and refining	16683	14959	91
Rautaruukki	Steel manufacturing, thin sheets	7613	9068	69
Tamrock	Drills and loaders	2070	2592	app. 90
Nordberg	Rock crushers	1892	2663	app. 80
Fundia Wire	Steel wires, concrete steel	904	990	72
Kuusakoski	Scrap trade, aluminium	876	477	67
Imatra Steel	Special steel products	799	1101	79

Box 4.4 Outokumpu Steel - specialized in a few niches

Outokumpu's steel industry was started 1959 in Kemi (Northern Finland) after a chrome deposit was found there. The manufacturing of stainless steel was started in 1976. In 1980 Outokumpu expanded downstream and bought *Ja-Ro*, which produced mainly stainless steel pipes. The steel industry expanded rapidly during the 1980s. In 1989 the steel business was organized under a new subsidiary - *Outokumpu Steel*.

Upon starting the steel business, Outokumpu adapted the advanced Argon-Oxygen Decarburization (AOD) method. It also uses nonstop casting as do many of the competitors.

Outokumpu Steel (and its predecessor) has been continuously more profitable than other companies in the steel industry; tightly integrated production and good logistics have made the company quite competitive.

The strategy of specialization has been chosen. Outokumpu enters the subsectors of the steel market, where it has potential to attain major market shares, at least on the European scale. The company maintains close contacts with its key customer groups.

The market can be divided to four major competitive arenas; these are summarized in table 4.8. In primary production (1), cost-efficiency is virtually the only requirement for success. In the basic products (2) logistics and 'service differentiation' are important. The group of semi-products (3) is heterogeneous. In any case, quality, customer orientation, and flexible terms of delivery are all parts of a lucrative business concept. One example of an R&D intensive product (4) is a specialty steel used in the automobile industry. Compared to previous groups, there are normally fewer providers of these specialty products - in some cases only a couple worldwide. Profits are higher but risks are also greater due to significant R&D investments. Various types of machinery and equipment are needed in the mining and refining of metals. They have to be sold globally due to rather narrow markets. The competition is similar to that in R&D intensive products.

All of the base metal companies are trying to further increase the value-added content of their products: Rautaruukki has moved vertically into the manufacturing of semi-finished products, while others have specialized into a particularly demanding segment (Imatra Steel, Fundia), and a few are developing new production technologies (e.g. Outokumpu). Increasing the value added is the only plausible strategy for Finnish producers, since the competition in the bulk markets is expected to be increasingly intense.

Box 4.5 Tamrock - the pioneer in Finnish mining equipment

Tamrock is one of the world's leading manufacturers of mining and quarry equipment. It is a part of *Tampella Corporation*, and it owns 25% of Swedish *Sandvik*. The main competitors are Swedish *Atlas Copco* and the American *Ingersoll-Rand*. Tamrock tries to break away from the competition by offering more customer-oriented products. In underground equipment Tamrock has app. 30% market share. The market demand fluctuates with the changes in the world market prices of metals. Earlier Tamrock was in close cooperation with Outokumpu in developing its products. Since then, the Swedish *LKAB*, *Canadian Inco* and *Falconbridge*, and the Australian *Broken Hill*, among others, have been R&D partners.

Table 4.8 The competitive arenas in the base metal cluster

(1) PRIMARY PRODUCTION: COST COMPETITIVENESS

Mining, Metal trade, Scrap trade

Cost efficiency, no product differentiation
Global activities
Technological know-how: mining, scrap refining
Finance, portfolio management
High risks: hedging, diversification
Very concentrated industry

Finnish companies: Outokumpu Mining, Zinc & Copper Resources; Kuusakoski

(2) BASIC PRODUCTS: METALLURGICAL AND PROCESS KNOW-HOW

Steel mills, Refining

Cost efficiency
Process know-how & innovations
Logistics, economies of scale
'Service differentiation', control of regional market
Energy and capital intensity
Concentrated industry

Finnish companies: Harjavalta Metals, Kokkola Zinc (Outokumpu M&R), Raahe Steel Factory (Rautaruukki), Koverhar Steel Factory (Fundia), Tornio Ferro-chrome and Steel Factory (Outokumpu Steel), Imatra Steel Factory (Imatra Steel)

(3) SEMI-PRODUCTS: CONTROL OF THE REGIONAL MARKET

Traded steel; Standard wires, pipes, and sheets; Construction supplies

Control of the regional market, logistics
'Mass tailoring', cost efficient ways to produce customer specific quality products
Presence on the market place, service
Flexibility
Intense competition: numerous producers and buyers

Finnish companies: processed steels: rolling mills of the steel factories; basic construction products (steel, copper): Rautaruukki's processing plants, Outokumpu Copper; Concrete steels: Fundia

(4) SPECIALTY PRODUCTS: DEVELOPMENT OF ADVANCED PRODUCTION METHODS

Specialty products for various customer groups (automobiles, vessels, machinery, electronics etc.)

R&D intensity
Global competition
Quick response to market changes
User-producer relations feed ideas to R&D
Oligopolistic competition

Finnish companies: Outokumpu Copper: radiator strips, oxygen-free copper, etc.;
Rautaruukki: ship building & submarine steels, steels for the automobile industry;
Fundia: wires; Imatra Steel: Steels for the automobile industry etc.;
Technology & equipment companies: metallurgical & mining technology

4.3.4. Imported ore feeds advanced Finnish production

Since the discovery of Outokumpu's copper deposits in western Finland early this century, there have not been major ore discoveries. A new chrome deposit has been spotted in northern Finland, Keivitsa, but currently it is unclear whether it will be economically profitable to quarry. A lack of domestic ore stock is not considered to be a serious disadvantage: iron ore can be bought from northern Sweden and others from international markets. Outokumpu is active in the international mining business and operates on all continents in to obtain raw material for its own production. As the Russian mining legislation develops, east may be a promising direction to go in order acquire raw materials.

Most Finnish ore deposits have been small, the concentration of metal has been low, and they have been located in hard bedrock. These disadvantages have necessitated a drive to develop advanced mining and metallurgical processes and equipment. An additional contributing factor has been the lack of domestic fossil fuels.

The production facilities in Finland are modern and highly automated. Although total production has grown steadily (with the exception of a slight downturn in the early 1990s), personnel have decreased somewhat since 1983.

4.3.5. Supporting industries: a source of innovation and a buyer for by-products

Finnish innovations made in mining technology altered the development of the base metal cluster. While heavy investments were a salient feature of the metal industry for a couple of decades after World War II, a spirit of innovation caused the domestic knowledge base to expand significantly. Cooperation between metal producers and equipment manufacturers has led to the development of environmentally friendly technology in mining, refining, and manufacturing.

Due to high labor costs, the metal industry has been keen on using the latest control equipment to automate production. Finnish process control and system management skills have been helpful. One typical feature of Finnish metal factories is a high degree of integration.[18)] By-products of metal

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18) The first computer-controlled concentrator was developed in the 1970s. World's first fully computerized blast furnace control system was put to use in Finland.

refining are used in a number of other industries. Construction, the chemical industry, and pulp mills can use the waste products.

Competitive energy prices, thanks to efficient Finnish power plants and distribution systems, have allowed metal companies to adapt relatively energy-intensive production methods[18]. Also the role of logistics should not be underestimated - end products are often rather bulky.

4.3.6. A publicly controlled branch - but less so than in many other European countries

The Finnish government has had a notable impact on the development of the cluster. The metal industry was partially publicly financed after the Second World War, and ore prospecting, education, as well as research have been subsidized. Regional politics have had an influence on the location of production facilities.

The steel industry in particular has been considered strategic for both national competitiveness and defense. Sizable subsidies have been commonplace in the industrialized countries. The Finnish government has not excessively disturbed normal business activities by state intervention - this has helped companies to maintain their dynamism.

4.3.7. Conclusion: increased competition in bulk products emphasizes the importance of specialization

The Finnish base metal cluster has been transformed from an importer to an exporter of technology and knowledge. It has evolved from the factor-driven stage before the Second World War to the investment-driven stage during the first postwar decades, and it has at least partly entered the innovation-driven stage since the 1970s. Even though the cluster will maintain its significance in the Finnish economy, by international standards it is small, yet surprisingly versatile. The cluster is resource based, and therefore the basic factors of production are important. The depth of metallurgical and mining knowledge is the only unique advantage the

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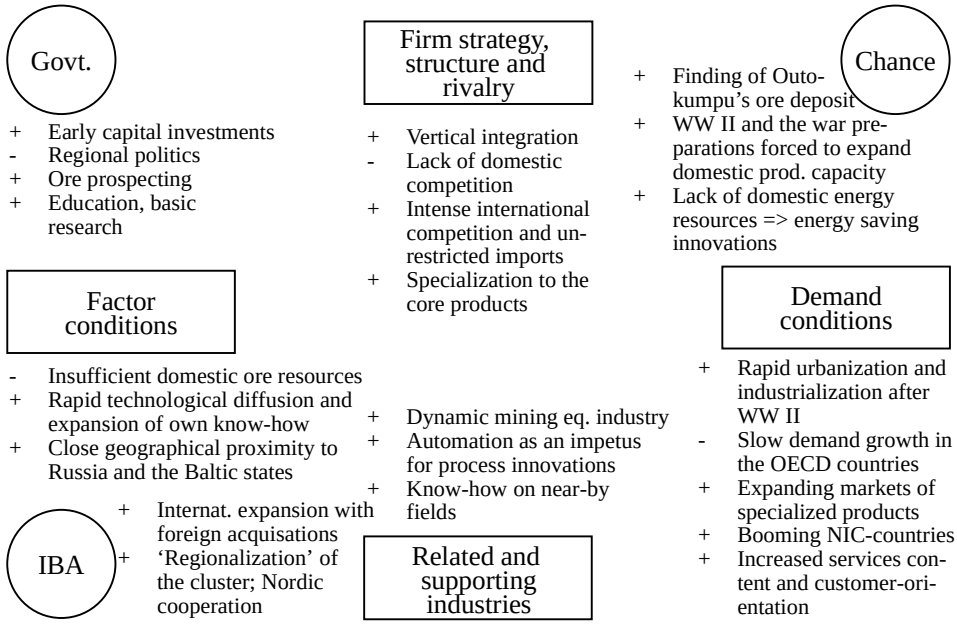
18) Some energy saving innovations were made in the Finnish metal industry. For instance in 1949 when Outokumpu's copper refinery was built, engineers had to solve the problem of limited energy availability. A strip casting method was developed enabling the capital and operating costs of casting and rolling to be cut by 75 per cent. A ton of Finnish steel is made with less energy than one in Sweden or Japan.

Finnish cluster has. The determinants of current competitiveness are summarized in figure 4.10 below.

Figure 4.10 Determinants of competitiveness in the Finnish base metal cluster



The end products of the cluster are typically not high technology, but the production methods used are rather advanced - the knowledge is embodied in the processes. The Finnish production control systems are sophisticated. Traditionally, Finnish managers have had engineering backgrounds and they have had a significant impact in improving the technology. The development of marketing, financing, and strategic skills have not quite kept up with the technological advances. Notable improvements, however, were made in the 1980s, partly due to incipient internationalization.

Finnish companies have been able to increase the value-added content of the products: non-ferrous metals are sold as semi-products, and iron in the form of specialty steels. Continuing this trend is vital to Finnish companies. This naturally provokes increasing intense R&D. Niche strategy is the key to technological leadership.

Most of the metal products are basic commodities, and markets are fairly stable. Knowledge of local customs and legislation give an advantage to

regional producers. Due to high transportation costs, neighboring countries are often the only possible export market. The base metal cluster is expected to grow slowly but steadily. The firms within the cluster are relatively competitive and profitable.

The future trends and challenges of the base metal cluster can be summarized as follows:

- Diminishing state intervention, especially in the European steel industry;

- Intensified competition in the low-end categories due to increased supply from the former communist bloc and developing countries;

- Technological progress will alter the production paradigms. For example, in the steel industry mini-mills using thin slab casting will gain market share due to better energy efficiency (lower costs) and greater flexibility.

- The globalization of the metal industry will accelerate. As the value-added content increases, exports will be profitable on a larger geographical area. This in turn puts greater requirements on logistics.

- Customers will demand increasingly customer-specific applications and product development. This is a challenge to the employees and can be a significant source of competitive strength.

4.4. The energy cluster - from scarcity to export of technology[18)]

The main clusters in Finland, forest and metal, are energy-intensive. This and the arctic climate, long distances and a low population density are behind Finland's high per capita energy consumption. Since Finland does not have domestic fossil fuel deposits, dependence on imported sources of energy is great. Thus Finns have been forced to search for low-cost and efficient means to produce energy. They have had success in their efforts; domestic energy prices have been extremely competitive.

The central powers in the development of the Finnish energy cluster have been utility companies and large-scale users of energy. Upon developing the Finnish power generation and distribution system, many unique technological solutions had to be made due to harsh conditions and quite limited financial resources. Domestic demand brought about Finnish equipment suppliers. Eventually Finnish energy technology entered the world market. The equipment used in energy production and distribution is identified as the center of the energy technology cluster. Figure 4.11 illustrates the basic structure of the field.

Unlike in some other countries, the demand for electric light and other electrical appliances was not the main driving force of technological development in Finland. It was the main industries, forest and metal, that set the strict requirements which power companies struggled to fulfill. Power producers turned to some domestic metal workshops to supply equipment. In the field of energy technology this cooperation to minimize energy expenditures brought about one of the most efficient and technologically progressive energy systems in the world.

4.4.1. Past and present: the industry's own generating capacity puts pressure on the power companies

In 1882 Finlayson's textile factory in Tampere started experimenting with electric light, the first firm to do so in the Nordic countries. By the turn of the century 10 cities had electricity distribution networks. The first high-voltage power line was laid in eastern Finland to fulfill the needs of a copper mine.

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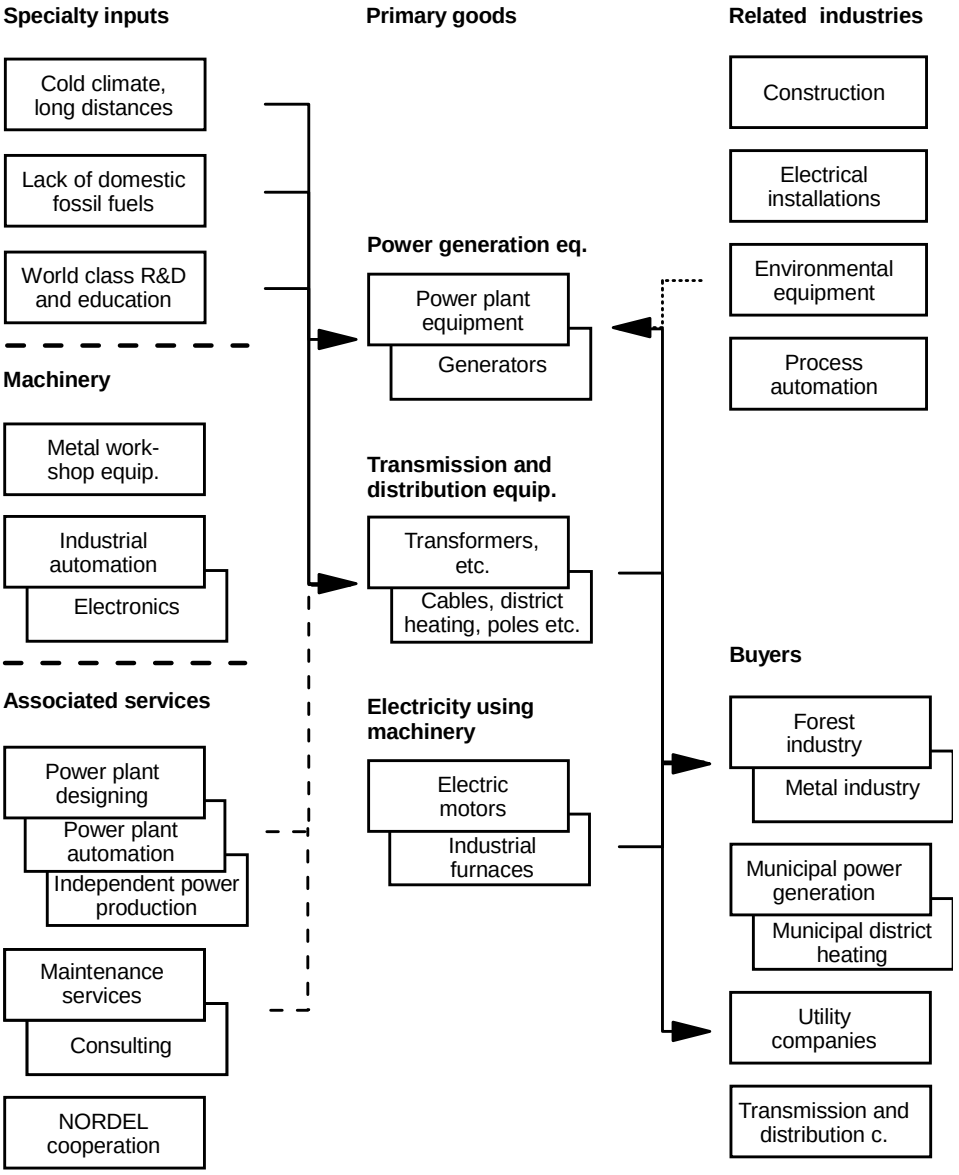
18) Follows P. Rouvinen, 1994, *From scarcity of energy to export of technology - competitiveness of energy cluster*, The Research Institute of the Finnish Economy, ETLA B 93 (in Finnish with English summary).

Figure 4.11 The Finnish energy cluster



The First World War was a breakthrough period for electric power in Finland. It brought about the demand to electrify the countryside. In 1920 the senate made a decision to build the biggest hydroelectric power plant in the country in Imatra (Eastern Finland). The Second World War was a severe hit to Finnish power generation. Along with part of its territory, Finland lost one-third of its hydroelectric generating capacity.

The Finnish pulp industry has a long tradition in energy production. As energy demand grew in the 1950s, the large-scale industry tried to maintain its self-sufficiency. Factories had their own hydroelectric plants, and pulp mills used back-pressure power to produce electricity.[18] By producing much of its own energy, the industry has been able to put pressure on the domestic power companies to keep energy prices competitive.

In the 1950s and 1960s factories started to use waste and excess warmth for district heating. This activity further expanded after the oil crises in the 1970s.

The first of the four Finnish nuclear power plants was started in 1977.[19] Since the last plants were put into use, nuclear power has been the main source of electric power in Finland, closely followed by both back-pressure and hydroelectric power. Industry uses about half of the electricity consumed.

The Finnish energy system is rather decentralized compared to its European counterparts (see figure 4.12). State, municipal, and private companies compete with each other. The biggest company is the state own *Imatran Voima* (*IVO*). The industry is fairly self-sufficient, covering 70% of its own power needs.

4.4.2. Energy markets: decreasing energy intensity with increasing total consumption

In the industrialized countries the need for primary energy is expected to grow by app. 2% annually until 2010. In the former communist bloc the total demand should remain roughly constant, whereas in the rest of the world total consumption increases by 4% per year. In the OECD countries energy intensity has been decreasing since the mid-1970s, and the rest of the world has been following the trend since the early 1990s (IEA 1993). The Far East Asian countries are the fastest growing single market.

[18] In the pulp mills, large quantities of low-pressure steam is needed. Rather than simply producing the needed steam, Finns use an alternative method. They produce high-pressure steam instead, and run it through a turbine to get electricity - in the process the pressure of the steam decreases, and it is ready to be used in the actual production process. Making low and high-pressure steam takes virtually the same amount of energy; therefore electricity is a ‘free’ side product of pulping. By using the back pressure power, the efficiency of energy usage is increased considerably.

[19] The operating factors of the Finnish nuclear power plants have been the best in the world - app. 90% (see Nuclear Engineering International, August 1991).

Figure 4.12 European electric power structures [18)]
National differences according to the degree of vertical integration, state ownership, geographical focus, and regulation.

Source: IVO communication services

The demand for technical energy equipment is generated by the need for new capacity. The market, however, is quite heterogeneous.

In the case of power generating equipment, the market is split. Old plants have to be remodeled to increase the energy efficiency and to meet new environmental requirements. New plants are built in the fast growing newly industrialized countries.

Since transmission and distribution networks in the industrialized countries are already built, main markets for this equipment are elsewhere; East Asia and the former communist bloc are the areas of growth.

The manufacturing of energy equipment has been one of the branches considered nationally strategic, and therefore it has been tightly controlled and protected in many of the industrialized countries. In Finland, however, domestic providers have felt the pressure of competition all along. Currently most of the previous restrictions in other European countries are removed, although the market is still far from perfectly competitive.

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18) According to *Kauppalehti* (19 July 1995), a daily business newspaper in Finland, there were 117 utility companies in the country in the beginning of 1995. The figure is estimated to drop to about 20 within the next few years due to market changes and further intensified competition.

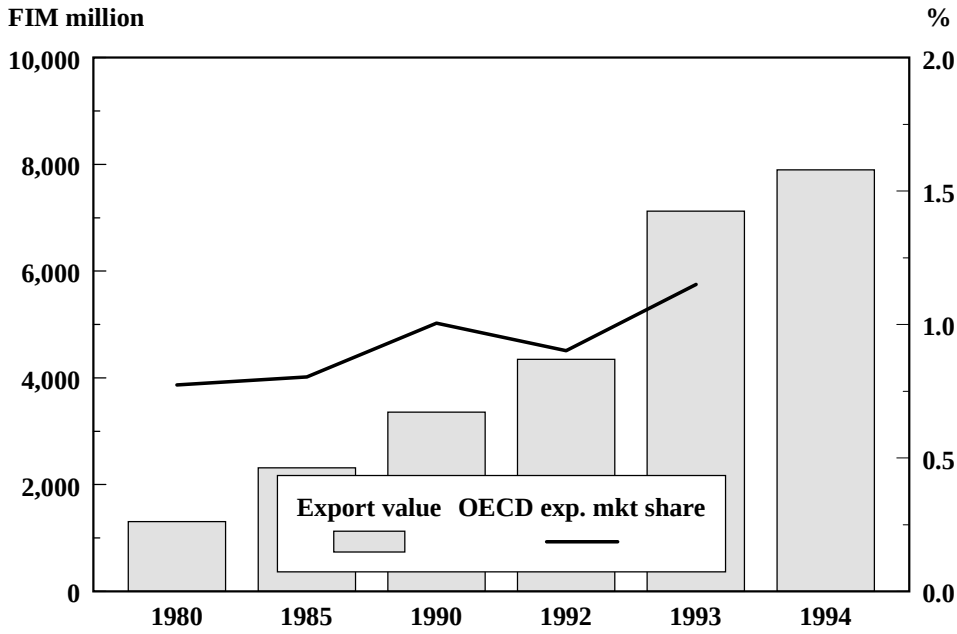
An additional restriction on exports has been the lack of international standards; technical specifications vary greatly from country to country, making it necessary to customize products for each nation.

The product cycles in energy technology are slow compared to, for instance, electronics. Once built, a plant is used for decades; the basic structures of a distribution network even longer. The customers in international markets are quite conservative; improved technologies have to be demonstrated a number of times before being accepted in the market place.

4.4.3. Global presence in various niche markets

In 1994 the exports of Finnish energy technology were about FIM 8 billion, accounting for over 5% of the Finnish exports. The Finnish share of OECD exports has remained at approximately 1%. Figure 4.13 illustrates the rather rapid growth of exports.

Figure 4.13 Exports of the Finnish energy cluster and its OECD export market share



Source: OECD, Board of Customs, ETLA

Diesel power plants, transformers, electric motors and generators, and boilers are among the most important products in terms of export value (see table 4.9). Cables are typically sold only in a geographically limited area due to significant transportation costs. Along with more traditional export countries, the Philippines, Thailand, Indonesia, and China are among the most important destinations.

The most important domestic companies (see table 4.10) in the field of power generating equipment are *Ahlstrom Pyropower*[18] (which has a 40% global market share in circulating fluidized boilers), *Tampella Power* (a 25-30% market share in recovery boilers), and *Wärtsilä Diesel* (a 20% market share in over 1 MW diesel power plants).

Nokia Cables and Machinery is the main domestic manufacturer of energy cables. *Ensto* has a selective line of transmission and distribution equipment (everything but the cables, transformers, and poles). The Finnish branch of *ABB* (originally *Strömberg*) produces a full line of equipment including transformers. *ABB Industry* and *ABB Motors* make electric motors, generators, and their controlling equipment. *Enermet*, a subsidiary of *Imatran Voima* (a state-owned power company), makes energy measuring and management systems.

Energy-related knowledge is a particularly promising form of export. The Imatran Voima conglomerate has various subsidiaries that have started to market knowledge gathered in the building and maintenance of the Finnish energy system. The *Jaakko Pöyry Group* and *Ekono Energy* are internationally recognized consultants in the field of energy as well. Automation systems are marketed by *TT-Carelcomp*, *Dativo*, and *Valmet Automation*.

[18] *Ahlstrom Pyropower* was recently sold to American *Foster Wheeler*.

Table 4.9 The main export products of the energy technology cluster

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 Diesel generating sets	10.6	1450	0.94	55
2 Static converters	4.3	1121	0.73	33
3 AC motors (over 37.5W)	3.6	818	0.53	29
4 Electric accumulators	0.9	381	0.25	46
5 Steam and other vapor boilers	10.7	309	0.20	32
6 Ballasts for discharge lamps	11.2	284	0.18	16
7 Insulated conductors for 80-1000V	1.3	260	0.17	7
8 Relays	1.5	257	0.17	26
9 Electricity distrib. boards, <1000V	0.9	251	0.16	14
10 Parts for rotating electric machinery	1.6	211	0.14	31
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 Power capacitors	12.7	76	0.05	14
2 Ballasts for discharge lamps	11.2	284	0.18	16
3 Steam and other vapor boilers	10.7	309	0.20	32
4 Diesel generating sets	10.6	1450	0.94	55
5 Super-heated water boilers	5.5	16	0.01	120
6 Electricity meters	4.9	62	0.04	33
7 Static converters	4.3	1121	0.73	33
8 Distilling and rectifying equipment	3.8	50	0.03	9
9 AC motors exceeding 37.5W	3.6	818	0.53	29
10 Parts for steam boilers	3.5	179	0.12	9
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of exports in OECD**	
1 Japan	6.0		20.2	
2 Austria	5.9		2.2	
3 Switzerland	5.9		3.6	
4 Portugal	5.8		0.8	
5 Finland	5.2		1.1	
6 Germany	5.1		17.6	
7 USA	4.7		18.5	
8 France	4.4		9.0	
9 Sweden	4.1		1.8	
10 Great Britain	4.1		6.5	

Source: OECD, Board of Customs, ETLA

Table 4.10 Some of the companies in the Finnish energy cluster

Company	Products and services	Net sales, MFIM	Person-nel	Foreign net sales, %
Energy production equipment				
Wärtsilä Diesel	Power plant engines	6687	6126	over 80
ABB	Power plants, transmission and distribution	6291	7971	47
Ahlström Machinery	Equipment and systems for the pulp and paper industry	4200	4400	na
Ahlström Pyropower	Power plant boilers and services	1200	1500	na
Tampella Power	Chemical recovery and power boilers	1156	1488	over 60
Neste Advanced Power Systems	Solar and wind power systems	54	112	na
Energy transmission equipment and systems				
Nokia Cables and Machinery	Cables, cable machinery	4768	4560	80
Ensto Distribution	Accessories for distribution and transmission	424	516	85
Enermet	Electric energy meters, energy metering and control systems	177	317	62
Services for the energy cluster				
IVO International	Energy production system plan-ning, consulting and construction	1811	1507	app. 55
Valmet Automation	Process and energy industry automation systems	1023	1560	73
Gasum (former Neste Natural Gas Unit)	Natural gas imports, sales, and transmission	827	126	-
IVO Voimansiirto	IVO's trunk network construc-tion and energy transmission services	776	259	-
Vapo (Fuel Peat Division)	Fuel peat	733	415	8
TT-Carelcomp	Power plant data systems	224	462	na
Dativo	ADP systems for power plants	55	117	na

Box 4.6 A shift from forest products to advanced machinery and equipment - The case of Ahlstrom Pyropower

In the early 1900s Ahlstrom manufactured boilers for inland waterway ships. The accumulated knowledge was later used to manufacture recovery boilers for the forest industry. The breakthrough in power plant boilers came in the 1970s, when circulating fluidized bed (CFB) technology was developed in Ahlstrom's R&D department in Karhula (Eastern Finland).

The American firm Foster-Wheeler was a leading manufacturer of competing technology, the bubbling floating bed (BFB). In 1976 it supplied a 125 MW plant, which never functioned quite as it should have (it was used only for 500 hours). In 1975 Ahlstrom started to develop CFB while others were still working on BFB. In 1978 the first 'demo' plant (5 MW) was sold. The plant size grew progressively and Ahlstrom became the leading company in the CFB segment. By mid-1993 it had manufactured 42.5% of the operating CFB boilers in the world.

In the 1980s Ahlstrom Pyropower's internationalization had reached a stage where it was necessary to move its headquarters nearer to its customers - San Diego (USA). In the spring of 1995 Pyropower was sold to Foster Wheeler; The Ahlstrom corporation decided to focus its expertise in forest industry machinery and special products.

4.4.4. Harsh conditions necessitate innovation

As the Finnish energy system was built up (mainly after the Second World War), the country lacked sufficient knowledge. The learning process, however, was quick, and considerable human capital was created. Since the Finnish energy sector is relatively small, the professionals in the field form a tightly knit network. This, along with a rather high quality initial engineering education, has formed the knowledge pool upon which the current success is built.

Selective disadvantages - the arctic climate, low population density, and lack of domestic energy resources - forced Finns to innovate: currently Finland is the world leader in the combined production of electricity and heat[18)], industrial waste is widely used as a source of energy[19)], and Finnish power plants are among the most efficient in the world.

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18) This joint production is estimated to save 10% of the entire country's primary energy need.

19) The energy usage of industrial waste has also brought about export products; e.g. research made to use black liquor, a by-product of a pulp mill, as an energy source, was the impetus behind the currently quite successful recovery boiler technology.

4.4.5. Open-minded Nordic customers as a source of competitive advantage

Domestic demand for energy technology has been sophisticated; Finnish power companies and industrial firms have not been satisfied with standard solutions; they have demanded more cost-effective, yet reliable, alternatives.

The buyers of energy technology are risk-averse; few are willing to take chances with the latest technology, even if its advantages are obvious. The Scandinavian customers have been quite interested in new technologies and willing to apply them. In the Nordic countries the life-cycle cost of a power plant is optimized; this typically means that the initial price of a plant is a bit higher, but unit cost of energy production lower.

The role of earlier references is important in energy equipment; customers make sure that the providers have a history of manufacturing well-functioning machinery. Quality is by far the strongest selling argument.

4.4.6. Finland has been a more competitive market than the rest of the European countries

Most Finnish producers of energy technology lack domestic competition. Luckily the importation of equipment has been unrestrained; foreign competition has been active.

The dynamism gained is needed especially in the new environment. Earlier, the customers were mainly public or regional monopolies. Now governments are liberating the energy market. Part of the new approach is that each power plant may be a separate entity owned by a diverse group of private investors. It is often required, that the provider of the power plant not only builds the facility but also participates as one of the owners.

4.4.7. A company needs access to a global distribution network

Many of the Finnish companies have tried to build up a network in order to be present globally. This may, however, be too costly to anyone but the largest firms, as seen in the case of *Strömberg*. Almost since merging with ABB, Strömberg has been profitable. Even as a separate company it had a sufficient technological base, but maintaining its own distribution

network was too costly. After the acquisition, Strömberg gained access to ABB's global network and could concentrate on what it does best - manufacture advanced electrical equipment.

Wärtsilä Diesel has a well-functioning network of daughter companies. Currently it has production facilities in Holland, France, Sweden, and India.

The German firm *Steinmüller* owns 40% of Tampella Power. A Swedish power company, *Vattenfall*, is a co-owner of Tampella's daughter company, *Enviropower*.

In the 1980s Ahlstrom Pyropower's internationalization reached a phase, where it was considered advantageous to move the headquarters nearer the customer, to San Diego (USA). In the spring of 1995 it was acquired by an American company, *Foster Wheeler*. Most of the R&D and manufacturing of the most demanding products takes place, nevertheless, in Finland.

In recent years, Imatran Voima and its subsidiaries have expanded their international activities.

4.4.8. Conclusion: from scarcity of energy to export of technology

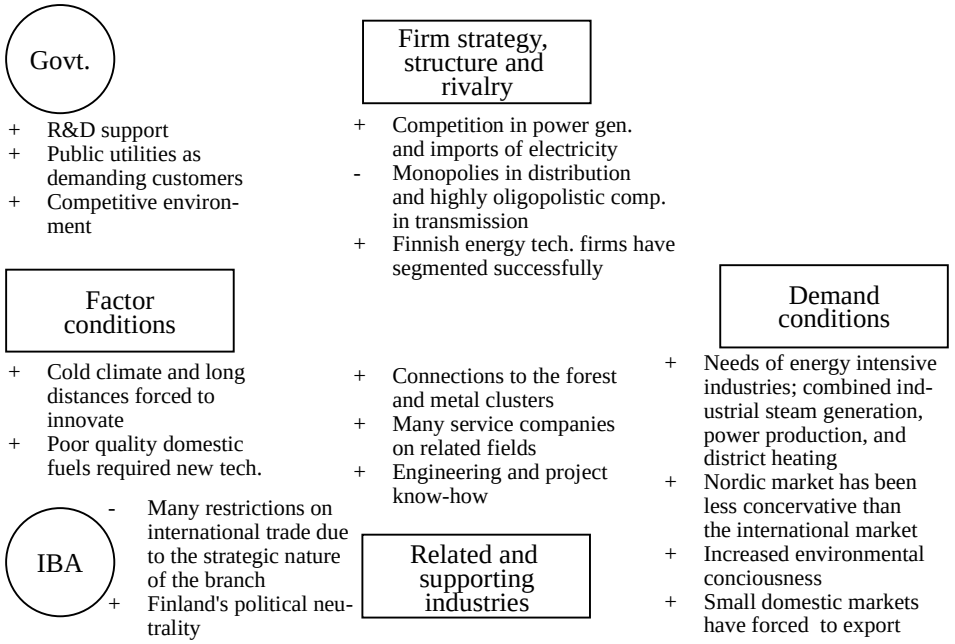
Finnish energy technology is an example of fast technological adaptation, diffusion, and eventually innovation. The cluster is relatively young. Early this century most equipment was imported. Then domestic manufactures were made under a foreign license, and not until the 1970s were there significant exports based on domestic R&D. Exports of the energy technology cluster are expected to grow by close to 10% annually during the next few years. The features of the industrial diamond are summarized in the figure 4.14 below.

The innovation level of Finnish energy technology has consistently increased. Research is done by private enterprises, universities, and laboratories. Industrial organizations and public authorities have supported the development of the cluster.

The changes in the former communist bloc may have favorable effects on Finnish suppliers. Energy systems in most of these countries are in serious need of remodeling to meet Western efficiency and environmental

standards. Many central European companies have acquired energy technology companies from these countries. In the long run this might make some markets even more oligopolistic (e.g., turbines).

Figure 4.14 Determinants of competitiveness in the Finnish energy cluster



The future trends and challenges are:

- *Increasingly conscious end-consumers*. End consumers are more aware of what kind of products they use; it is not only a matter of how expensive the energy is - environmental and social issues are also considered.

- *Increased business risk*. Hardened competition, the unpredictability of future energy consumption, and expected technological revolutions (solar energy, renewable resources, fuel cells, etc.) will increase business risk.

- *Preserving the environment*. Some energy forms are considered especially harmful, and nowadays the environmental effects of a power plant should be considered throughout the life-cycle of the plant.

- *R&D intensity*. The world is currently in the search of new energy sources and more efficient ways to use the existing ones. While many new technologies seem promising, there have not been clear breakthroughs. The costs of developing new solutions are getting higher and higher. Only the first marketer of a new technology is rewarded, and therefore the risk of wasting valuable research money is high.

- *Alliances*. The average size of a company will increase. Global manufacturers, such as ABB, are able to take a full advantage of the economies of scale and to be extremely price-competitive. If independent power production concept (IPP) becomes common, equipment manufacturers and power companies may form coalitions to compete in this market.

4.5. The telecommunications cluster - an obsession for success[32)]

The telecommunications cluster is the fastest growing cluster in Finland. It is the first significant Finnish cluster in which the importance of raw materials is secondary, and knowledge plays a central role. Furthermore, efficient telecommunications services are essential to the improvement of other clusters' performance.

The key components of the telecommunications cluster are the telecommunications equipment industry, operation, and value-added network services (VANS) (see figure 4.15). The main products of *the telecommunications equipment industry* are switching and transmission systems, terminals, data communications and mobile communications equipment. *Operation* involves planning, construction, and maintenance of networks, as well as the running of telephony and data services therein. *VANS*, in turn, utilizes operator services as inputs.

The cluster is an important customer for many specialty input suppliers, such as electronics and semiconductor manufacturers, and outside contractors. The most important *associated services* to the telecommunications sector are provided by the education and research sectors. VANS combine telecommunications technology and information from countless service sectors to provide value added to the telecommunications network services. The importance of VANS and the so called 'content provision' is going to exceed the value of basic network services (voice telephony and simple data transmission) in the near future.

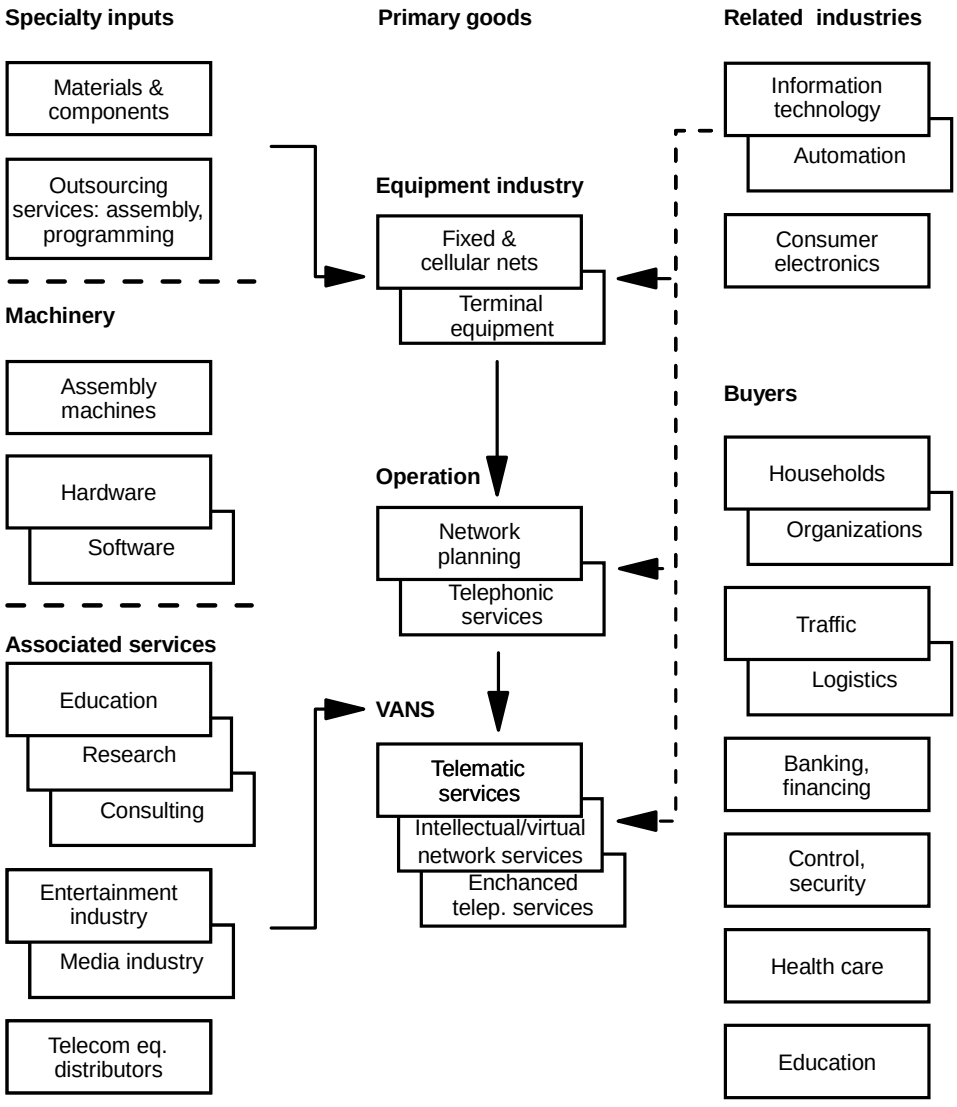
From a pioneering user of telecommunications technology Finland has succeeded in becoming a forerunner in the development and production of telecommunications technology. Behind this evolution there is a long history of competition, rational strategy choices, as well as extensive R&D.

Moreover, the sustained interaction between government, telecommunications operators, and the equipment industry has formed the backbone for today's telecommunications cluster. This interaction has been further intensified by open competition between operators, and between Finnish

32) The original manuscript for this chapter was provided by L. Paija. Follows mainly K. Mäenpää and S. Luukkainen, 1994, *From Telecommunications Technology to Multimedia Communication - the Competitiveness of the Telecommunications Cluster*, The Research Institute of the Finnish Economy, ETLA B 96 (in Finnish with English summary).

and foreign equipment providers. As a result, the Finnish telecommunications industry has attained a leading position in one of the fastest growing industries.

Figure 4.15 The Finnish telecommunications cluster



Box 4.7 Early and progressive adaptation of telecommunications

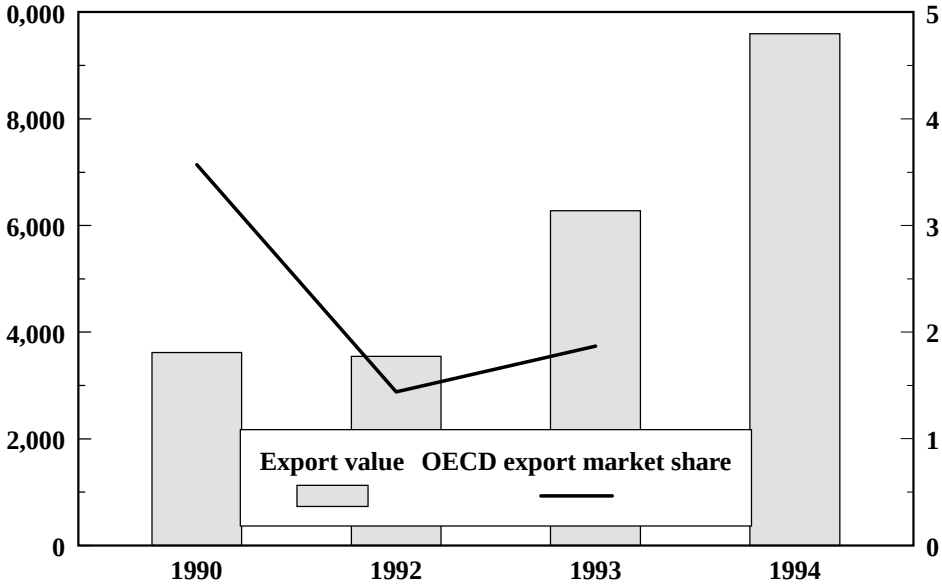
The Finns have been zealous adopters of telecommunication technology from the outset. It was hardly a year after the invention of the telephone when it was already tested in Finland. Six years later the first national telephone company was founded. Network operators have aimed at rapid adaptation of latest technology thus challenging the equipment industry throughout the history.

At the time when Finland was laying the foundation for its developed and extensive telecommunications industry it was a Russian Grand Duchy. The Tsar favored the telegraphic network for military purposes and neglected telephony services, and thus, the Finnish Senate was authorized to grant licenses in telephony operation. In the 1930s, the number of private telephone companies reached 815 (46 in 1995). The Finnish state had understood the importance of the telephone as a utility of general usefulness and intended to nationalize the industry, but these plans were rejected by the Parliament. Thus, unlike in many other countries, the Finnish telecommunications market is divided between the public and private operators. However, competition in telephony services was fully liberalized no earlier than in 1994.

4.5.1. Nokia is the dominant domestic player

Total *net sales* of the Finnish telecommunications cluster were FIM 24 billion in 1994, of which operation accounted for 10 billion and the equipment industry for 14 billion. Equipment industry exports were 10 billion.

Figure 4.16 Exports of the Finnish telecommunications cluster and its OECD export market share



Source: OECD, Board of Customs, ETLA

The bestsellers in the Finnish telecommunications equipment exports are mobile network systems, mobile phones, and associated equipment. Moreover, specialized equipment and systems for, for example, health care, banking, and energy production and transfer are produced.

The driving force behind the rapid development and international success of the Finnish telecommunications equipment industry is the free market. Domestic manufacturers have not been sheltered from foreign competition. Additionally, Finnish operators have been exacting and progressive customers, demanding technology that has anticipated future telecommunications demand globally. Moreover, the high number of independent operators has guaranteed demand for several suppliers unlike in many other countries where the monopolist carrier has had a 'purveyor' in network and equipment provision.

Box 4.8 *Nokia* - the engine of the telecommunications equipment industry

In international comparison, *Nokia* is the only Finnish telecommunications manufacturer of significance. In 1992 it was 17th biggest manufacturer in the world. The largest units, Nokia Telecommunications and Nokia Mobile Telephone, account for 70 percent of the net sales. Nokia General Communications concentrates on interactive household electronics and is poised to attack the multimedia market. This new division will sharpen the Group's image as a comprehensive telecommunications company. The basic strategy of the company is to take swift advantage of changes in the industry and to be present in all of the leading markets.

Nokia Telecommunications is a global leader in the development and production of mobile and fixed network systems. The products are delivered to some 50 countries. Nokia Mobile Phones, in turn, specializes in mobile phones that are sold in some 100 countries. Nokia is the world's second largest manufacturer of mobile phones after *Motorola* (USA). Although the main production and R&D activities have been maintained in Finland, the divisions have production units in Europe, the USA, Australia, and the Far East.

Box 4.9 *Benefon* - a small but strong ally of Nokia

In 1987, a top manager with Nokia, Mr. Jorma Nieminen, with 12 colleagues, left the company to set up a new mobile phone company specializing in NMT 450 standard. In the shadow of Nokia, the company has been able to conquer more than 20% of the world's NMT 450 market, being the second only to Nokia.

By targeting on niche areas and differentiating on high-quality phones with sophisticated design, *Benefon* has been able to avoid price competition, and has an operating margin higher than competitors. The backbone of the company's success has been its strong position in the East European markets where the analogue standard has been popular for its lower price. The company has exceeded its targets by achieving a 30% yearly growth rate, and FIM 304 million in revenues in 1994.

Table 4.11 The main export products of the telecommunications cluster

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 Mobile phones	5.7	4481	2.91	61
2 Cellular and fixed network systems	6.7	1767	1.15	34
3 Parts for cellular telecom equipment	1.5	1413	0.92	24
4 Parts for line telecom equipment	1.2	1087	0.71	50
5 Telephonic switching apparatus	1.6	291	0.19	-24
6 Cables for telecom systems	0.8	206	0.13	10
7 Modulators for carrier-current lines	0.5	98	0.06	-24
8 Optic fiber cables	2.3	52	0.03	102
9 Radio transmission apparatus	0.4	46	0.03	8
10 Enclosed loudspeakers	0.4	34	0.02	22
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 Cellular and fixed network systems	6.7	1767	1.15	34
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6 Parts for line telecom equipment	1.2	1087	0.71	50
7 Electrical traffic control equipment	1.1	12	0.01	18
8 Parts of elec. traffic control equipm.	1.1	19	0.01	7
9 Cables for telecom systems	0.8	206	0.13	10
10 Modulators for carrier-current lines	0.5	98	0.06	-24
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of exports in OECD**	
1 Sweden	6.7		5.3	
2 Japan	5.2		31.1	
3 Finland	4.7		1.9	
4 USA	2.9		20.8	
5 Great Britain	2.2		6.4	
6 Ireland	1.8		0.8	
7 Denmark	1.8		1.0	
8 Canada	1.7		3.7	
9 Portugal	1.6		0.4	
10 Spain	1.6		1.7	

Source: : OECD, Board of Customs, ETLA

Table 4.12 Some of the companies in the Finnish telecommunications cluster

Company	Products and services	Net sales, MFIM	Personnel	Foreign net sales, %
Nokia Group	Mobile and fixed network systems, mobile phones, cables	30177	28593	89
Telecom	Fixed and mobile network operation	4927	6341	-
48 local operators, (incl. HTC)	Local operation	4193	8276	-
Helsinki Telephone Co.	Local operation	1711	3341	-
Martis	Transmission and cross-connection systems	395	252	na
Teleste	Cable TV operator systems, PABX	390	704	83
GWS Perlos	Electronics and plastics components for mobile phones	334	684	52
Benefon	NMT phones	304	222	85
Kaukoverkko Ysi	Long-distance operation	240	6	-
Tecnomen	Paging and voice messaging systems, industrial data collection systems	125	166	91
Datatie	Data transmission services	121	28	-
Radiolinja	Mobile operation	76	54	-
Elektrobit	Electronics systems	71	75	40
Comptel	Telecom software, network management systems	61	112	10
Solitra	High frequency filters	46	103	43
Omnitele	Consultance	26	32	24
Sondi	Health care systems, public phones	26	38	-
Telivo	Long-distance and international operation	23	9	-
Telecon	Consultance	14	22	99
Satel	Radio modems	13	16	70
Bitfield	Video conference equipment	12	13	94
VistaCom	Video conference equipment	11	20	98

There are also several Finnish industrial companies specialized in advanced telecommunications equipment, such as *Martis* (transmission and cross-connecting equipment, network management systems), *Tecnomen* (paging and voice messaging systems), *Sondi* (public telephones and health care systems), *Teleste* (private branch exchanges, integrated

systems for hospital, school, and ship communications), *Bitfield* and *VistaCom* (videoconferencing systems).

Telecom versus private operators in network competition

Of the 48 telecommunications carriers, state-owned *Telecom Finland* is the peerless leader with its FIM 5 billion turnover in 1994. The biggest private operator is *Helsinki Telephone Company* attaining FIM 1.7 billion net sales in the same year. Other operators accrued some FIM 2.5 billion in total. In view of the liberalization of all network operation in 1994, Telecom and the *Finnet Group* (a consortium of private local operators) founded companies to compete in long-distance, international, and mobile telephony services. In addition, *Telivo*, a subsidiary of the national power producer *Imatran Voima*, utilizes the parent's trunk lines in providing telecommunications services.

In telecommunications consulting, Telecom's *Telecon* and the Finnet Group's *Omnitele* are presently the leaders, while traditional consultants and new entrepreneurs are entering the market in increasing numbers.

By international standards, the Finnish operators' foreign operations are modest. The telecommunications equipment industry, by contrast, depends heavily on foreign markets; 76% of the production was exported in 1994, and the share is expected to rise. The prospects for success in the international telecommunications markets are exceptionally promising as the number of mobile phones alone is expected to reach 250 million, which is ten times as many as there were in 1993. The internationalization of the Finnish telecommunications equipment industry has been much faster than in other domestic industrial sectors.

Presence in the expanding global market

The following factors are likely to fuel global demand:

- In developed countries, the demand for mobile communications systems continues to grow remarkably.

- Those economies in transition are investing heavily in telecommunications infrastructure. Investment decisions often combine fixed and mobile networks, which creates challenging new opportunities for technical applications.

- In the rapidly developing countries of the Far East, the telephone has only begun to be implemented on a mass scale. In China alone, the market will consist of some 250 million subscriptions when the penetration rate attains that of the industrialized world.

4.5.2. Demanding conditions and know-how as sources of competitive strength

The bases for competitiveness of the Finnish telecommunications cluster have been demanding geographical conditions, a widely scattered population and rigorous environmental conditions. These can be regarded as selective disadvantages that have challenged both the telecommunications operation and the equipment industry. However, more important determinants for the improvement of competitiveness have been advanced factors, e.g. high-grade education and R&D that are behind the phenomenal growth of the cluster.

Box 4.10 Great demands on technology

Owing to Finland's scattered settlement over wide geographic distances, applied telecommunications systems must be economical and reliable. The difficult physical conditions gave a spur to the development of the first exchanges in the world that were designed especially for small population centers. This innovation has found vivid demand particularly in developing, and in the Eastern and Middle European countries.

Exacting conditions - a cold climate, varying landscape, large numbers of waterways, extensive forest areas, etc. - have given rise to some innovations as well. For example, to improve the quality of circuit lines, production of coated cable was started as early as in the 1920s. The rapid progress in the development of radio technology is also due largely to the conditions of the Finnish landscape; in remote areas radio links have been preferred to fixed networks.

Risky investments in R&D are bearing fruit

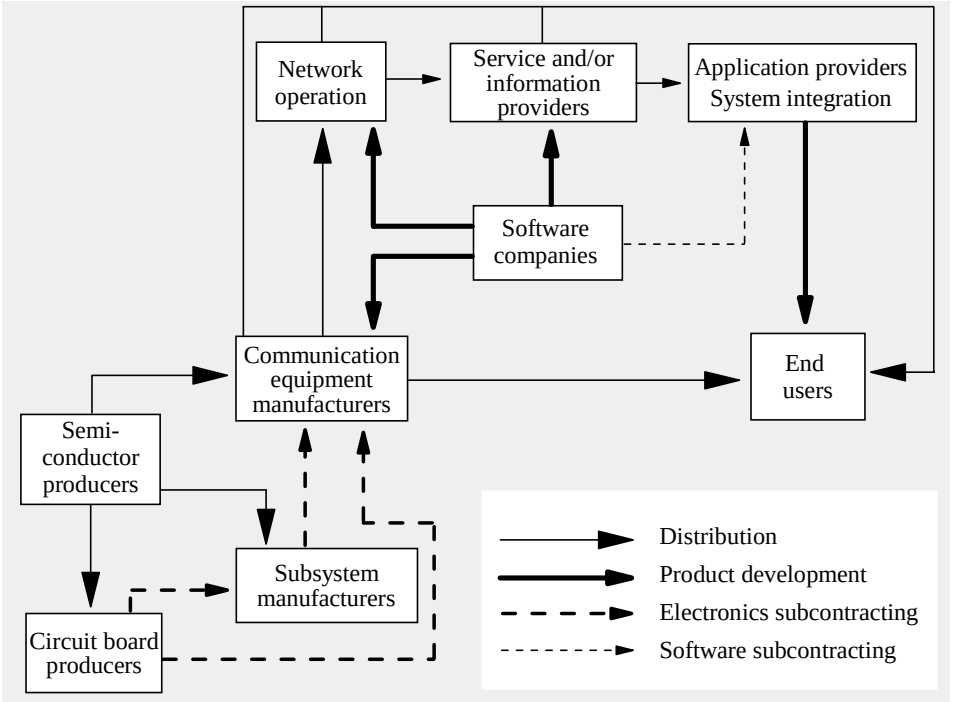
Public investments in the industry have been remarkable. TEKES, a state-owned fund for technical development, has focused on telecommunications technology in the recent years, granting funds to the industry disproportionately to its relative industrial importance. Universities and other public organizations have directed notable resources to the industry as well. Nokia's investments in R&D have consumed some 6% of yearly net sales. Without minimizing Nokia's and other telecommunications companies' contributions, it can be stated that without public support a comparable progress would have been improbable as investment in R&D is costly and risky, and spillovers to competitors are difficult to prevent.

Advanced subcontractors as input providers

Intensifying competition in the global telecommunications equipment market and operation has made outsourcing an increasingly important means of improving competitiveness, enabling organizations to concentrate on their strategic core.

Around the telecommunications equipment industry, there has developed a group of subcontractors providing the industry with advanced specialty inputs, and highly customized contract manufacturing. *Elcoteq*, *Kyrel*, *Aspocomp*, *LK-Products*, *Elektrobit*, and *GWS Perlos* are examples of such subcontractors. The boom in the telecommunications equipment industry has greatly benefited this sector by stimulating, for example, the electronics and electrical industries which have become some of the main manufacturing industries in Finland. However, the share of imported components is considerable as there is a range of components are not yet produced domestically.

Figure 4.17 The value-adding chain of the telecommunications cluster



Nevertheless, innovative information technology applications make up a typical example of strategic key products of the telecommunications equipment manufacturers, whose development and production are not externalized, while less significant software production and physical input manufacturing are more easily outsourced.

Chronic shortage of qualified employees

An important, created input is qualified labor. In the telecommunications cluster, the role of engineering is significant; the share of white collar workers' salaries of the total cost of the cluster was 12% already in 1989, being threefold compared to the percentage in the pulp and paper industry. The number of technicians and other blue-collar workers has been in a steady decline at the expense of more educated white-collars.

In Finland, education in telecommunications technology is given in four universities and in 13 vocational and professional educational institutes. Moreover, the industry, with Nokia as a prime example, provides its employees with a substantial variety of courses in telecommunications technology.

The level of education is good, but the number of new telecommunications graduates, engineers, and technicians lags severely behind the actual needs of the industry. The industry has taken actions to influence the education sector, and consequently, the number of yearly accepted new students in the telecommunications field of study has been augmented.

The lack of competent labor has not been acute only in the equipment industry and operation, but also in the telecommunications education sector and research. This has forced the industry to move R&D activities abroad, though the management and the core functions have been maintained in Finland.

Employment in equipment production explodes

In 1994, there were some 11,600 employees in the telecommunications equipment industry. The expansion in the employment level has been remarkable (114% between 1987 and 1994) despite the harsh recession of the early 1990s. The growth estimate for 1995 has been set at 30%. The majority of the work is in assembly and other technical work, but the share of high-technology work is on the rise as production processes are

being automated, and personnel in R&D are being increased. Personnel at the operational level need to be added as well since the demand for equipment is on a constant rise.

Direct operator employment totaled some 14,700 in 1994, and it has been in a continuous fall owing to technical progress and the opening of competition. Excess capacity has emerged especially in traditionally low-skill technical jobs. For example, digitalization has made manual switching obsolete, and the relative importance of maintenance personnel and line workers in operator employment has decreased. Just as in the equipment industry, the need for highly-skilled labor is increasingly important. New VANS often require only the re-programming of equipment. Moreover, telecommunications operation is changing from a technical to a customer-oriented business, and operators need to redirect human resources into customer service. This new direction in development is giving rise to an entirely new information technology (IT) industry providing services to the operation sector.

4.5.3. Fortunate to have a progressive and experimenting clientele

The clientele of the telecommunications cluster is composed of clearly separate groups. For operation, they consist of private customers and organizations, as well as application sectors. One of the fastest growing customer groups is that of service providers (VANS) that buy network capacity as input. The amount of chargeable service numbers (enhanced network service) and telephone-utilizing service systems is expanding constantly.

The equipment industry, in turn, sells to both operators and their customers. Operators are provided with investment goods and related advanced services. Since the liberalization of terminal equipment provision (1987) and the increasing popularity of mobile phones, the telecommunications equipment industry is becoming an important consumer product industry.

Test field for new technology

Finland has been an exceptional market area for the telecommunications equipment industry for its numerous operators and equipment suppliers. A corresponding market structure can been found only in the United States.

The Finnish equipment market has been open to both foreign and domestic manufacturers to test new applications in a small, anticipatory, and demanding market. Risk taking has been less costly or image-damaging for suppliers in a small, multi-operator market than in a monopoly market. Exacting Finnish operators have supported manufacturers' R&D activities with their own. Successful performance in the Finnish market has served as a good reference in international markets.

The size of the Finnish market is small. Nevertheless, the level of telecommunications investment is relatively high due to long distances, high penetration, and parallel networks induced by competition. In international comparison, domestic market growth is still fast, and the saturation level is not yet in view.

Instead of buying equipment from separate suppliers, as in the past, Finnish operators acquire a whole telecommunications system. The supplier is also often responsible for the functioning and maintenance of the network. The carrier concentrates on the operation of the network and on defining the product range and its marketing. It is the competition in telecommunications that has made operators to focus on critical customer orientation - and has lead to an externalizing of the traditional operator's duties. As the European telecommunications market will open up in 1998, this redefinition of roles is likely to spread over the European continent.

The changing relation between producer and customer

The telecommunications industry is exceptional in that customers are rarely able to define precise requirements for new products. Product innovators in the telecommunications technology bear great risk. They need to foresee their customers' future needs years before the introduction of a product because development of an innovation is time consuming.

On the other hand, as soon as consumers realize the possibilities of new products, they may be able to announce progressive requirements to the manufacturer, and are usually willing to test equipment with new characteristics. The high level of education has made the Finns open-minded customers who are willing to experiment.

4.5.4. Telecommunications is converging to supporting information technology

The most important related and support industries of the Finnish telecommunications cluster are research, education, and IT industry.

The domestic telecommunications equipment industry has achieved its best results by the swift implementation of new technology. The role of competent research is crucial because of the fast progress of the industry. Nokia, for instance, has chosen the role of a forerunner in global markets. Extra pressure comes from operators that are delegating their research activities to the equipment industry.

Telecommunications and IT are strongly converging. Network management and intelligent operation, as well as new network services call for remote file sharing. Also, customer management and invoicing require a good deal of information technology. Telecommunications devices, in turn, are distinguished by IT applications; the characteristics of physically similar terminals may differ significantly depending on the embedded applications inside the device.

4.5.5. The Finnish telecommunications cluster - a pioneer in competition

The structure of the Finnish telecommunications market has been quite exceptional from the beginning; unlike in many other countries, private telephone companies have been granted license to operate in their concession areas. Even though local operators did not have statutory, exclusive operating rights in their concession areas, in practice they had local monopoly status until full liberalization in 1994. In local operation, *Telecom* has been responsible for areas not served by private companies. The national trunk network, in turn, was the monopoly of Telecom until 1994. In mobile communications, GSM services are provided by Telecom and *Radiolinja* (owned by the Finnet Group), while NMT network is the monopoly of Telecom.

The great number of operators has supported the development of the cluster in many ways. Despite the monopoly status of local carriers, private owners have been able to control local service prices and quality levels through comparisons between other operators. Telecommunications technology and knowledge were greatly improved by the demanding task of

combining technically incompatible local networks into a nationwide network. The plurality of carriers has also sustained the emergence of many equipment providers, which in turn has stimulated technical innovation in the equipment industry. In addition, the Finnish equipment industry has had to struggle against foreign competition as operators' investments have been open to international bid offers[32].

Technical progress encourages gradual liberalization of competition

The process of liberalization of telecommunications competition had its initial stimulus from the outdated telecommunications legislation, dating from 1886, that could no longer shelter the public operator's monopoly rights in new services like telefax and data transmission. As a consequence, in 1985 private operators with their major business customers founded *Datatie* to construct and operate nation-wide data transmission network. This was a historical event as the network was the first to be constructed parallel to the state-owned trunk network.

Since then, the telecommunications market has been gradually opened to full competition, and the level of telecommunications competition in Finland is among the highest in the world, which has, together with advanced technology, made Finland practically the cheapest country for a telecommunications user. However, in the absence of new economical technology and number transferability, competition in local telephony has had a sluggish start, which has impeded the fall of local prices to the same extent as those of trunk telephony and data services. In mobile services, price structures between the competitors are very heterogeneous, and competition seems to have stimulated the fast introduction of advanced network services rather than substantial price cuts.

4.5.6. Government as a 'stand-in' customer

The role of public operations has been multiple and important in the development of the telecommunications industry. The activities of the public *Posts and Telecommunications* (PT) expanded soon to R&D and equipment production. Gradually, state-owned manufacturing ended up strengthening Nokia's position.

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32) For example, Telecom's mobile network systems have been supplied by Nokia as well as by Ericsson and Siemens.

Mobile communications were initiated by operations in the public sector. The development of radio technology began in 1963 when the Finnish Army ordered a prototype for a small radio telephone from Nokia and two other private companies. Finally, as the Army did not retain the innovation, the industry started to launch radio telephones to civil markets.

In 1966, the responsibility for the planning, construction, and operation of the first mobile phone system was granted to PT. Technical specifications were prescribed public so that mobile terminal production and distribution were free from the outset. Three manufacturers (*Televa, Salora*, and *AGA*) developed the first equipment that was brought to the market. The final breakthrough in the mobile phone industry was the Nordic joint venture in the development of the NMT (Nordic Mobile Telephone) standard.

The above example illustrates the state's important role as a 'stand-in customer' in an innovative industry like telecommunications. The NMT standard would hardly have been created from private customers' or even an equipment manufacturer's initiative.

The Government has shown open-mindedness in its gradual but comparatively fast liberalization of the telecommunications market, which was completed in 1994 by the opening of all network operation. First, with the state's demanding commissions, cooperation in standard specification, and risk financing, the equipment industry has been given incentive to develop technology. Second, contrary to many other foreign telecommunications markets, the Finnish Government has always supported a certain level of competition in both operation and the equipment industry.

4.5.7. Conclusion: from telecommunications technology to multimedia

It is probable that the telecommunications cluster will become one of the cornerstones of the Finnish economy, alongside the traditional industries of forest and metal. Behind this scenario there is the phenomenal growth in global demand. The critical factors for future success of the telecommunications industry are:

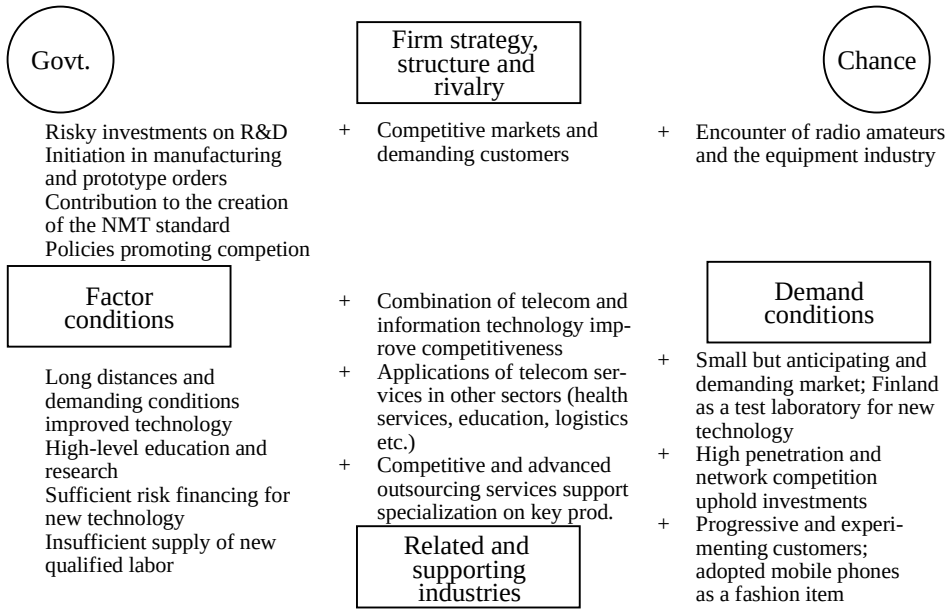
- *Timely and sufficient generation of advanced input factors, i.e. qualified workers.* The lack of a skilled work force may become a bottleneck for domestic research and production. But, with sufficient and

high-quality human resources, Finland may even become a lucrative home base for foreign equipment producers.

- *Ability to maintain and enhance leading market position.* Competition with big electronics manufacturers requires vast investments in R&D and marketing. In the future the mobile phone, for example, will become a mass product. Success in the future terminal market calls either for larger capacity to induce economies of scale, or differentiation.

- *Challenges at both ends of the value chain.* Expansion and differentiation of the component and outsourcing sectors could further improve the equipment manufacturers' competitive edge, while at the end of the value chain, the constant development of new applications is of utmost importance if the position achieved in the global market is to be maintained.

Figure 4.18 Determinants of competitiveness in the Finnish telecommunications cluster

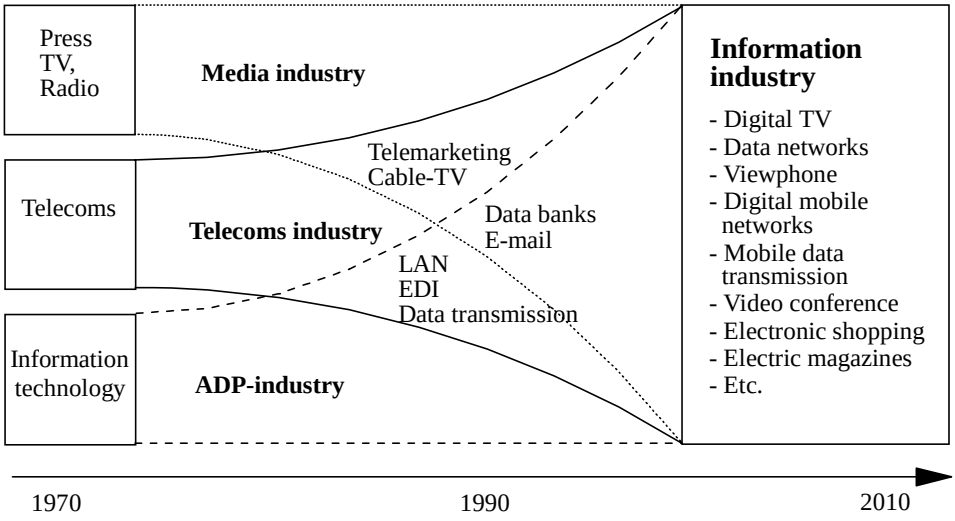


Multimedia offers great possibilities for the Finnish telecommunications cluster. Domestic production of telecommunications technology, television sets, personal computers and other terminals is advanced. Software production is also highly evolved, and the coverage of optic fiber and

broadband networks is practically nation-wide, which enables extensive and swift introduction of multimedia and speedy ATM services. Also advanced national operators have great possibilities in the emerging global content provision market.

The distinction between information technology and telecommunications is becoming increasingly blurred. The three central means of data processing and transmission, i.e. the telephone, PC, and television - are converging, which offers tremendous possibilities in application. One of the most significant will be interactive television. Moreover, there is expected to emerge a whole new industry which is going to integrate - in addition to the former media - publishing, information provision, advertising, delivery, and retail trade.

Figure 4.19 Convergence of industries



In addition to investing in the multimedia market, there is vast potential in more extensive applications. Education, inter-organizational communication, and health care are examples of domains that can greatly benefit from new telecommunications applications. Moreover, today the key words in maintaining and improving competitiveness are *intelligent production processes and enhancement of communications*, and on the other hand, *development of intelligent and communicating machines*. Finnish industries, like the forest and the basic metals, are already taking advantage of highly evolved intelligent machines - products that could also become successful export items.

4.6. The well-being cluster - a niche in the palm of your hand [32)]

4.6.1. The future of the Finnish welfare society

It has been a widely accepted idea in Finland that every citizen has a right to comprehensive health care, and that public authorities have to promote the health of the population in every conceivable way. In Finland this has meant that most of the services are also publicly financed. So far the principle of free (or nominal fee) treatment has been applied, although it is currently subject of debate.

In the post-war era the health care expenditures have constantly increased. Most of the industrialized countries are using 7-10% of GNP on health services (Finland 9-10%). Due to extensive public coverage, in Finland this has contributed to growing public-sector deficits. In order to reach external balance, even previously untouched cost items may have to be reconsidered. In the case of health care this arouses a difficult ethical question: on what grounds are the patients and/or the level of care chosen?

An extensive health care system is not simply a burden; it can also be a resource. It provides excellent premises to develop technological solutions to the identified problems. In the following the Finnish pharmaceutical and health care equipment industries are reviewed.

4.6.2. The industrial structure

Health care services employ 200,000 persons in Finland. The annual expenditures reach FIM 50 billion. These services are clearly the centerpiece of the cluster, although in the following the focus is on industrial activity.

A typical feature of the well-being cluster is the significant public involvement in virtually every part of the cluster. A majority of the high quality basic research is publicly funded, and a considerable share of the applied research is supported. Advances in medical science are naturally the main impetus for new product lines. Many related fields: chemistry,

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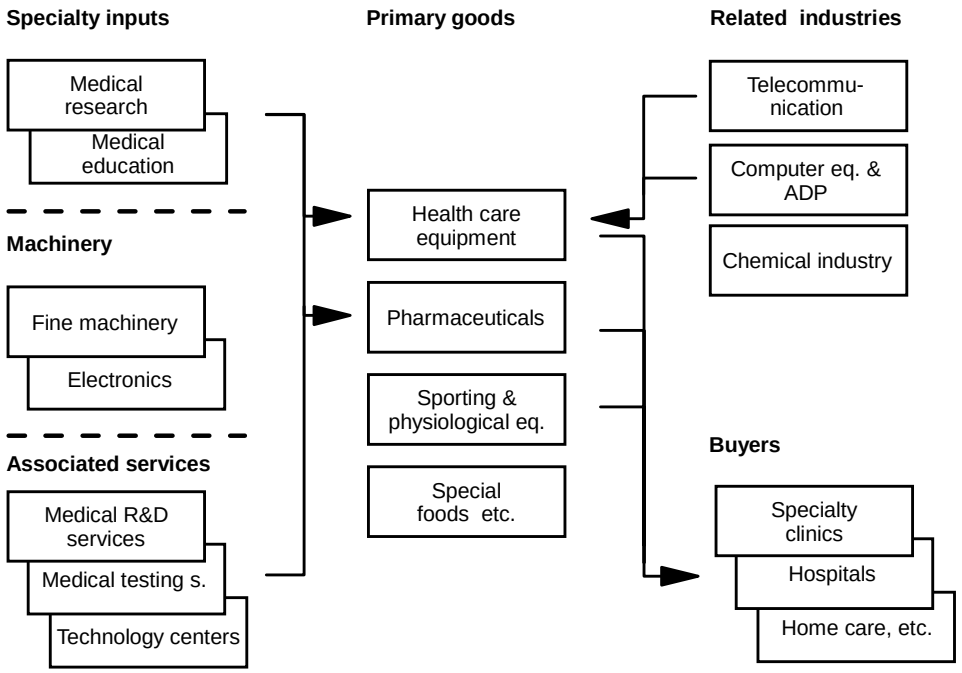
32) Follows P. Rouvinen, N. Saranummi and M. Lammi (ed.), 1995, *Finnish health care sector sprouts new industrial activity - competitiveness of well-being cluster*, The Research Institute of the Finnish Economy, ETLA B 109 (in Finnish).

biotechnology, electronics, and automation, are also sources of innovation. The driving force is naturally the needs of health care.

Export products include pharmaceuticals, diagnostic devices, various instruments, hospital equipment, and sporting & physical conditioning equipment. The industrial structure is presented in figure 4.20 below.

Figure 4.20 The Finnish well-being cluster



4.6.3. History in brief: publicly supported growth in health care

Developments in health care

One of the earliest nationwide attempts to improve the Finnish health system was the creation of the network of maternity and child care (MCH) in the 1940s. Thanks to MCH centers the Finnish infant mortality rates are among the lowest in the world. The foundations of Finland's current health system have been laid relatively recently; the National Health Insurance Act in 1963 provided the financial basis for public health care. In 1972 the Primary Health Care Act included primary care and guaranteed

regionally and socially equal access to health care services[32]. The building of the hospital network was started in the 1950s. Between 1945 and 1975 a total of over 30,000 new general, mental, and special facility hospital beds were created.

Industrial history

The history of the Finnish medical industry started in 1897, when a company was founded to manufacture malt extract and rolls of gauze. The first pharmaceutical factory was established in 1899; tall oil and sticking plasters were produced. In the early 1900s the imports of pharmaceuticals increased considerably. In 1911 *Helsingfors Apotekares Centrallaboratorium* started to compete with the foreign supply; in 1927 the name was shortened to *Medica* and in 1985 it merged with *Leiras*, currently one of the two major pharmaceutical companies in Finland. *Orion*, an other Finnish pharmaceutics manufacturer, was founded in 1917.

Instrumentarium, the oldest Finnish manufacturer of medical equipment, started its operations early this century as an importer. Finland has been a pioneer in the research of radio isotopes. The first commercial application was made in 1950, when professor Jorma Wallasvaara founded *Wallac* to develop equipment based on the usage of gamma and beta rays.

4.6.4. The 1980s: a decade of brisk growth in medical technology

Pharmaceuticals

In 1992 the global net sales of pharmaceuticals were USD 225 billion (Deutsche Bank/IMS). 'Nearby' fields, vitamins and weight-reducing substances, have a combined market value of USD 440 billion (SCRIP 1992). Although only one-fourth of the world's population lives in the industrialized countries, 80% of the medicaments are sold there.

During the 1980s the sales of over-the-counter (OTC) drugs grew 20% a year (Financial Times). Due to cost pressures the share of genetics will increase; nevertheless, moderate growth in market value during the next few years in expected. Global population growth and aging inhabitants (especially in the industrialized countries) will support growth.

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[32] For instance free dental care to all up to the age of 17 was included.

Medical devices and equipment

In 1992 the total market for medical devices and equipment was estimated to be USD 70 billion (MDIS 1994); North America is close to half of the total market. In per capita terms the United States uses USD 112 worth of health care equipment per person - Finland only USD 60.

There are a few clear market trends. Difficult operations are more often carried out in specialized units, which are very equipment-intensive, and methods of non-invasive surgery are in high demand. In order to cut costs, equipment simplifying primary care operations is developed. Self and home care appliances are also a rapidly growing subsector.

Preventative care

Sporting goods and physiological equipment are used to maintain or regain physical fitness. Well over half of the global markets are in the United States.

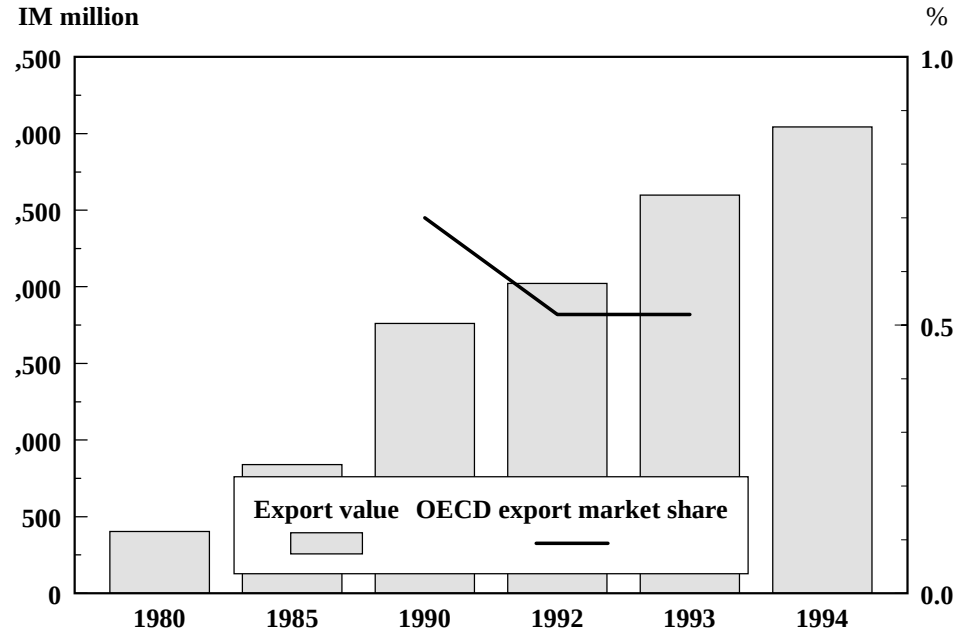
4.6.5. A cluster of small, high-technology companies

Unlike the main industries in Finland, the well-being cluster is comprised of small and medium-sized companies. The two biggest companies manufacture pharmaceuticals; others, medical equipment. Finnish health care companies are typically specialized in narrow segments. These markets lack sufficient market volume to be interesting for big companies but can be profitable for smaller players. Often these technology firms were established to take advantage of a single innovation of the founder.

In 1994 the exports of the cluster were FIM 3 billion - approximately 2% of the total Finnish exports (figure 4.21). Finnish companies have not been able to keep up with the rapid market growth, and as a whole the OECD export market share of Finland has decreased.

Consumer packed pharmaceuticals are the single most important export product, closely followed by diagnostic equipment. The OECD export market shares in dental equipment and radiological devices are relatively large (table 4.13).

Figure 4.21 Exports of the Finnish well-being cluster and its OECD export market share



Source: OECD, Board of Customs, ETLA

Ten years ago there were 13 Finnish pharmaceutical companies; now only *Orion* and *Leiras* are left. It has mainly been a question of industrial rationalization rather than closing down of unprofitable plants. The domestic market share of the Finnish companies has dropped due to intensified competition - in the early 1980s the market share was close to 60% but in 1994 only 37%. The removal of overlapping product lines has further reinforced the trend; since 1989 over 200 parallel preparations have been cut. Growth has been sought after in the export market.

Until recently, Finland had used a method patent system rather than a product patent. This allowed domestic companies to copy foreign compounds as long as the actual production method was different. The Finnish pharmaceutical companies were thus quite profitable, and they may have lost some of their desire to develop original products. Currently two main strategies can be identified: development and patenting of original medical molecules, and/or taking advantage of existing compounds and techniques by combining them in a new way[32]. Pharmaceutical exports have grown from less than FIM 10 million in 1970 to over FIM 1,6 billion in 1994.

32) For instance new dosage techniques are developed.

Table 4.13 The main export products of the well-being cluster

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 Medicaments in retail packages	0.4	610	0.40	13
2 Electro-diagnostic apparatus	2.0	490	0.32	21
3 X-ray based apparatus	1.4	251	0.16	17
4 Pharmaceuticals (excl. medicaments)	2.6	159	0.10	30
5 Ice-hockey sticks	2.1	142	0.09	24
6 Athletics articles	4.0	125	0.08	15
7 Special medical equipment	0.2	115	0.07	0
8 Medical furniture	2.5	105	0.07	17
9 Alfa, beta & gamma radiation appar.	4.9	99	0.06	-1
10 Dental drill engines	10.2	99	0.06	13
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 Dental drill engines	10.2	99	0.06	13
2 Alfa, beta & gamma radiation appar.	4.9	99	0.06	-1
3 Ultra-violet and infra-red ray appar.	4.5	25	0.02	106
4 Athletics articles	4.0	125	0.08	15
5 Fishing equipment	3.7	89	0.06	3
6 Ski suits	3.1	11	0.01	-7
7 Medical sterilizers	2.9	45	0.03	25
8 Chemical prophylactics	2.6	159	0.10	30
9 Medical furniture	2.5	105	0.07	17
10 Ice-hockey sticks	2.1	142	0.09	24
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of exports in OECD**	
1 Switzerland	11.4		8.3	
2 Ireland	8.7		2.7	
3 Sweden	7.6		4.1	
4 Denmark	6.0		2.3	
5 Austria	4.7		2.2	
6 Great Britain	4.5		8.7	
7 France	4.0		9.9	
8 Germany	4.0		16.5	
9 USA	3.8		18.0	
14 Finland	1.9		0.5	

Source: OECD, Board of Customs, ETLA

Table 4.14 Original Finnish medical compounds

Registration year	Commercial name (manufacturer)	Product Information
1978	Nova T (Leiras)	Intrauterine copper contraceptive device
1983	Domosedan (Orion-Farmos)	Used for sedating large-hoofed animals
	Domitor (Orion-Farmos)	Used for sedating small animals under treatment
1985	Bonefos (Leiras)	A chlodronate medicine
	Clastoban (name in France)	
1985	Finnferon-Alpha	Used for treatment of tumors
	(the Finnish Red Cross)	
1985	Normosang (Leiras)	A treatment of porphyria (a blood disease)
1987	Broilact (Orion-Farmos)	Used to prevent salmonella in poultry
1987	Erasis (Orion-Farmos)	Used to treat bacteria infections
1988	Fareston (Orion-Farmos)	Used to prevent hormonal breast cancer
1989	Antisedan (Orion-Farmos)	An antagonist for sedatives and analgesic for animals
1990	Levonova (Leiras)	An intrauterine hormonal contraceptive device

Source: The Pharmaceutical Information Center

There are many Finnish manufacturers of health care equipment. Most of these firms were founded during the 1980s. The average size of these companies is rather small, and their markets are often less than USD 100 million globally. The main exporters are *Datex*, *Wallac*, and *Planmeca*. As mentioned before, Wallac was founded in the 1950s by Jorma Wallasvaara. In the 1960s *Palomex* launched a range of X-ray apparatus based on the research of professor Paatero; later *Instrumentarium Imaging*, *Sorodex*, and *Planmeca* took advantage of the same technology. In the 1970s *Labsystems* and *Kone Instruments* started to manufacture diagnostic equipment. About 25 years ago operating room and intensive care units began to use electronic circuits. Some of the early innovations were made in Finland; now *Datex* (a part of Instrumentarium group) is a significant manufacturer of patient monitoring systems.

After the initial start-up, the main problem is marketing and distribution of the goods. Different technical specifications of equipment are also a restriction to international trade; the situation is improving with the new directives of the European Union.

Table 4.15 Some of the companies in the Finnish well-being cluster

Company	Products and services	Net sales, MFIM	Personnel	Foreign net sales, %
Laboratory test and equipment				
Wallac	Test systems	240	500	96
Orion Diagnostica	Test systems	203	383	80
Kone Instruments	Diagnostic systems	81	125	91
Labsystems	Diagnostic systems, pipettes			
Electronic medical equipment				
Instrumentarium/ Health care eqpmt. units	Patient monitoring systems, anesthesia delivery products	1055	1565	79
Diagnostic imaging equipment				
Planmeca	Dental X-ray systems	234	234	96
Dental care equipment				
Planmeca	Dental drills and chairs	234	234	96
Medicine manufacturers				
Orion Pharma	Pharmaceuticals	2005	2705	48
Leiras	Pharmaceuticals	868	1251	53
Fitness equipment				
Tunturipyörä	Bicycles, fitness equipment	361	462	63
Polar Electro	Pulse meters	263	307	95

4.6.6. The extremely R&D-intensive cluster needs highly trained personnel.

The companies of the well-being cluster are scattered around the centers of medical research: Helsinki, Turku, Tampere, Oulu, and Kuopio. Medical equipment companies in particular, maintain close cooperation with the medical universities - in fact many of the companies were founded by the professors and researchers in these institutions.

The pharmaceutical companies also need highly trained staff for their activities but so far they have chosen to do their R&D in-house. The cooperation is hindered by academia's eagerness to get publications - obviously highly sensitive results of a commercial research project can not be published. There are also some historical reasons for currently

somewhat dull cooperation; in the 1970s and 1980s the educational and medical authorities had negative attitudes towards joint efforts between academia and private enterprises.

4.6.7. Sophisticated public demand could be the key to success.

The most important domestic customer of the cluster is the public sector which provides social and health care services[32]. Private doctors, health care centers, and hospitals, however, are becoming increasingly important. Institutional conditions from country to country vary greatly (see table 4.16).

Table 4.16 The financiers and providers of health care services in various countries

I	Privately financed and privately provided	USA, Turkey
II	Publicly financed and (mainly) privately provided	Japan, Germany, The Netherlands, to some extent also Belgium, France, and Italy
II	Publicly financed and provided	**Finland**, Sweden, Norway, Denmark, the UK, and some countries in Southern Europe.

Source: Besley and Gouveia 1994

The Finnish market is too small in almost every segment, and therefore global sales are needed in order to cover the R&D costs. The first customer is nevertheless an important source of reference.

The major components of change in the global demand for the products and services of the well-being cluster are identified as follows:

- *Mounting cost of care:* Between 1970 and 1990 spending on health care in the industrialized countries has increased over 4% annually in excess of inflation. This trend can clearly not continue in the long-run and significant restructuring has to be made.

- *Aging population:* The oldest age groups are expanding rapidly. This puts pressure on the health care system, since the majority of services are used by the elderly.

[32] 80% of the Finnish health care services are publicly provided.

- *Altered disease patterns:* Cancer, chronic, and infectious diseases are on the rise.

- *Higher expectations:* Customers are demanding better and more specialized services.

4.6.8. Combining medical and communication technologies

The developments of the companies in the cluster are often related to other branches of industry. For instance, *Huhtamäki* group's foodstuffs industry laid the foundations for the medical subsidiary *Leiras*. In Germany and Switzerland, several companies first produced pigments for the textile industry, and only later evolved into pharmaceutical production (e.g. *Bayer*). British *Glaxo* diversified into medicine after becoming a well-known manufacturer of infant foods. Many electronics and electrical equipment companies as well are involved in the production of medical devices (e.g. *Toshiba, General Electric, Siemens,* and *Philips*).

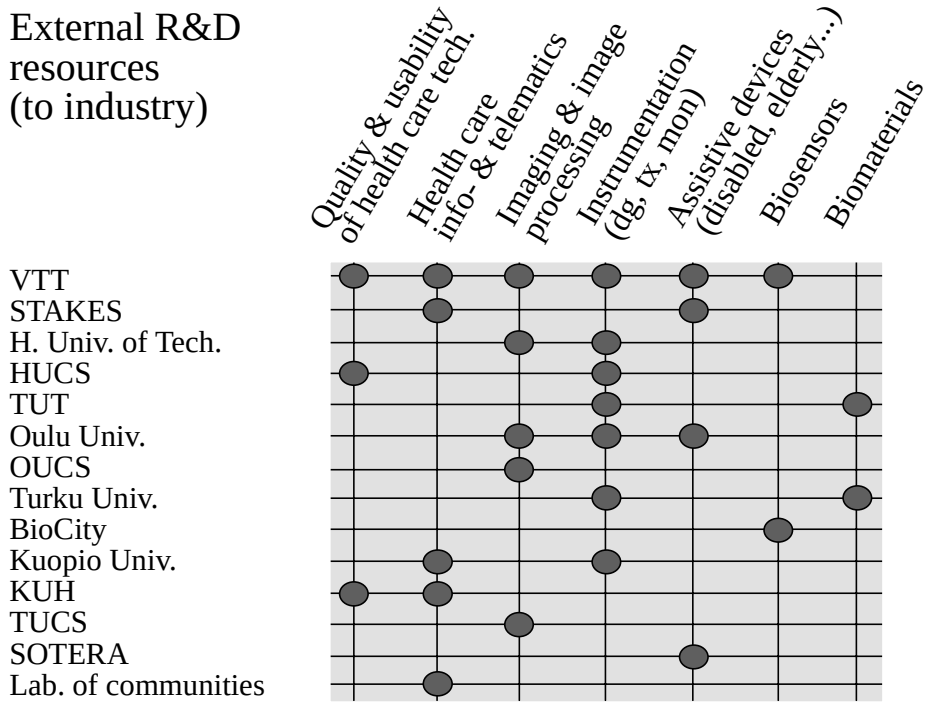
Due to relatively small firm size, external R&D units are important. These are summarized in figure 4.22 below. Many of the units mentioned are publicly supported.

Patient experiments done in the hospitals are important for the pharmaceutical industry. In the production of medical equipment, electronics and small-series workshops are used. Knowledge of chemicals, machinery, plastics, and ceramics is needed. As home and remote care increases, communication technology is becoming one of the most important supporting branches. Combining Finnish telecommunication and medical knowledge is a particularly promising subsector of the cluster.

4.6.9. How can local opinion leaders be reached around the world?

It should be obvious that medical technology companies can not survive by supplying only the Finnish home markets. Upon launching new commercial products, manufacturers have to win the approval of at least some of the local opinion leaders in each of the target countries. International research cooperation, seminars, and direct marketing can be used. Especially in the case of pharmaceuticals, new products are also tested locally before registration.

Figure 4.22 Outside R&D units available to the health care industry in Finland



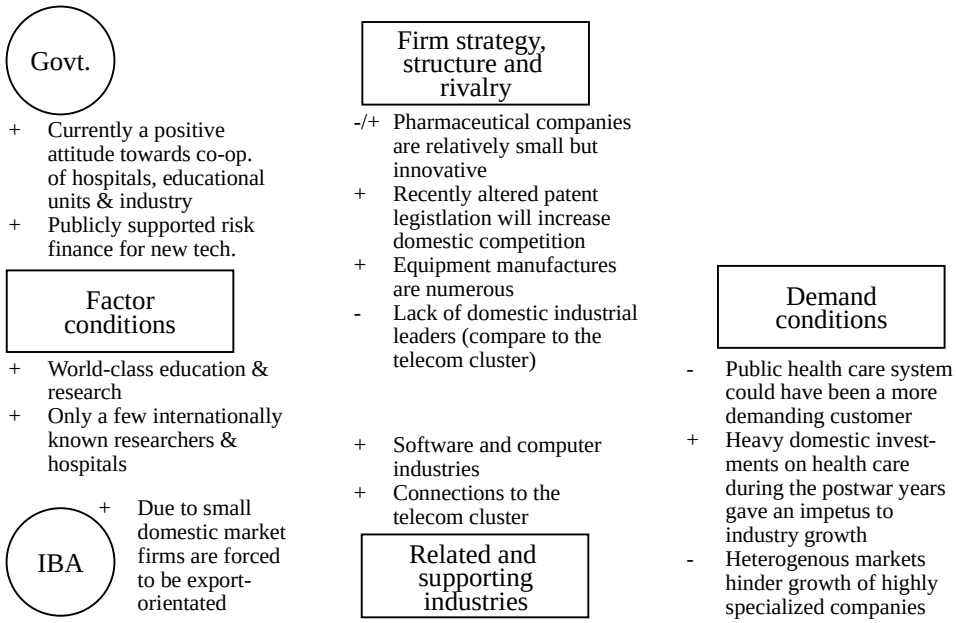
4.6.10. Conclusion: great preconditions but disappointing growth

Industries based on medical technology are particularly suited to Finnish conditions, where the technological level is high, the labor force highly trained, and the infrastructure is sufficient, but where there are few natural resources.

Finnish medical research is globally recognized, and our health care system is envied. Finland has been selected as one of the model countries for WHO's[32] *Health for All by the Year 2000* program. In principle the preconditions for exports should be most favorable. The well-being cluster's share of the Finnish exports, however, is only 2% whereas the OECD average is 3.3%. For one thing Finns are not heavily involved in the globally biggest sector of the cluster - pharmaceuticals. The determinants of the cluster's competitiveness are summarized in figure 4.23 below.

32) World Health Organization - part of the United Nations.

Figure 4.23 Determinants of competitiveness in the Finnish well-being cluster



In the pharmaceutical industry, Finnish companies have to be specialized. Their combined research resources are ten times smaller than the R&D expenditure of any of the biggest companies - *Roche*, *Johnson & Johnson*, *Merck*, or *Glaxo*, and therefore they can not compete in the same arena. Finnish companies' domestic market share has dropped almost 20% percentage points during the last twenty years, and the export market is the only source of growth. Both Orion and Leiras are now exporting about 50% of their production. On the fiercely competitive international markets increased specialization is needed, and the stakes are high due to R&D risks.

On a global scale, Finnish manufacturers of medical equipment have been most successful in diagnostic and radiological devices. In these products predicting the changes in market trends is crucial; thus the role of domestic customers is emphasized. The Finns have also been successful in dental equipment - this is easy to understand, given the historical background[32]. Home care aids and minimally invasive surgery equipment are undoubtedly some of the future growth areas. Compared to other Finnish industries, health care equipment is truly unique; the field is filled

32) Recall that the Primary Health Care Act in 1972 guaranteed free dental care to all up to the age of 17.

with small, high-technology companies that have reached (or have the potential to reach) high global market shares. From the viewpoint of the national economy, however, the problem is that each of the markets these companies capture is rather small - possibly less than USD 100 million.

Applications of genetic research are expected to be a big segment of the cluster in the near future. Although commercial applications are limited, Finland is one of the world leaders in the field; for instance, links to several genetically transmitted diseases have been discovered there.

The well-being cluster is the second fastest growing in Finland - second only to the telecommunications cluster. If Finland were to reach the OECD average of specialization, the value of exports would be FIM 4 billion (1993 level). If Finland were as specialized in medical technology as Denmark, the export value would be FIM 9 billion annually. This would mean 10,000 - 15,000 new industrial jobs for highly trained personnel.

The big question regarding the cluster is: how can currently small or medium-sized companies grow to become larger ones? Many companies have reached the size that they are major players in the niche they are in, and only way to expand significantly seems to be diversification. Yet the management, often led by the founder, have knowledge of only their own specialty. When compared to the fastest growing Finnish cluster, telecommunications, the importance of a 'locomotive' company can clearly be seen. In telecommunications, *Nokia* has been the engine of growth and smaller companies have followed in its footsteps. None of the well-being companies is dominant - probably only *Orion* or *Instrumentarium* has the potential to become the front runner in the near future. Even if one of these were to take a more active role the problem would still be the heterogeneity of the cluster.

Box 4.11 The unavoidable growth of health care - a brighter future for the well-being cluster?

There are four major explanations for the growth of health care expenditures.

1. Technological development

The techniques applied in health care have developed rapidly. 'Revolutionary' equipment and new methods of treatment are constantly offered. Ethical reasons demand that the latest developments are put to practice as soon as possible. On the other hand, society also saves since untreated illnesses may turn out to be extremely expensive. (Weisbold 1991)

Normal laws of a competitive market do not always apply in the case of health care. New equipment is often publicly financed. Incentive mechanisms may be biased and unnecessarily expensive products may be used.

An additional reason for rising expenditures is the labor intensiveness of the branch. According to Baumol (1993), new techniques will not decrease the labor intensity of some sectors; examples include health care, education, and the arts. Since industrial productivity is increased by new innovations, the relative cost of health care will rise.

2. Equal access to health care services

Most civilized nations try to guarantee every citizen equal access to health care services. Therefore many countries have a publicly supported health care system. A welfare society is committed to maintaining the well-being of each individual. Advances in the medical sciences have expanded the scope of services offered, and thus also expenditures have risen. (Besley and Gouveia 1994)

3. Rising living standards boost demand

The private expenditure on health care increases disproportionately as disposable income increases; besides quantity, requested quality is higher. As wage decreases, private consumption of, for instance, sporting equipment is likely to decrease; in the case of public services, however, cuts are less likely to be made.

4. Dual aging

The single most important force behind higher health care costs is the aging population, particularly in the industrialized countries. In 1950 the elderly (over 65) comprised on average 10% of the population in the OECD countries. In 2050 the figure is expected to be 20%. The proportion of the population over 80 years of age is increasing considerably faster.

This is particularly important, because the oldest age groups use health care services intensively. Between 1980 and 2040 the elderly's share of the total health care expenditure is expected to increase from 22% to 30% in Belgium, and from 51% to 63% in Sweden. The trend in Finland is similar.

The increasing life expectancy and expanding share of the oldest age groups will drive up the demand for health care services. Hospital care may not be an affordable alternative any longer. Work-saving innovations and technologies are needed. Home care and minimally invasive surgery may thus be the most vigorously growing markets in the near future.

4.7. The environmental cluster - preserving the planet[32)]

The year 1995 has been named the Year of Environmental Care in 40 European countries. This theme year was first celebrated in 1970. After 25 years one fact remains unchanged; conservation of the environment is one of the greatest technological, economic, and social challenges of our times. The focus, however, has shifted. Twenty years ago water pollution and sufficiency of raw materials were considered to be the main troubles, whereas currently global warming and the thinning ozone layer are regarded as the greatest problems. Early efforts concentrated on spot loads of large industrial plants; nowadays traffic and agriculture are also accused of having a detrimental effect on the environment.

In the late 1980s and early 1990s environmental awareness increased considerably. Consumers became more informed of the effects of their expenditure - in the industrial context, pollution control was not only an unnecessary increase in expenditure any longer; environmental consciousness had become a source of competitive edge in the market place. A new line of business, environmental management and technology, is looking for ways to reduce the pollution burden. The market potential is great; in the future environmental technology could be one of the cornerstones of the Finnish economy.

4.7.1. The problematic definition of the environmental cluster

In the case of environmental management and technology (or simply the environmental industry) even the definition of the branch is somewhat problematic. Recent studies have taken a wealth of different approaches.[33)]

Defining the environmental cluster

A narrow definition: Only products and services that are exclusively dedicated to the protection of the environment are included. Conservation is their sole goal, and they are not embedded or integrated into products or services with other functions. In principle this definition is clear, even though in practice borderlines may be hard to find - for instance some

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32) Follows mainly R. Lovio, 1995, *Competitiveness of the environmental cluster*, The Research Institute of the Finnish Economy, ETLA B (forthcoming, in Finnish).

33) In Finland: Salminen and Mettälä 1993, Heinonen 1994; internationally: OECD 1992b and 1994b, Kaiser 1992, Skotte and Rasmussen 1993.

measuring devices may have alternative uses; the customer decides what is to be the main purpose of the apparatus.

A loose definition: Environmentally-oriented production technology[32)] is added to the previous definition. The definition of environmentally friendly production technology is a matter of dispute and it changes over time. This definition may include products of any conventional industry; traditionally, however, only the most environmentally intensive branches are considered, such as power generation.

A broad definition: Besides the above definitions, environmentally-friendly consumer products and services are accounted for - therefore commodities manufactured with environmentally oriented production technology are also included.

In the literature both the narrow and loose definitions are commonly used. When the cluster approach is applied, the broad definition is the most appropriate; it allows us to uncover the connections between different branches.

Products and services for environmental protection formed the core of the cluster in the past. So far, market growth has been rapid. Currently, however, the emphasis is on production technologies where environmental thinking is embedded. In the long run the focus will be more and more on environmentally friendly consumer products.

Table 4.17 Sectors of the environmental cluster

	Investment goods	**Consumer goods**
Products & services of environmental protection	'End-of-pipe' technologies	(Environmental care equipment for households)
Environmentally friendly products & services	Energy & raw material saving production technologies	Environmentally friendly commodities

32) Energy saving technologies, clean/er technology, process integrated environmental protection.

Box 4.12 The Finnish market for environmental technology in 1992

The market value of environmental technology can be estimated indirectly by using environmental protection cost figures. The value of environmental technology is considered to be the cost, relative to the use of conventional technology.

In 1992 the total environmental protection expenditure of the Finnish industry was FIM 3.2 billion, out of which investments were FIM 1.8 billion and operating costs FIM 1.4 billion. Investments abroad were 68% of the total. Foreign operating costs accounted for 94% of the total. Protected element expenditures break down as follows: air 47%, water 38%, waste management 15%, and others 1%. By branch of industry the costs were divided in the following way:

- The paper and pulp industry	FIM 941 million
- Power generation and distribution	FIM 818 million
- The basic metal industry	FIM 372 million
- The chemical industry	FIM 361 million
- The foodstuff, beverage, & tobacco industry	FIM 287 million

Source: Central Statistical Office of Finland

4.7.2. The structure of the Finnish environmental industry

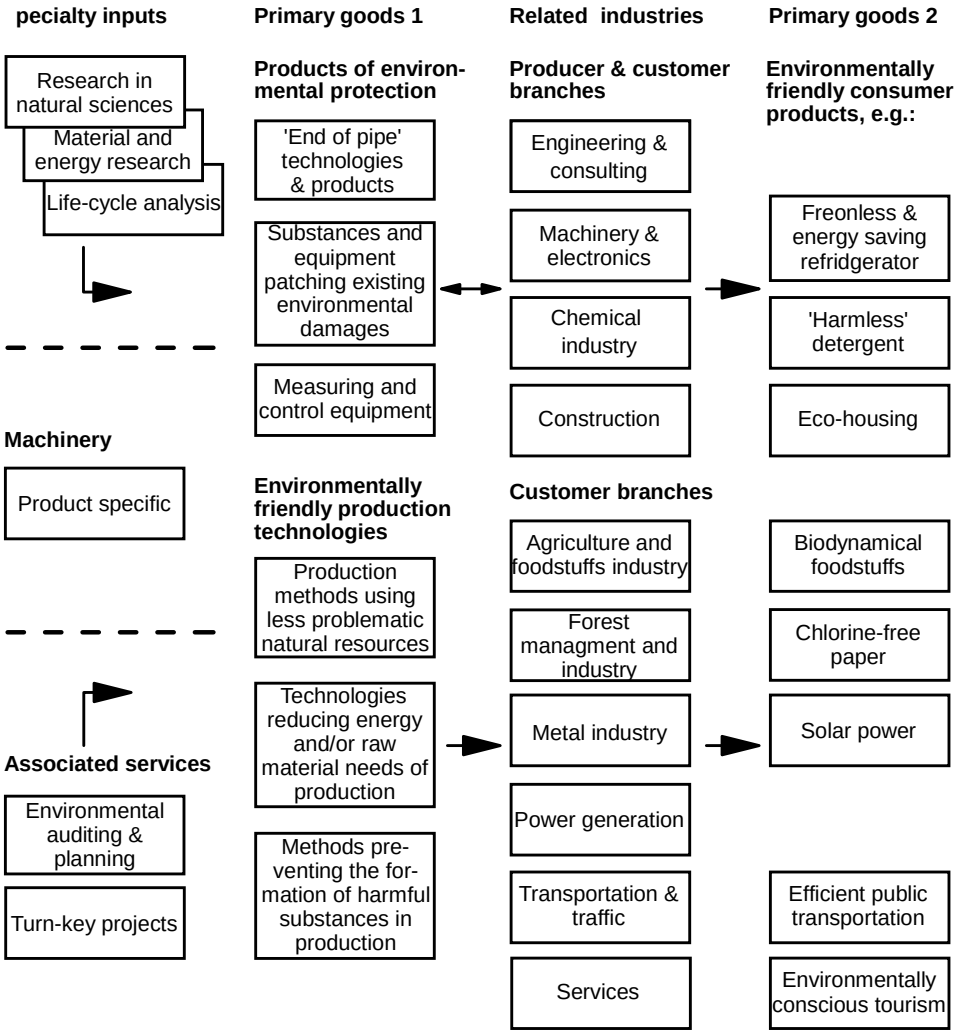
The environmental industry is quite heterogeneous and is currently not a cluster in the traditional sense. It is an integrated part of virtually all of the major industries.

The companies in the Finnish environmental industry number approximately 300; most of these are relatively young, and half have entered the field since 1985. The structure of the industry is illustrated in figure 4.24 below.

The cluster's firms can be divided to three groups: firstly there are 40 to 50 old companies that have diversified into environmental technology; in table 4.18 it can be seen that out of the 8 biggest Finnish companies 7 are also involved with this field. Secondly there is a group of mainly small and medium-size companies mostly or solely specialized in environmental technology. Thirdly there are some ideologically 'green' companies that manufacture and sell environmentally friendly consumer products and equipment[32)].

32) Although the economic significance of these businesses is minor, they are pioneers preparing ground for more traditional business enterprises.

Figure 4.24 The Finnish environmental cluster



4.7.3. Markets are found between the earth and the sky

A great variety of chemicals, equipment and machinery are needed in water pollution control and waste water treatment. The biggest Finnish company is *Kemira*, manufacturing FIM 500 million worth of water treatment chemicals annually. For instance *Jaakko Pöyry Group*, *Raisio Engineering*, *Rauma Ecoplanning*, *Rautaruukki Engineering*, *Lemminkäinen*, and *YIT* design and build treatment plants.

Table 4.18 Some of the major companies in the Finnish environmental cluster

Enterprise	Industry	Subsidiary/division, main product	Sectors	Size
Alko	food	Biotechnology, enzymes	5	small
Raisio	food	Engineering, wastewater treatment	5/7/8	med.
Tamfelt	textile	Filter Fabrics, fabrics for filtration	7	small
Kymmene	forest	Wisaforest, environmental analysis	2/3/5	small
Enso-Gutzeit	forest	Forest Dev., reforestation technol.	3/5	med.
Veitsiluoto	forest	Paperikemia, water chemicals	3/5/7	med.
Kyro	forest	end products	3/8	small
Neste	chemical	NAPS, solar energy technology	2/3/7	med.
KWH Group	chemical	Pipe, wastewater pipes	7	large
Kemira	chemical	Chemicals, water chemicals	3/7	large
Partek	multi b..	Multilift, waste management products	6	med.
Outokumpu	metals	technology in metallurgy	1/4-8	large
Rautaruukki	metals	Engineering, metallurgical processes	2/5-7	large
Raute	engin.	Wood Processing Machinery	3/5	small
Kone	engin.	Instruments, water instruments	4	small
Valmet	engin.	Automation, automation and instr.	3-5	med.
Sisu	engin.	Auto, materials handling equipment	8	small
A.Ahlstrom	electron.	Pyropower, combustion technology	2/3/5/7	large
ABB	electron.	Env. Systems, SO_2/NOx reduction	1/3/5/8	large
Vaisala	electron.	environmental measurement systems	4	med.
Wallac	electron.	environmental radioactivity measur.	4	med.
Repola	multi b.	Rauma Ecoplanning, water treatment	5-7	med.
Tampella	multi b.	Power, combustion technology	1/2/5/6	large
Lännen Tehtaat	multi b.	Systems, reforestation technol.	2/3/5	small
Asko	multi b.	Uponor, wastewater pipes	7	large
LassilaTikanoja	multi b.	Säkkiväline, waste management	6/7	large
Vapo	energy	Biotech, wastewater treatment techn.	1/5-8	small
IVO	energy	International, energy consulting/eng.	1-4/6/7	large
Lohja	constr.	Rudus, remediation of soil	6	small
YIT	constr.	wastewater treatment plants	6/7	med.
Polar	constr.	wastewater treatment plants	7	small
Lemminkäinen	constr.	wastewater treatment plants	1/6/7	med.
Huber	constr.	Industry, water piping systems	1/7	small
Pöyry	services	Maa ja Vesi, water consulting/engin.	1-4/5-7	large
Viatek	services	Tapiola, waste managem. cons./eng.	1-4/6/7	med.
PI-yhtiöt	services	Consulting, environmental consulting	2	small
Tietotehdas	inf. tech.	Carelcomp, forest ind. automation	3/5	small

Sectors in environmental technology: 1 = air pollution control, 2 = environmental consulting, 3 = forestry, 4 = monitoring & measuring, 5 = process technology, 6 = waste management, 7 = water engineering, 8 = other

Source: Envirotec (1995)

Table 4.19 Some of the medium-size companies in the Finnish environmental cluster

Company	Products and services	Net sales, MFIM	Personnel	Foreign net sales, %
Water protection				
E.Sarlin	Sewage pumps, products and solutions to environmental protection	280	359	37
Larox	Automatic pressure filters, pinch valves	155	210	90
Waste management and recycling				
Kuusakoski	Metals recycling and processing	876	477	67
Waste Management Finland	Solid waste management services	245	500	0
Ekokem	Waste management services	163	154	0

Air pollution equipment manufacturing is clearly split between two types of companies. Older and larger companies, e.g. *ABB Strömberg Power Environmental Systems*, *Tampella Power*, *IVO International*, and *Ahlstrom Machinery*, produce exhaust gas purifying equipment, and smaller companies, i.e. *Environics*, *Rados Technology*, and *Vaisala*, make measuring and monitoring devices.

Soil treatment is a rapidly expanding subsector; many previously used dumping places are currently being cleaned up. Finnish innovations include biotechnical methods to treat polluted soil. Waste management and recycling are traditionally controlled by small local companies. Tighter new requirements on waste management are changing the situation. *Säkkiväline* is the biggest waste management company in Finland. The most significant exporter is *Halton Systems*; it is the second biggest manufacturer of automatic bottle return machines in the world.

Environmentally friendly production is expanding. Products of *ABB Industry*, *Ahlstrom Pyropower*, and *Tampella Power* are identified as environmentally friendly investment goods.

Environmentally friendly consumer products in Finland are still rare except in the foodstuffs industry. Labels carrying the Nordic environment symbol comprise a small share of environmentally friendly products; at the moment companies are not applying for the symbol even if they would

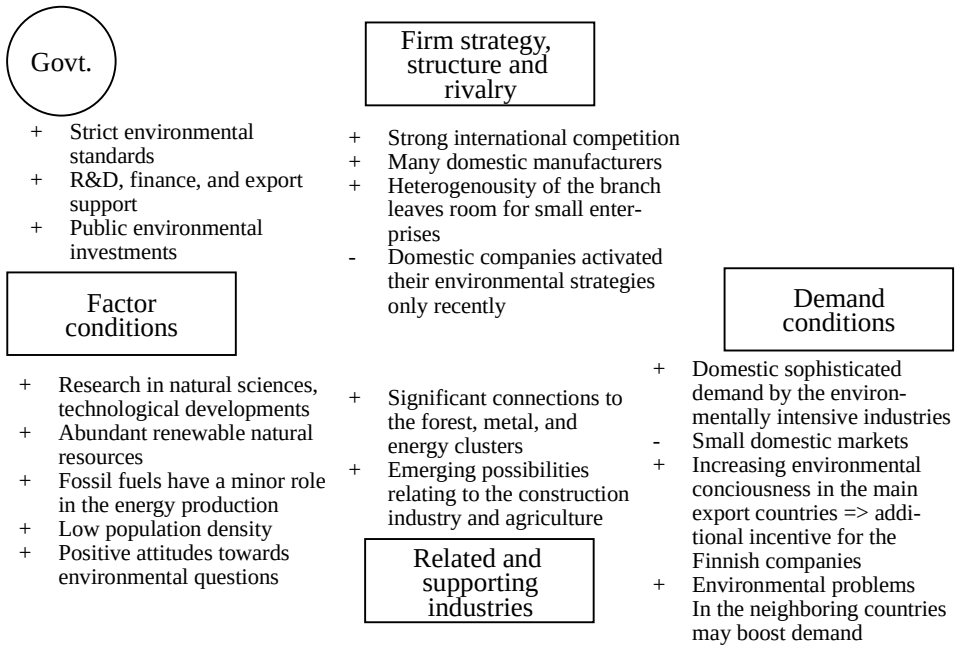
qualify as far as product features are concerned. There are some exceptions: all of the producers of fine papers have a right to use the symbol. Many of the detergents are also labeled.

According to one estimate (Salminen and Mettälä 1993) the turnover of the Finnish environmental industry is approximately FIM 15 billion and employment 15,000. The share of total Finnish exports are about 5%; if a looser definition is applied the export share increases to 20%.

4.7.4. Conclusion: the strengths of the Finnish environmental cluster link to forest, metal, and energy

The strengths of the Finnish environmental cluster can be found in its subsectors, where Finnish legislation has been particularly strict. Successful applications can be found, for instance, in the forest industry and in water pollution control. Many industries - power generation, mining, and the metal industry to mention a few - have also developed quite environmentally friendly production methods. The determinants of the cluster are summarized in figure 4.25 below.

Figure 4.25 Determinants of competitiveness in the Finnish environmental cluster



Along with the well-being cluster, the environmental cluster is one of the most state-dependent clusters: environmental standards are set publicly, the development and commercialization of environmental technology is subsidized, and public authorities can also be seen as customers.

Besides public demand, sophisticated industrial customers have been important. Process industries are environmentally intensive, and thus the home market for environmentally friendly technology is relatively large. Since the buyers are often quite large companies compared to the suppliers of environmental equipment, they may be attractive R&D partners or co-producers. In this field user-producer relationships are rather close.

Clearly technological knowledge and human capital are the crucial factors. While Finland has relatively good basic (environmental) research and process knowledge, the knowledge base relating to environmentally friendly consumer products could be upgraded. The main, and practically only, resource of Finland, forest, is renewable; this improves the country's environmental balance considerably.

The competitive atmosphere in the industry has been healthy. There has been a sufficient number of suppliers to guarantee a functioning market. Finnish companies as a whole could have had more aggressive environmental strategies. Particularly the forest cluster was sluggish in its reactions, and therefore it was forced to be unnecessarily defensive.

A peculiar feature of the cluster is the seeming randomness in the order of 'environmental' preference. Sometimes activists attack issues that are rather marginal but easy to point out. For instance in the case of the forest industry some issues - first chlorine, then recycling, forest management, and followed possibly by energy - have come up in a surprising order. Systematic life-cycle analysis of environmental effects can nevertheless be a source of competitive advantage.

The emphasis in the Finnish environmental cluster has evolved from 'end-of-pipe' techniques to environmentally friendly production technologies. In the previous stage companies concentrated on cleaning up the generated pollution; now they try to avoid harmful side effects all together. The demand of process industries has driven the growth of the cluster. Requirements of the forest industry in particular are behind many of the successful products; for instance *Kemira* is a leading manufacturer of peroxide which has replaced chlorine in pulp production.

4.8. The transportation cluster - a great future behind?[32)]

Finland is away from the main markets, and its exports are comprised of rather bulky products. Therefore logistics - transporting, handling, and warehousing of commodities - has been essential for the main industries in Finland. It has often been argued that the profitability of major Finnish exporters could be further increased by improving the current logistical system. Table 4.20 presents possible savings in some industries.

Logistics has sprouted a robust transportation and transmitting equipment industry. Recently, transit traffic through Finland has also grown vigorously. On the other hand a negative development has been the decreasing fleet under the Finnish flag. It has been claimed that the Nordic collective labor agreements are too restrictive and costly - Norwegian shipping companies, however, have been able to succeed under similar terms. Industrial activity has diminished as well; Finnish passenger car manufacturing efforts have been disappointing. Sufficient market volumes seem to be out of reach of the Finnish producers - yet the Swedish automobile manufacturers are pulling through.

While many of the Finnish industries/clusters have roared during the 1980s, the transportation cluster has been in constant trouble. Currently some parts of it are quite competitive while others barely survive. In the following, two very different parts of the cluster are reviewed - the equipment industry and transit traffic. Issues of logistics are also discussed briefly.

4.8.1. The Finnish transportation equipment industry

Estimated net sales of the transportation equipment industry are FIM 20 billion, and it employs some 30,000 people. The branch has shrunk during the recent years. Industrial/passenger elevators and conveyers, heavy duty timber and gravel loads, harbor equipment[33)], specialty vessels[34)], and diesel-electric propeller systems are a few of the successful products.

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32) See E. Matikainen 1993 (ETLA DP 446), P. Kauppala 1994 (ETLA DP 499), and M. Kaloinen 1993 (ETLA DP 459) for further information (all in Finnish).

33) Includes for instance terminal tractors, container forklifts, and straddle carriers.

34) Includes among other things luxury cruisers, ice-breakers, liquid natural gas tankers.

Earlier, substantial car manufacturing sprouted a network of subcontractors making plastics, windows, cables, electronics, and computer software. Some of these have been able to substitute decreasing demand from domestic manufacturers by increasing exports[32]. Table 4.21 lists some of the firms in the cluster.

Table 4.20 An estimate of the possible logistics savings in Finland, by branch of industry

Branch of industry	FIM million	Measures to be taken
MANUFACTURING		
Food, beverage & tobacco	1	From beggar-thy-neighbor competition to cooperation: minimizing logistics costs by joint transportation, outsourcing
Textile, wearing apparel & leather	200	Industrial networks, appropriate locations of production facilities, increased customer-orient.
The forest industry	2,000-2,500	Minimizing employed capital, increased control
Publishing	230	Decreased material transportation by using datacommunication equipment
Furniture manuf.	80	-
The chemical industry	1,000-1,500	Synergies of other foreign trade and transit traffic, trading of own transportation capacity
Non-metallic minerals	300	Better location and optimized size of the production plants
Basic metals	350	Optimization of the whole logistic chain and increased cooperation
Metal prod., machinery, transport eq.	1,500-2,000	Industrial networks, increased use of the communication infrastructure
Electrical equipment	300	Industrial networks and value added services
WHOLESALE AND RETAIL TRADE	4,000-5,000	From beggar-thy-neighbor competition to cooperation: minimizing logistics costs by joint transportation, outsourcing
CONSTRUCTION	800-900	Increased attention on logistics
TOTAL	**12,260-16,350**	**Increased training and R&D, further improvements in the communication infrastructure, emphasizing the role of logistics**

Source: Ministry of Transport and Communications 1993

32) Catalytic converters, exhaust sensors, and acceleration sensors are some of the currently exported products.

Table 4.21 Some of the companies in the Finnish transportation equipment industry

Company	Products and services	Net sales, MFIM	Person-nel	Foreign net sales, %
Wärtsilä Diesel	Diesel engines	6566	5828	app. 97
Sisu-Auto	Tractors, trucks, terminal systems	4588	4564	73
MacGregor	Tracked vehicles, products for the automotive industry	2200	2765	app. 80
Kvaerner Masa-Yards	Cruise vessels, special technol-ogy vessels	2075	4489	80
Partek/Cargotec	Cargo-handling equipment for vehicles	1977	2323	94
Finnyards	Cruisers, car ferries, icebreakers	822	2050	app. 58
Outokumpu/ Roxon	Conveyor components, bulk materials handling equipment	429	661	na
Saab-Valmet	Passenger cars	381	804	90
Fiskars/Bronto Skylift	Mobile access platforms	221	255	96
Rocla	Loading and stacking equipment	150	252	56
Kotka Shipyard	Modernization and maintenance of ships	101	207	70

By reviewing Finnish industrial history one can note that Finland has produced virtually all kinds of transportation equipment at some point. The bulk of the domestic demand has been fulfilled by Finnish suppliers at points in the past. Later, many of the manufacturers proved to be unable to find segments where they could operate globally. The ones that are left are specialized in few products and are often serving only selected industries.

The Finnish contribution in the world vehicle markets has been limited. Although a few brands of passenger cars and heavy trucks have been made in Finland at some point, only some rather narrow segments can be considered a Finnish territory; unsurprisingly forest felling tractors is the most obvious example (*Ponsse*, *Timberjack*, and *Sisu Logging*). *Sisu* has had some success in the heavy truck market[32)] and in armored troop transport vehicles. Currently only SAAB (convertible) automobiles are made on Finnish soil[33)].

32) It has widely recognized technologies in some components, such as axles.

33) *SAAB-Valmet*'s convertibles have been quite successful; in 1992 the car commanded 19% of the US convertible market in the over-USD 25,000 price bracket.

The biggest segment of the Finnish shipbuilding industry is in large passenger and cruise ships, currently manufactured by *Kværner Masa-Yards* and *Finnyards*. Early domestic demand was a major factor in developing the necessary knowledge; the ship route from Helsinki to Stockholm is one of the busiest ones in the world in terms of passenger volume. Currently, the vessels used are some of the biggest in the world, averaging over 2,000 persons and hundreds of cars and trucks each. Many of the smaller firms in the cluster are subcontractors of shipyards, and as the domestic shipbuilding has reduced a few have been able to expand abroad. Finnish manufacturing of specialty steels, diesel engines, and electrical equipment have been the main supporting industries. Many of the crown jewels of the transportation cluster are no longer under Finnish ownership: *Mac Gregor* is owned by Swedish *Incentive*, *Masa-Yards* is part of Norwegian *Kværner*, *KCI Kone Cranes International* is controlled by a Nordic group of investors. A significant part of *Partek Cargotec*'s production and R&D is outside Finland.

The developments in the former Soviet Union may bring new life to the currently crippled cluster. The eastern customers are familiar with the Finnish quality - they have acquired Finnish products first as the war reparations were being paid, and later through active bilateral trade. The whole logistic chain in Russia desperately needs patching.

4.8.2. Transit traffic - Finland's trade ?

Transit traffic to Russia is currently about 7% of Finland's external shipping. It has been estimated that the annual income from this activity will increase from the current FIM 2 billion to FIM 6 billion by the year 2010. In the long run, Finland could adapt a role similar to that of Holland in the German trade, and develop to a logistic hub between Russia and the rest of the world.

Four major factors are behind the growth of the Russian transit traffic:

1. When the Baltic states became independent, Russia lost the control of a number of important harbors and some of the railroad network. Increasing external commerce will be guided through other channels.

2. Since Russia has adapted the principles of a market economy, it will unavoidably participate in the specialization process, and thus trade will increase.

3. The structure of Russian imports is changing: article freight will increase, and imported parcels will be smaller. This favors Finland especially when the north-western Russia is the target area.

4. Currently, active traffic is giving a head start to Finnish entrepreneurs. Heavy investments in Finnish logistic infrastructure will make Finland an even more attractive hub on the way to Russia.

It would be illogical to assume that the Baltic states and St. Petersburg will not upgrade their own transportation infrastructure. The speed of change, however, has been a disappointment for many, and time is working in the favor of the Finns. Railroads and sea traffic are the main channels in bulky goods. Article freight uses road transport and air cargo.

Given the inferior infrastructure in the former Soviet Union, investments on the Russian side of the border are crucial for Finns. The situation is the same as in environmental protection; marginal return on one unit of investment is far greater when the starting point is poor.

4.8.3. Logistics - a nightmare for Finnish exporters

Logistics costs as a percentage of turnover are higher in Finland than in other European countries. Explanatory factors are the remote location of the country, relatively low transport volumes, and a rather low value-added content of production.

Until recently, the trucking business has been heavily regulated. This, and a lack of competition have undoubtedly caused inefficiencies. Railroads, as in many other countries, are a state monopoly. The number of Finnish harbors is high, but transport volumes are low. The cost of air transportation is decreasing, and is thus boosting Finnish competitiveness in the form of cheaper cargo and business transportation.

Nowadays the telecommunications infrastructure is considered a major part of the transportation network. Finland, along with other Nordic countries, has one of the most advanced communication networks in the world. Truck routes, for instance, are often monitored via satellite. Electronic data transmission (EDI)[32)] is replacing customs and dispatch documents.

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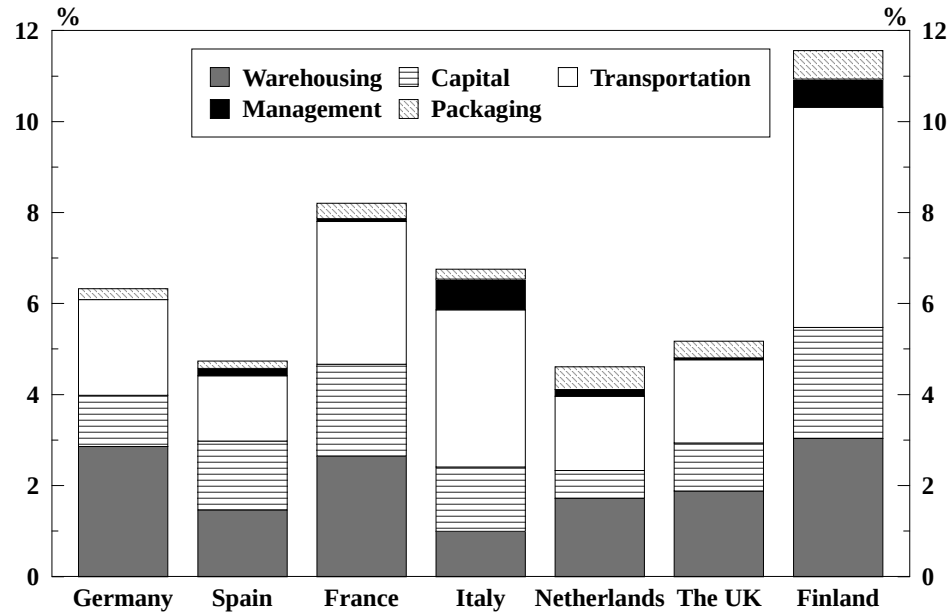
32) This system is also used in the forest industry. Information of the type of timber needed is transmitted from a central European sales office directly to a felling tractor in the forest. The needed trunks are found and cut to the right length and trans-

Figure 4.26 Logistics costs in various European countries, as a percentage of turnover



Source: Ministry of Transport and Communications (1992)

4.8.4. Conclusion: will the transportation cluster see the dawn?

The transportation cluster is contradictory. While some companies are quite competitive, other are fading away. Transit traffic and the emerging Russian market may give new impetus for growth, but there are no signs of 'fresh' industrial activity. Considering the role of logistics in Finland, it is unfortunate that the transportation sector has been so weak. Even the new possibilities are a consequence of a historical development. Finland has a good chance of becoming a major logistic hub in the east-west trade, but unless the Finns act fast the early lead will be lost.

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ported by satellite guided trucks.

4.9. The chemical cluster - from home abroad

The chemical industry is by far the most important supplier of intermediary inputs for other industries. In Finland its ties are closest to the forest and construction industries.

4.9.1. Oil products and fertilizers for the domestic market

The foundations of the Finnish chemical industry lie in the domestic demand of other industries, agriculture, energy and transportation. Until the 1970s the chemical industry grew by producing oil products and fertilizers for the Finnish markets. The 1970s was an era of rapid export growth and development of new products in the chemical industry, followed by a period of vigorous internationalization in the 1980s. The industry is currently facing a third period of transition: new competitive strengths have to be found outside traditional segments of standardized volume products.

4.9.2. Dominance of two state-owned companies

The *Kemira Group* and *Neste*[51)] jointly account for over half of the chemical industry's value-added. Kemira's roots lie in agriculture's need for fertilizers and Neste was set up after the second world war to take care of the storage of oil. Kemira has recently been partly privatized and Neste is following suit, but the state will still own a majority of their shares.

Neste has gradually built up a chain from oil refining to oil products, petrochemicals and plastics. It is also active in oil exploration and production and the gas business. Furthermore, it has vertically integrated the production of plastic products into its production chain. In 1994 Neste merged its polyolefin production - a major part of its oil chain - with the Norwegian *Statoil*'s respective business.

The oil refining chain extends to plastic products and semi-finished products, of which plastic films and sheets are by export value the most significant. A handful of firms dominate this often volume-driven and capital-intensive plastic product business, where the small and medium-sized enterprises serve only the domestic market. Cost competitiveness is vital on international markets. Export market prospects of domestic firms

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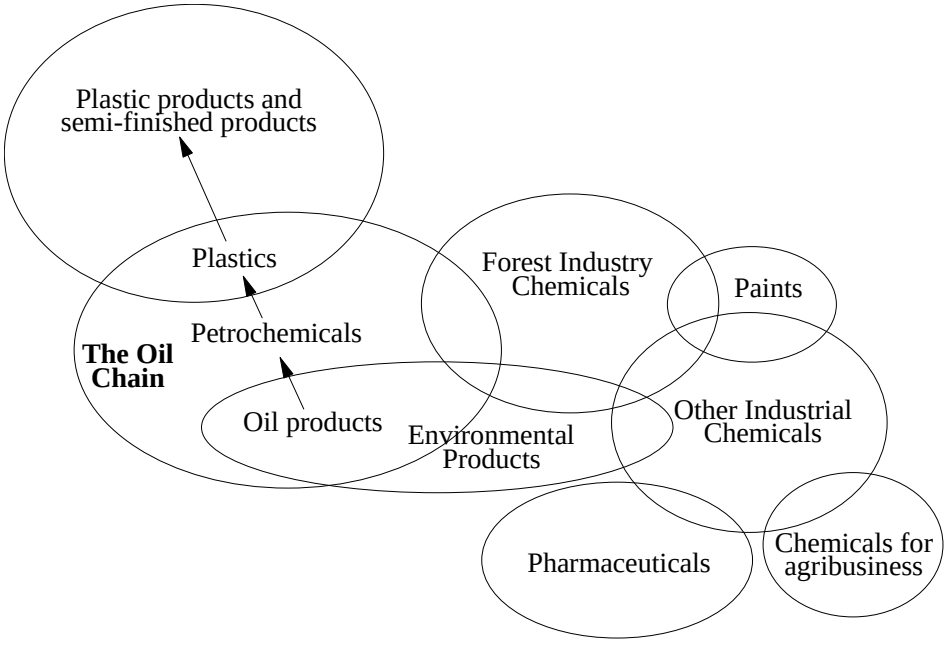
51) Including the parts now in *Borealis* (a merger of Neste's and Norwegian *Statoil*'s plastics polymer businesses).

are limited by intense price competition by firms in the developing countries. The present (relatively small) size of domestic firms is also a disadvantage. Exceptions still persist. Success has been found in the wake of the electrical industries, using know-how accumulated in the construction industry or by intensive internationalization. *Polarcup*, for instance, is a multinational food packaging group with headquarters now in the Netherlands, but roots in Finland.[51)]

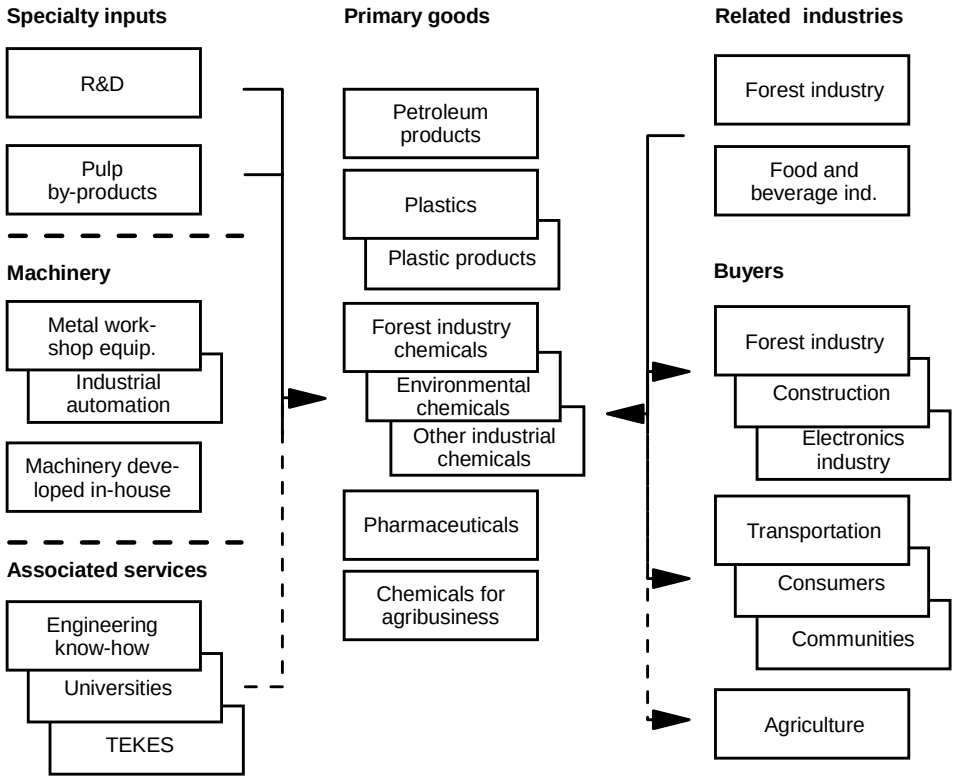
The Kemira Group has grown into a multi-product chemical company; it is one of the world's leading producers of fertilizers and titanium dioxide pigments. A wide array of other industrial chemicals e.g. in the pulp and paper sector as well as water treatment chemicals and paints are offered as well. Various activities in the Finnish chemical industry are summarized in figures 4.27 and 4.28.

Figure 4.27 Core areas of the Finnish chemical industry



51) Polarcup's market shares in fast food packaging products and vending cups for cold drinks is almost 70 % - in Australia!

Figure 4.28 The Finnish chemical cluster



4.9.3. Strong connections to domestic customers

Interrelations in the chemical industry are not particularly strong - e.g. the oil chain outside Neste/Borealis is rather loose. However, the chemical industry belongs to and strengthens many other clusters. For instance, pharmaceuticals are part of the well-being cluster (section 4.6).

The Forest cluster: a demanding and innovative partner

Over a dozen companies manufacture chemicals for the forest industry in Finland. Some of them - like *Dow Finland* - are subsidiaries of foreign companies, and serve mainly the Finnish market.

The resolute internationalization strategy of both *Raisio* and *Kemira Chemicals* has given these two companies firm footholds also in the international markets for forest industry chemicals. They have also benefited from the internationalization of their domestic buyers, Finnish forest

industry firms, who have pulled their chemical suppliers along with them to Europe. Kemira Chemicals' main growth areas are pulp and paper chemicals, e.g. bleaching chemicals such as hydrogen peroxide (H_2O_2). Its strengths in these rather oligopolistic markets are innovative production technology - the H_2O_2 process has been developed in-house - and sophisticated products. Kemira ranks 7th among world peroxide producers in terms of market share. Kemira is also one of the leading firms in the world in TiO_2 pigments for such processes as paper laminating (see box 4.13).

The Raisio Group's paper chemical production started a quarter of a century ago, but hardships on the path to internationalization were not overcome until the 1980s. Raisio enjoys a raw material advantage, because its production process utilizes recovery potato-starch. Its European market shares top 25%. Its domestic market shares are high and growth is sought from abroad where the company has several production units. Raisio's R&D investments in paper chemicals are high and it has one of the largest paper chemical know-how centers in the world.[51)] An exceptional feature is the cooperation in R&D with other firms in the forest cluster - most notably *Partek*, a building products and minerals manufacturer and Valmet, the world's leading paper machine manufacturer. The latex product line, on the other hand, was started together with a major Finnish paper producer.

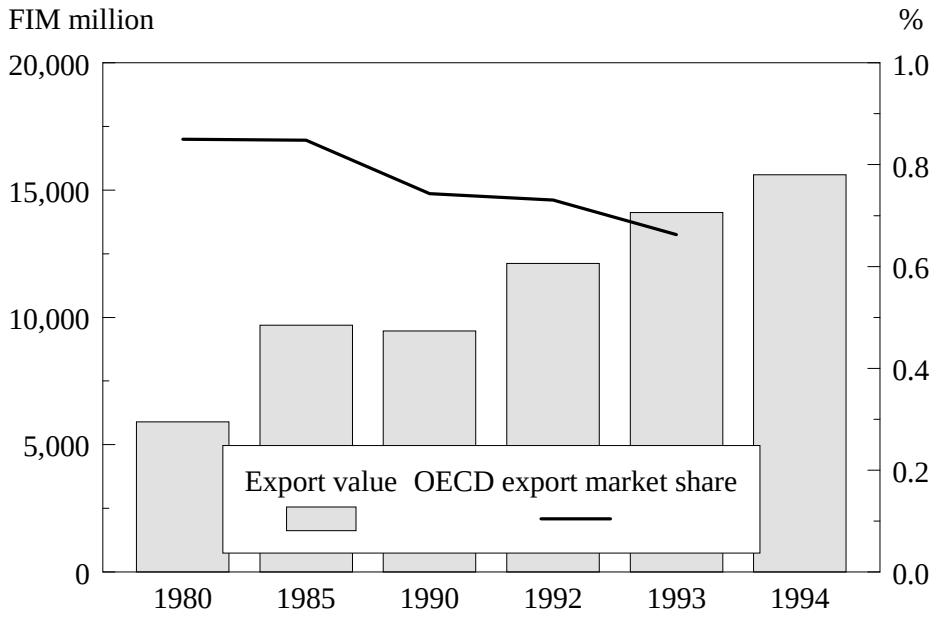
The geographical proximity to the Scandinavian pulp and paper industries gives domestic chemical firms some advantage against foreign competitors. Cooperation within the Finnish forest cluster and the sophisticated and demanding domestic customer base is, however, more important. The chemical producer offers solutions to specific problems and the business depends heavily on customer orientation and the relationship of trust.

Anticipatory demand in construction

Uponor is among the world's top five plastic pipe producers. The production is raw material-intensive and the bulk of pipe systems are produced locally in some 30 plants in Europe and North America. Technically advanced fittings are exported. Neste (a former shareholder) provided business backing in Uponor's internationalization but the primary competitive instrument - product know-how - was acquired from connections to construction. Finnish construction has been forward-looking in

51) Huge R&D investments were carried out in the early 90s.

Figure 4.29 Exports of the Finnish chemical cluster and its OECD export market share



Source: OECD, ETLA, Board of Customs

using plastic pipes and the markets abroad are expanding. Competition with another Finnish owned firm, *KWH Pipe*, is keen. In contrast to the troubled construction sector, the exports of building services offer growth opportunities also for the plastic products producers.

Packaging foodstuffs and medical equipment

Plastic films and sheet production is a volume-driven, capital-intensive business, where economies of scale persist. UPM's[51)] plastic packaging business enjoys synergy with the group's packaging board production. *Wihuri* has specialized in food and medical packaging and internationalized to Europe (no. 1) and North America. Cost-efficient innovations in complex production technology and cooperation with a domestic food firm have boosted business. Other film and sheet producers are in the lower value-added segments, where cost pressures are even more stringent.

Components for electronics and telecommunications

The boom in Finnish electronics and especially the telecommunication industry has also stimulated subcontractors of plastic products. The raw

51) United Paper Mills - one of the leading paper mills in Europe.

materials (technical plastics) are procured abroad and the competitive advantage lies in mastering the high precision production process. Total net sales are somewhat over one-half billion FIM and come from a few dominating firms (e.g. *GWS Perlos*). Future prospects are bright.

Main firms of the chemical industry are listed in the table 4.22. Neste tops the ranking (net sales include trading: FIM 24,338 million). The joint venture of Neste and Statoil, Borealis, ranks second, but its activities in Finland are smaller than those of Kemira's. Petroleum products, pharmaceuticals and car tires are the only consumer products produced by these major Finnish chemical firms.

Neste's oil products top the list of commodities by export value (table 4.23.). Kemira's artificial fibers production (6th) originate from the Finnish forest cluster back before WW II. Cobalt oxides and hydroxides have the highest export market share. They are a spin-off from the base metal cluster firm Outokumpu and are now produced by *Kokkola Chemicals*. The bottom of table 4.23. reveals the somewhat grim fact that the importance of the chemical industry in total national exports is not relatively high in Finland.

4.9.4. Scarce domestic raw materials

Domestic raw material inputs for the chemical industry are scarce. Domestic minerals are used in fertilizers and some industrial chemicals (e.g. talc for the paper industry). Kemira is expanding gypsum paper pigment production. Agriculture gave rise to Raisio Chemicals' starch upgrades, which are gaining worldwide momentum as paper binders and coaters.

Wood pulping gives by-products e.g. tall oil and pulp to the production of carboxmethylcellulose (CMC). Two major Finnish paper mills (UPM and Enso) jointly own *Forchem*, which is among the world's five largest distillers of tall oil and turpentine. Upgrading of by-products offers a broad product range, the customer base of which is growing, most notably in biodegradables. Forchem's distillation is bounded by the growth of the pulp production in Finland, but upgrading possibilities are notable. CMC is a pulp upgrade manufactured by *Metsä-Serla Chemicals*, a subsidiary of a major Finnish paper mill, Metsä-Serla. End-uses of CMC are versatile, market-share high and the production is technology-intensive. A formerly domestic pulp grade is used to produce fibers (Kemira) and artificial sausage casings (*Visko Oy*). Both have an export share well over 80%.

Table 4.22 Some of the companies in the Finnish chemical cluster

Company	Products and services	Net sales, MFIM	Person-nel	Foreign net sales, %
Neste	Oil refining, resins, oxo products, polystyrene, SB latex	49 201	8 195	70
Borealis Group	Polyolefins, crackers	12 200	6 536	> 90
***Borealis Polymers**	Polyolefins	4 900	1 164	80
Kemira	Industrial chemicals, pigments, plant nutrients, paints, fibers	11 698	11 156	76
Orion	Pharmaceuticals, cosmetics, hygiene products	3 856	5 092	37
Uponor Group	Plastic pipe systems	3 512	3 210	over 80
Wihuri Oy Wipak &Winpak Group	Food and medical packaging material	1 551	1735	over 95
KWH Group ***KWH Pipe** ***KWH Plast**	Polyolefin-based pipe systems, PVC and PP sheetings	1 140	1 591	74
Raisio Chemicals **Raision Tehtaat** **Repola**	Starch products, latexes, paper chemicals	1 055	547	25
***W.Rosenlew**	Plastic packagings	1 000	1 684	na
Nokian Renkaat	Car tires	976	1240	71
Kokkola Chemicals	Cobalt and nickel chemicals	947	215	97
Leiras	Pharmaceuticals	868	1 251	53
Finnish Chemicals	Pulp bleaching and paper chem.	670	379	12
Metsä-Serla Chemicals	Carboxmethylcellulose (CMC)	602	348	83
Aga	Air and fuel gases	541	572	1
Teknos	Paints	493	650	0
Dynoresin	Panel board resins, paper overlays	420	403	15
Rani-Plast	Agricultural, stretch and coexstruded films	390	430	50
Forchem	Tall oil fatty acids&distilates, rosin derivatives, turpentine	380	241	80
Akzo Nobel Deco	Paints, adhesives, inks	360	336	18
Dow Finland	Chemical raw materials, latexes	340	41	0
GWS Perlos	Technical plastic components, e.g. mobile phone covers	334	684	52
Kiilto Group	Adhesives and related products	302	261	12
Genencor International Europe	Enzymes	216	180	over 90

Table 4.23 The main export products of the chemical cluster

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 Gasoline	4.9	1976	1.28	24
2 Gas oils	2.1	958	0.62	-2
3 Titanium dioxide pigments	6.6	760	0.49	5
4 Medicaments in retail packaging	0.4	610	0.40	40
5 Special plastic films, foils and sheets	3.4	549	0.36	10
6 Unprocessed artificial staple fibres	14.5	453	0.29	1
7 Fertilizers containig N, P and K	5.7	321	0.21	4
8 Car tires	0.6	307	0.20	46
9 Prepared special enzymes	3.6	299	0.19	3
10 Cobalt oxides and hydroxides	40.3	291	0.19	20
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 Cobalt oxides and hydroxides	40.3	291	0.19	-2
2 Pitch and similar rosin preparations	36.5	44	0.03	42
3 Unprocessed artificial staple fibres	14.5	453	0.29	8
4 Tall oil	12.8	47	0.03	4
5 Wood pulp residual lyes	11.3	44	0.03	10
6 Phenol and its salts	8.9	242	0.16	14
7 Phosphoric and polyphosphoric acids	8.7	142	0.09	20
8 Nickel sulphate	8.0	203	0.13	24
9 Carbonates (subgroup)	7.4	124	0.08	37
10 Calcium chloride	7.0	47	0.03	23
Exports of national clusters in selected OECD countries, 1993	**% of total national exports**		**% of exports in OECD**	
1 Switzerland	26.2		4.5	
2 Netherlands	24.7		8.9	
3 Ireland	23.6		1.7	
4 Belgium	20.7		6.3	
5 Great Britain	18.9		8.5	
6 Norway	18.4		1.5	
7 France	17.5		10.0	
8 Germany	16.9		16.5	
9 USA	14.3		15.9	
17 Finland	10.5		0.7	

4.9.5. From state-owned companies to world players

Chemicals can be characterized as being either bulk commodities or fine and specialty chemicals. The nature of commodity chemicals offer substantial economies of scale both in production technologies and in marketing. Concentration rates are high and the need to be a world player is decisive. Competitive advantage lies in mastering the production technology, gaining high market shares and controlling backward integration to raw materials. Logistics costs favor multi-country production. In international comparison, the share of commodity chemicals is high in Finland.

Finnish chemical firms have striven to be world players by specializing in selected narrow segments and by foreign acquisitions. For example Kemira has purchased a major share of European fertilizer production and is also strong in TiO_2. Both Uponor and KWH Pipe have several units abroad.

Only a few plastic products manufacturers have so far gained a foothold in international markets. They are either volume-driven producers with adequate economies of scale (plastic films and sheets, food packaging, pipes) or electronics subcontractors. 'High-tech' production, e.g. composite materials is rather insignificant.

Box 4.13 Kemira Pigments Oy - a world player in titanium dioxide pigments

The joint efforts of several state-owned companies brought about the production of titanium dioxide (TiO_2) from a domestic iron ore by-product in the early 1960s. The production process of titanium dioxide is one of the most complicated within the chemical industry. The predecessor of *Kemira Pigments* licensed the know-how from the world leader of those days, and it was widely conjectured whether the Finns could even master the technology.

The TiO_2 pigment production was not developed to serve the domestic market: the share of exports was soon over 80 % and the export strategy was to serve global markets. In addition to building up domestic capacity, major acquisitions have been made in the USA and the Netherlands. The share of foreign operations (incl. exports) is now over 96% and world production share is 10%.

The strengths of Kemira's TiO_2 products lie in the successful internationalization in order to acquire modern production technologies in existing plants and thus avoid risks. Through acquisitions Kemira has achieved synergistic advantages in marketing, product range and production technology. Kemira Pigments follows a customer-oriented differentiation strategy and aims at producing to all TiO_2 segments offering unique solution to its customers.

The size of Finnish chemical companies is often small even in their core segments. Neste Chemicals had a strong polyolefin production, but

merged it with Norwegian Statoil's petrochemicals and polyolefins businesses to form the Borealis Group. It is now Europe's largest and the world's fifth largest producer in its field. The rest of Neste Chemicals consists of many unrelated products often in niche areas. Emphasis is on adhesives and coatings applications, e.g. in forest industry products, where the world market shares are the highest and the advantages from the strong forest cluster most evident.

4.9.6. Lost opportunities

As a consequence of the bilateral trade between Finland and the former Soviet Union, oil product imports to Finland were regulated until 1991. In practice Neste enjoyed as a refiner a domestic monopoly in many oil products. This and the benefits of state ownership caused slack in the business, although technical productivity was high and Neste's refineries were developed on a par with the top European refineries.

Value-added was also sought after in vigorous vertical integration, e.g. with oil retail sales. With several acquisitions Neste also entered into semi-finished and finished plastic products businesses, competing with its own clients. This distorted competition and caused considerable mistrust among other plastic products producers. The R&D efforts with Neste are still shunned. Neste has now withdrawn from some enterprises. Neste's R&D was active in developing various high-tech plastics and combining plastics and wood. Research on conductive plastics is promising.

The Finnish pharmaceutical industry is in the hands of two firms, Orion and the somewhat smaller Leiras[51)]. Intensified foreign competition has cut domestic market shares by one-half to one-third but through specialization exports have grown threefold in 10 years. In addition, substantial exports to the former Soviet Union have been redirected to the West.

The Finnish pharmaceutical industry enjoyed patent legislation for decades, which allowed them to copy foreign compounds as long as the production method was different. The resulting high profitability did not, however, lead to respective stakes in R&D. The two main strategies now followed are combining existing compounds and techniques in a new way and developing and patenting original medical molecules. Especially the

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51) In international comparison both are small. See section 4.6, p. 99: The well-being cluster

latter involves great risks - as does the pharmaceutical industry as such, in particular for firms operating in narrow segments.

4.9.7. New possibilities

Neste's petroleum refining has three main sources of competitive advantage. First, it has a logistic cost advantage in supplying products to Finland, the neighboring Baltic States, and northern Sweden. Neste also profits from the geographical proximity of Russia for its imports. A second cost advantage stems from Neste's process know-how. The two refineries are technically good. Neste has not been an innovator, but rather followed a second-best strategy: it is superior in adapting new technology.

Neste's third advantage is its effort to make environmentally superior products. This goal is evident in all Neste's activities, but especially in its petroleum products. Consumer environmental awareness is growing, but for the time being their willingness to pay extra for environmental products has been moderate. Neste has, however, benefited from tax relief on the line of environmentally friendly products it produces. In this field it is a leading innovator and has a competitive edge in more distant markets.

Kemira provided pulp mills with water treatment chemicals already in the 1970s. Environmental management was launched at Kemira in the late 1980s and environmental protection was seen from the very start as an opportunity, not a threat. The focus has hence shifted from environmental protection to utilizing its business opportunities. The environmental business covers almost 10% of Kemira's net sales.

Water treatment chemicals for municipalities and the forest industry are Kemira's specific strength. Kemira advocates a method where chemical treatment supplements the traditional biological process. Kemira is the largest supplier of water treatment chemicals to the Nordic countries. The greatest potential in chemicals for communities are in Western and Southern Europe, where market shares are now considerably lower and (in the long run) in Eastern Europe. Market growth outside the Nordic countries is estimated to be fast.

The relationship of trust with the Nordic forest industry gives Kemira a strong foothold in the Nordic countries but internationally, market shares are small. The respect the Nordic forest firms enjoy worldwide also helps

Kemira to expand markets to Europe as well as the U.S. and Canada, where the demand is increasing.

Besides water treatment chemicals, Kemira's environmental products include e.g. H_2O_2, which replaces chlorine in pulp bleaching, special forest nutrients and catalytic converters.

Strict environmental standards have given impetus to the environmental business in Finland, and protecting the environment offers huge business possibilities. Neste, Kemira and to a lesser extent Raisio and *Primalco* are, however, in the chemical industry the major active firms in Finland.

Box 4.14 Biotechnology: Limited size and success

There are only a dozen established firms active in biotechnology in Finland. They are major firms in food and agriculture, well-being (diagnostics) and the forest industry. In addition there are some 30 small and medium-sized firms in biotech.

Clear commercial success stories are largely lacking in Finland. Some diagnostics products (by *Wallac* and *Finnzymes*) have a more or less stable market position. Industrial enzymes are also promising. *Genencor International Europe* (*Cultor Ltd* and *Eastman Chemicals*) has grown into a major producer of industrial enzymes in Europe.

Limited resources hinder the development. Finland has limited possibilities to participate in the development of new drugs. Diagnostics can, however, derive advantage from the high level of the Finnish health care system and biomedical research. Furthermore they do not require as costly control and testing as drugs.

The forest industry, on the other hand, has internationally competitive resources, traditions and know-how. Some products are in the research and development phase or their commercialization and marketing processes are under way.

The inevitable solution is to form alliances with large foreign companies in order to get financing and marketing channels, as in many cases has already happened. Biotechnology will still for long have only a marginal significance in the Finnish industry.

4.9.8. Conclusion: an industry in transition

Some two-thirds of chemical production in the world can be characterized as being some kind of bulk commodity. This constitutes the core of Europe's chemical industries' dilemma. In commodities the focus on cost dominates production, competition from industrializing and oil-producing countries grows and the demand rises merely in accordance with GDP. In other words, the industry is in part matured.

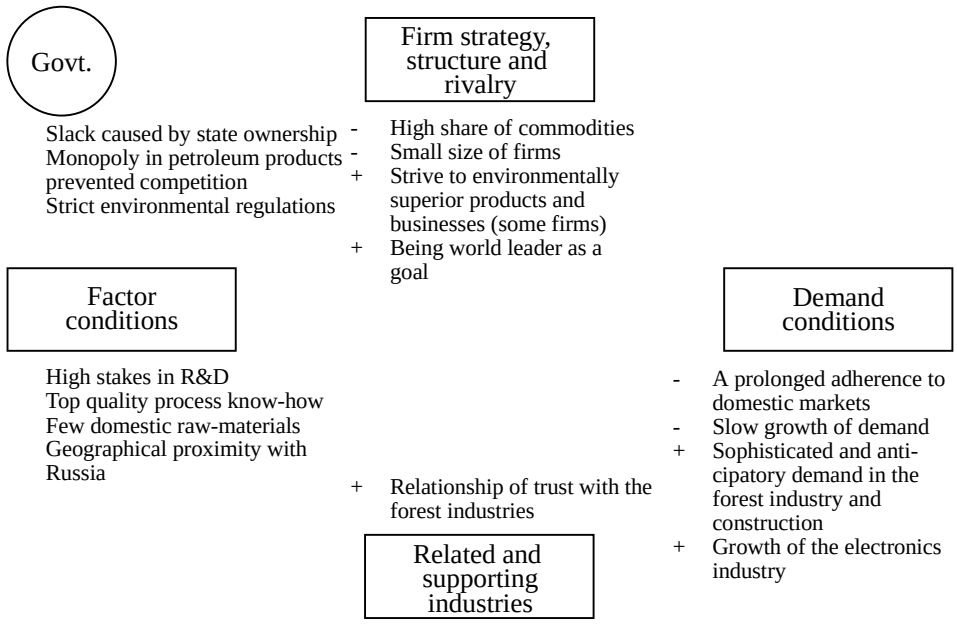
In Finland this is even more evident, because the share of commodities is remarkable. The chemical industry has responded to this varyingly. It has

through acquisitions gained a critical mass and become a world player. It has, through superior process know-how, gained cost advantages. It has differentiated products by adding environmental content to them. But most promisingly, the emphasis has turned to specialty and fine chemicals; this is particularly the case in forest and environmental chemicals.

The Finnish chemical industry manifests this need to create competitive advantages based on product differentiation and know-how. Competitively priced factors of production, economies of scale, bulk products or even productivity growth do not as such offer sustainable advantages.

Operations in the forest and environmental clusters prove this right. Neste is acquiring through its environmental products a lead, from which profits will be reaped in the future. Neste's other advantage - a location between oil sources and consumption - is of a more traditional nature, but still considerable: it will strengthen Neste's position in the Baltic Rim.

Figure 4.30 Determinants of competitiveness in the chemical cluster



Kemira's shift into environmental and forest chemicals (incl. TiO_2) is also a clear sign of a need to withdraw from a slow-growth bulk business that

the chemicals for agribusiness offer.[51] The whole sphere of forest-related chemicals, both as inputs and as by-products and upgrades, benefit from the keen competition, cumulative know-how and many interactions in the forest cluster.

The growth of the Finnish chemical industry will be hindered for some time by its high share of commodity-type products. Some businesses grow slowly or are scaled down and new ones need time to establish themselves. Additionally, the need to internationalize the new segments from the very beginning calls for time. However, as late as it may have happened, the Finnish chemical industry is slowly turning to advantages based on know-how and slowly gaining a foothold in the more advanced segments of the branch.

[51] Raisio is likewise shifting strongly from foodstuffs to paperchemicals.

4.10. The construction cluster - Who needs a customer anyway...? [51)]

As far as employment is concerned, the construction cluster is one of the most significant ones in Finland. At the beginning of the 1990s the cluster nose-dived; personnel dropped from 350,000 to 200,000 in a few years. The core of the cluster, the construction itself, was hit the hardest. The sheer magnitude of the branch emphasizes the importance of a recovery. Mostly building materials and equipment are exported, although Finns have had varying success in building projects, mainly in the territory of the former Soviet Union and earlier in the Arabic countries. Figure 4.31 illustrates the broad scope of the cluster.

The most internationalized companies of the cluster are *Abloy* (security systems) *Kone* (elevators), *Metra Sanitec* (bathroom ceramics), *Uponor* (plastic pipes), *KWH Pipe* (district heating pipes), *Partek* (concrete), *Rettig* (radiators), and *Halton* (air conditioning).

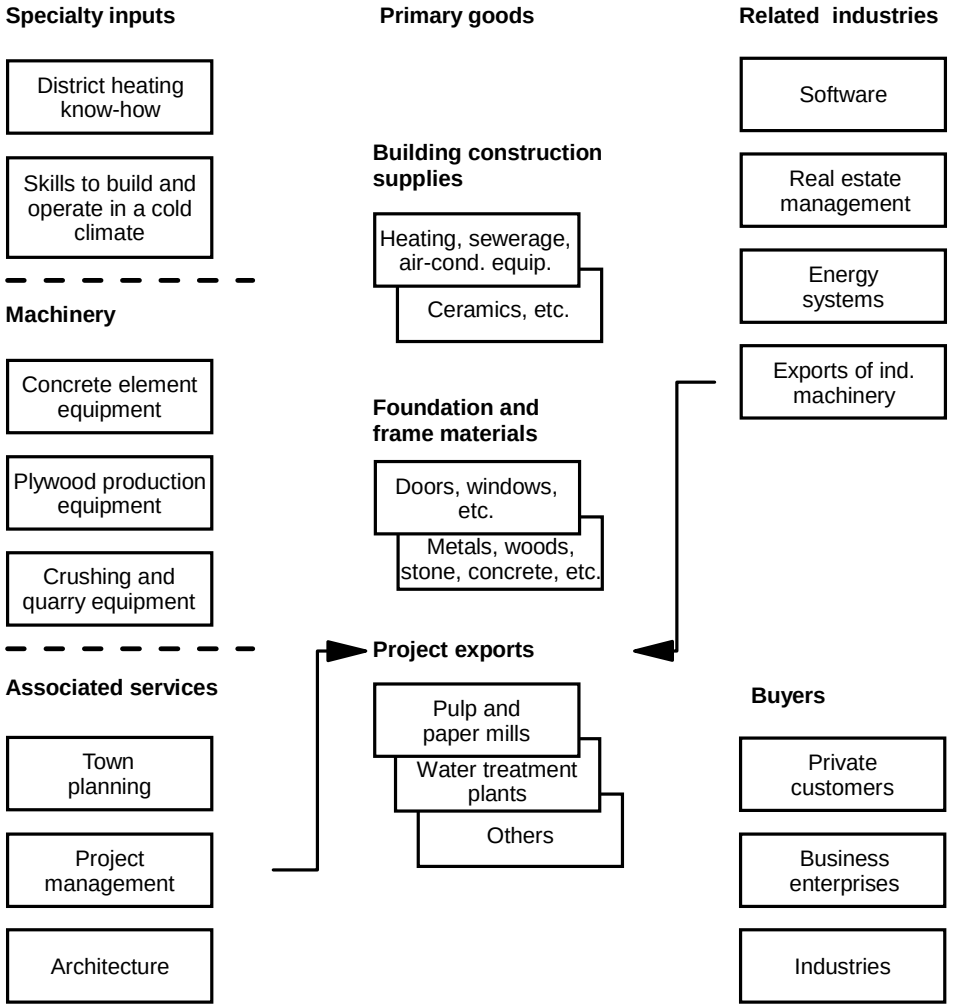
In 1994 the exports of the cluster were FIM 27 billion; out of this over FIM 3 billion were exports of building-project expertise. Main products were sawnwood and timber (see the forest cluster), semi-finished metal products (see the metal cluster). Actual construction products were a minor share of the cluster, the two biggest products being prefabricated houses and faucets.

4.10.1. Reconstruction laid the foundations of the cluster

During the Second World War 9,000 Finnish homes were destroyed, 70,000 Karelians (the people living in Eastern Finland) were forced to relocate as part of the territory was lost to the Soviet Union, and 60,000 front-line soldiers and veterans were given new homes or a site for one. Also, a significant part of the industrial infrastructure was lost, and it had to be rebuilt. Paradoxically, it was this fierce reconstruction that is one of the reasons behind current problems and unsatisfactory export performance. High demand meant easy earnings for constructors. Government set the standards in order to maintain the desired quality, but at the same time left little room for innovation. In the late 1980s the construction industry experienced a boom before bust; during the expansive years real estate

[51)] Follows mainly J. Matilainen, P. Pajakkala, E. Lehtinen, 1994, *Innovations for new markets through cooperation - competitiveness of the construction cluster*, The Research Institute of the Finnish Economy, ETLA B 97 (in Finnish).

Figure 4.31 The Finnish construction cluster



and stocks were two of the main speculative instruments. The prices of old and new sites broke the ceiling. The stock market tumbled in the late 1980s, and real estate followed shortly. The participants of the construction cluster were left with empty hands; they had relayed on the booming home market and had not looked elsewhere.

In some cases the experiences of the reconstruction have also been a source of competitive edge. Finns developed rather sophisticated methods to build concrete structures almost overnight - the concrete element standard rationalized efforts. Currently Finnish companies are contractors in the Russian military-town projects financed by the Germans; an enormous

amount of affordable accommodation is needed the relocate the Russian soldiers from the former East Germany.

4.10.2. Timber in a new disguise

Wood as a raw material has been neglected in domestic building. Finns have let foreigners gain a competitive edge over the most forest-dependent country in the world. The mechanical forest industry (sawnwood, plywood, etc.) could have been more active in offering its products. Instead it has chosen to produce standard grades of sawn timber. The main reason, however, has been a lack of demanding customers - wood has been an unfashionable material among the most important buyers.

Timber, once the sole building material in Finland, is experiencing a second coming. Research has found methods to increase the hardness, durability, and fire resistance of wood. Prefabricated wooden houses have also found surprising export destinations - the market share of Finnish log houses has grown in Japan.

4.10.3. Conclusion: customer relations should be established

The basic problem of the construction cluster is a lack of customer orientation. End-users are not consulted during the designing and construction phases; information about customer needs is transmitted through a rather weak mechanism of what is bought and sold. Legislation rather than customer needs have guided constructors. Now arrogance should be replaced with a willingness to serve.

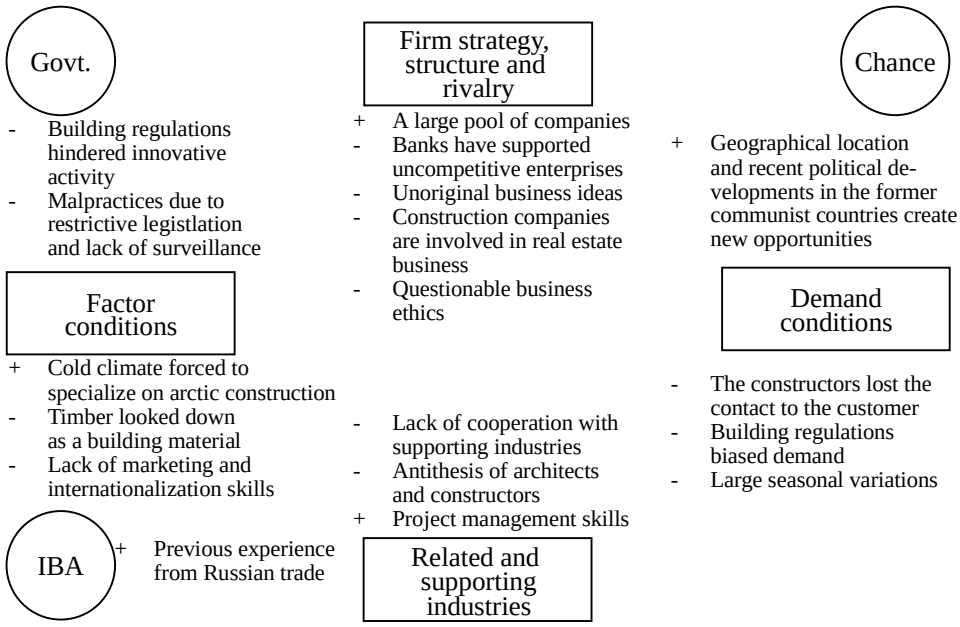
The Finnish banking sector, and consequently the Finnish taxpayers, have supported unprofitable construction firms. By supporting the least competitive enterprises they have destroyed the preconditions for a functioning market. Structural imbalances were maintained too long and now the bill is being paid.

The former communist bloc is the most promising markets for Finnish export efforts. The vanguard of the export market has been, and is, successful even in the most demanding markets in Central Europe.

Chemical pulp and paper mills, water-treatment plants, and cold-storage systems are export projects which have clear links to other Finnish

clusters and domestic factor conditions - designing and managing these projects abroad is a strength that could be further exploited. Determinants of competitiveness are summarized in figure 4.32 below.

Figure 4.32 Determinants of competitiveness in the Finnish construction cluster



4.11. The foodstuffs cluster - Please, just maintain the status quo.[51)]

4.11.1. Abundant lobbying power has guaranteed ample public subsidies

The institutional context of the foodstuffs cluster is quite different from the ones discussed above. The farmers' interest group (MTK) has been one of the ruling powers on the Finnish political scene, and it has managed to arrange heavy public subsidies for agriculture. Besides direct income transfers, effective import protection was provided. Against this background it is obvious, that the incentive mechanism in agriculture has been biased. A hefty 80% of production is directed to the Finnish markets of only 5 million consumers. Exports even at this level would not have be possible without public support.

The national importance of the foodstuffs cluster is nevertheless significant: the foodstuffs industry employs 40,000 people, and there are an additional 150,000 persons in agriculture. The cluster has been caught in a negative spiral - the functioning of the determinants supporting competitiveness has been hindered or their development neglected.

As Finland became a full member of the European Union, a new era started in the foodstuffs cluster. Competition has increased especially in processed foods, whereas the Union is not pushing for a rapid restructuring of agriculture itself. It should be noted, however, that since Finland joined the EU many actions have been taken to reform Finnish agriculture.

4.11.2. A historical chance to turn the negative trend around

Processed foods and refined raw materials are considered the core of the cluster. Agriculture is naturally the main source of raw materials. The structure of the field is illustrated in figure 4.33 below.

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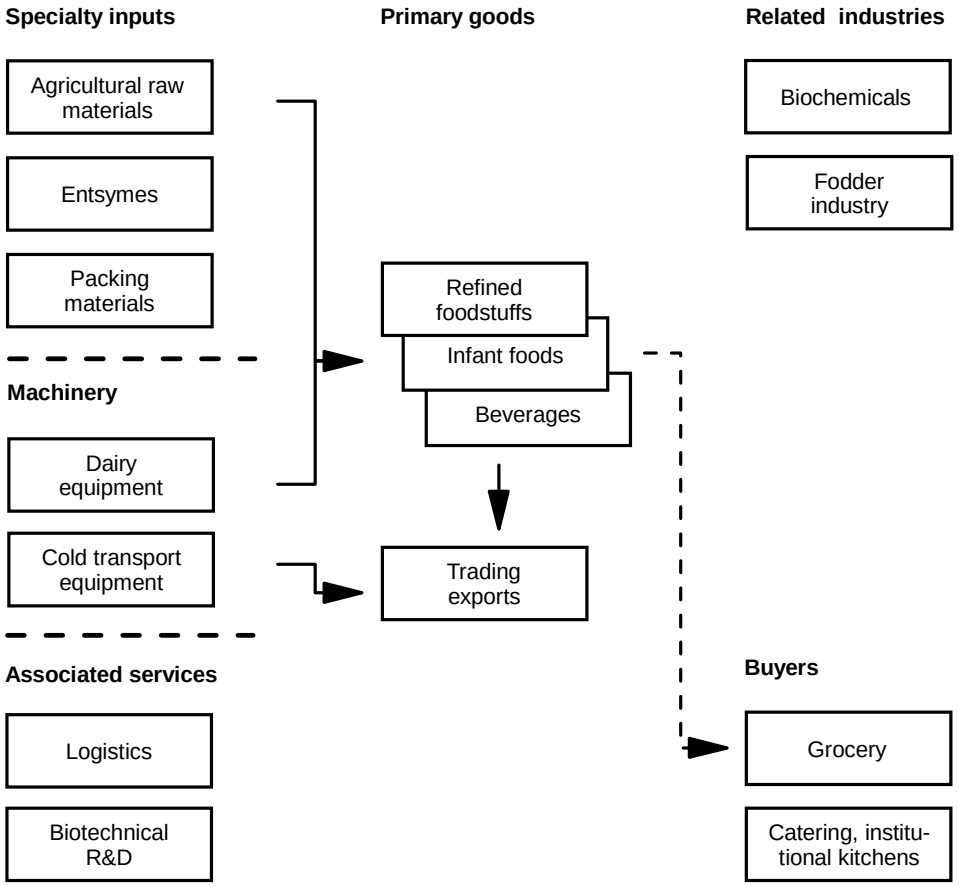
51) Follows partly K. Laaksonen and R. Volk, 1995, *Competitiveness of food cluster - preliminary results*, The Research Institute of the Finnish Economy, ETLA DP 501 (in Finnish).

Figure 4.33 The Finnish foodstuffs cluster



Trading exports to Russia and to the Baltic countries have increased considerably in the 1990s. Chemical production based on agricultural raw materials is expected to expand; for instance, potato based chemicals are a success in the paper industry.

Few companies manufacture machinery for the foodstuffs industry. Only dairy machinery and cold transportation & storage units are argued to be internationally competitive. *Huhtamäki* and *Cultor* have been the flag ships of Finnish foodstuff exports. *Huhtamäki* has acquired many internationally known confection brands and is currently the 10th biggest manufacturer in the world. *Cultor* has marketed a Finnish sugar-free sweetener - birch based *Xylitol*.

The firms in the cluster have been unable to support each other. A beggar-thy-neighbor policy has been favored in the inwardly orientated

oligopolistic competition. Most of the participants in the cluster have been defensive - they have tried to maintain the status quo instead of developing real competitive strengths. The state of affairs in both east (Russia) and west (the EU) offers a historical chance to turn around the negative trend in the cluster.

Box 4.15 A counterexample - Huhtamäki succeeds internationally in extremely competitive segments

Huhtamäki was founded in 1920 to manufacture confections and chemicals. Currently the biggest part of the Huhtamäki Group is *Leaf*, which produces confections. Other subsidiaries are Leiras (pharmaceuticals) and Polarcup (packaging and throwaway dishes).

Huhtamäki started export experiments in the 1930s, although as late as the 1950s foreign sales were quite irregular, functioning mainly to smooth the fluctuations in the domestic markets. In the 1960s the company decided to put more emphasis on its efforts abroad; the focus evolved more clearly to confections. In the 1970s exports increased considerably, and sales offices were established for the main destination countries. In 1983 the clearly Finnish firm made a radical move: during the later half of the year 13 confection manufacturers were bought from the United States, Canada, and Ireland. A new subsidiary, Leaf, was formed. An intense restructuring took place and was not finished until 1989. Between 1983 and 1989 an additional 40 acquisitions were made. From 1990 to 1992 FIM 1,5 billion was invested on improvements of production facilities.

Huhtamäki has had numerous competitors in domestic and international markets. It has been able to compensate for the high price of domestic raw materials by concentration on high value-added products. Nowadays it has a solid foothold in the market place, a strong portfolio of brand names, and efficient production. Courage in the early stages of development, aggressive competition in the international markets, and excellent management has made Huhtamäki a prosperous company.

4.11.3. Conclusion: death throes of a dinosaur or a new beginning?

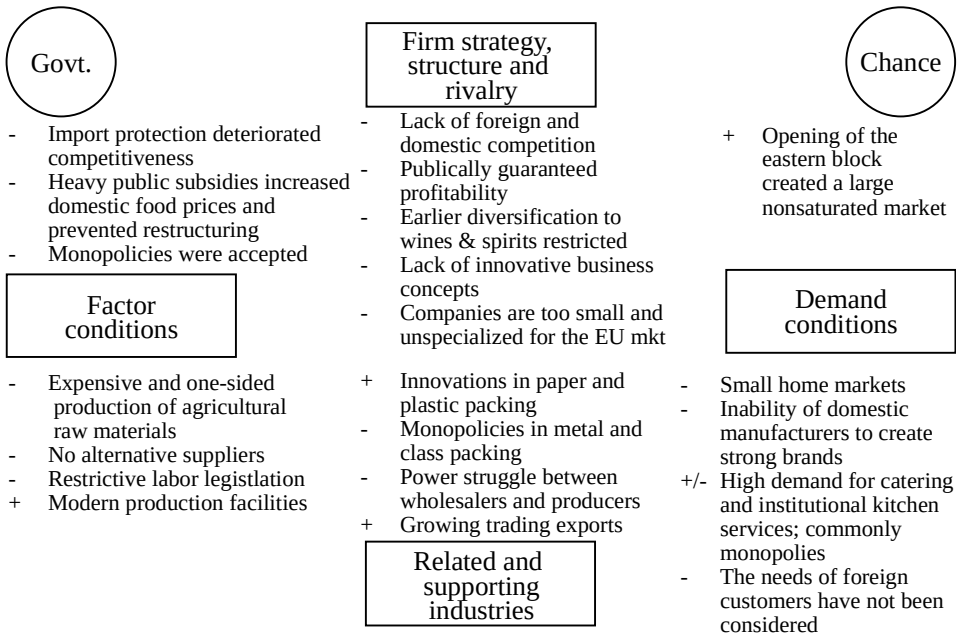
The foodstuffs cluster is a good example of what can happen if the natural functioning of a competitive market is hindered for decades. In Finland, and often also elsewhere in the world, the agricultural sector has been supported to an excessive extent. Competition in many products has been nonexistent. The farmer’s interest group, MTK, was at the height of its power during the Finnish European Union negotiations; with its backing the agricultural sector was guaranteed transition support, which must be considered fortunate.

At the same time it is obvious, that the Finnish economy can not maintain the agricultural sector in its current form for much longer - the costs are simply intolerable. Eventually increasing competition will shake off the

fat, and leave the companies and entrepreneurs that are capable of finding true competitive advantages.

Natural products and health foods are promising articles for Finnish farmers in today's context. It is known that the Finnish environment is much less disturbed than in central Europe - Finland could provide Europeans with the environmentally friendly and pollution-free foodstuffs they passionately desire. Developments in Russia and in the Baltic states have opened many new possibilities for the Finnish foodstuffs industry. St. Petersburg alone is a market of seven million consumers. Especially in Estonia, Finns have been active investors in this segment. There have been signs that some Swedish and Finnish companies may merge in the near future to form bigger and more competitive units. The determinants of the cluster's competitiveness are summarized in figure 4.34 below.

Figure 4.34 Determinants of competitiveness in the Finnish foodstuffs cluster



4.12. Successful enterprises outside established clusters - visionaries forge new paths[51)]

There are many examples of companies succeeding without the support of a cluster - entrepreneurs pushing through solid rock, trusting their own visions. In Finland the number of these lonesome but successful companies is small, and yet they just may be one of the few ways to expand the Finnish national wealth in the long-run. In the following small high-technology companies are in focus. The findings are based on case studies of *Exel*, *Fimet*, *Finlandia Interface*, *Polar Electro*, *Suunto*, *Tunturipyörä*, and *Vaisala*.

4.12.1. Core competencies: innovativeness and personal contacts

Innovativeness is the most salient and defining characteristic of a successful entrepreneur. Personal contacts are also particularly important as an efficient means of information gathering. Before founding a business enterprise, the core competence is accumulated for quite some time - typically from 7 to 20 years. Especially technology-driven companies often have close ties to academia and research institutions. The knowledge base itself, however, is not enough. The character of an entrepreneur is quite important - the initial decision requires a lot of courage, and the founder sets the operating principles of his firm.

The first few years after the company is founded normally show the true market potential. Studies in various countries demonstrate that approximately 50% of newborn companies are eliminated within the first five years.

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51) Follows mainly P. Lehtonen, 1995, *Success of small technology-driven companies - an analysis of seven cases*, The Research Institute of the Finnish Economy, ETLA DP (forthcoming, in Finnish).

Table 4.24 The core competencies of some technology-driven small companies

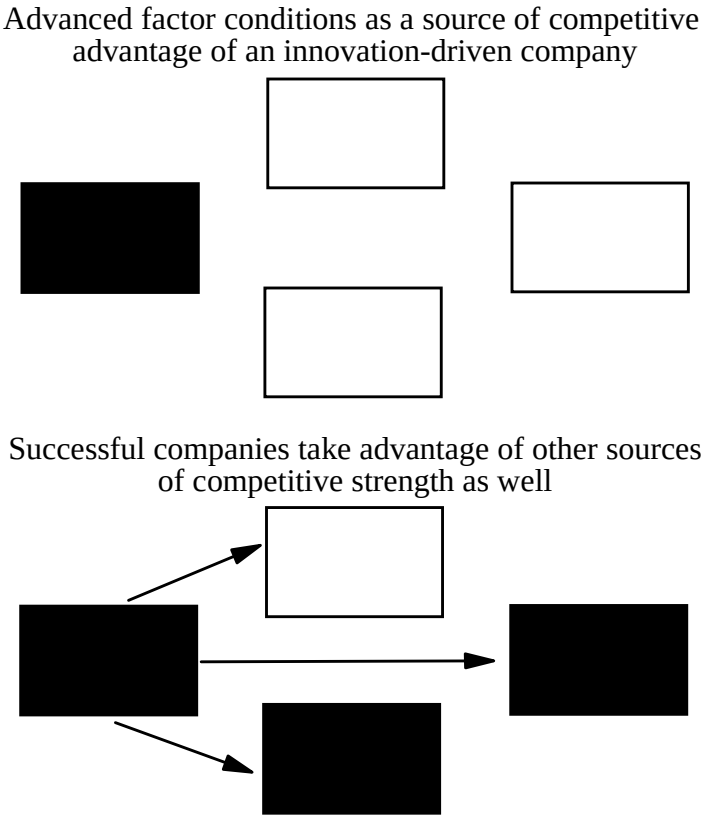
Company: products	Founder/innovator	Source of core competence
Exel: sporting goods, fiberglass etc. profiles	Yrjö Aho and two other chemists	Profound knowledge of chemicals and composite materials. Aho's hobby (shooting).
Fimet: dentist's chairs	Tuomo Janhunen	Research in the Helsinki University of Technology and managerial duties in two companies manufacturing dentist's chairs.
Finlandia Interface: power supplies	Many developers	Knowledge acquired by working in previous jobs.
Polar Electro: heart rate monitors	Seppo Säynäjäkangas	Work at the university. Personal contacts.
Suunto: compasses	Tuomas Volhanen.	Previous work (surveying) and hobby (orienteering) gave ideas for needed products.
Tunturipyörä: fitness bicycles & other equipment	The Harki brothers.	Owned previously a bike repair shop, and gathered some of the required skills. Internationalized when the know-how in building bikes was applied to fitness equipment.
Vaisala: meteorological measuring	Vilho Väisälä	Work at the university. Personal contacts.

4.12.2. Prelude to a cluster

An innovation-driven cluster may be born in the surroundings of a single high-tech company. The process can be illustrated by figure 4.34.

In the first stage advanced factor conditions, often world-class research in some branch, are the driving force. It is quite possible that the market segment as such does not even exist at the moment, but some entrepreneurial scientists have a vision of the future developments. In the next stage, when a business enterprise is founded, many practical matters have to be considered. While the founders are quite acquainted with the core technology, they will need knowledge of many related fields before plans for the new product are finalized. Contacts to suppliers and subcontractors should be established. The target customers have to be identified. Also potential competition needs to be considered.

Figure 4.34 The birth of an innovation-driven cluster



After initial success, new companies may enter the market. It is quite possible that competitors are geographically close - they take advantage of the same favorable factor conditions and even recruit key personnel from the leading company. In some cases a vigorous new cluster is born; the time span, however, can cover decades.

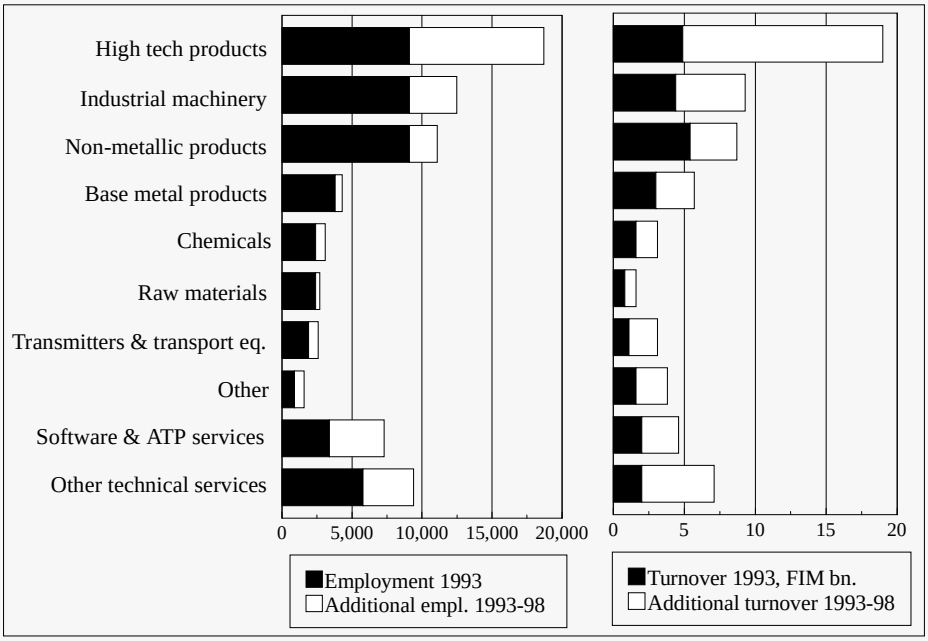
The Finnish telecommunications cluster has gone through the development described above. In the first stage, Jorma Nieminen and his R&D crew developed mobile phone specifications in a company called *Mobira*. In the second stage *Nokia* took over the business. It established a supplier network, and skimmed the cream from the market it practically created. Shortly competition emerged, including *Ericsson* (a Swedish pioneer in the field). Jorma Nieminen, at the time one of the top managers with *Nokia*, quit his job and set up a firm in direct competition with *Benefon*. Since basic factors of the telecommunications industry have been in place, it is developing into a robust cluster, and thus entering the third stage.

Box 4.16 The growth prospects of the Finnish technology-driven companies

The Finnish National Fund for Research and Development (SITRA) has evaluated the growth potential of Finnish technology-driven companies (Lumme 1994). Experts named 1,445 firms totaling FIM 27 billion in turnover and having 48,000 employees in 1993. Based on a questionnaire survey the total turnover is expect to grow to FIM 66 billion and personnel to 74,000 by 1998.

These companies are particularly important to the Finnish economy due to their high labor intensity. Most hired personnel is highly educated. In 1993 the exports of these companies were FIM 7.7 million; In five years it is expected to grow to FIM 28 billion. Also indirect exports are considerable. The development of a high-tech company can be publicly supported by investing in education and research. Venture capitalism also has a central role.

Figure 4.35 The employment and turnover of technology driven companies



5. DYNAMICS OF THE FINNISH INDUSTRIAL CLUSTERS

The development of a cluster from a few companies to a major branch takes decades. Strengths in all the corners of the diamond are needed - advanced and specialized factors of production, fierce competition in the market place, sophisticated (domestic) demand, as well as a wealth of supporting and related industries. The Finnish forest cluster has a history of over 500 years, and it has entered the innovation-driven stage only recently. The exports of the telecommunications cluster have expanded during the last decade, but the Finnish root - competitive telephone service - is over 100 years old.

5.1. Factor conditions dominate in the early stages of development

Comparative advantages in factor conditions are often the initial impetus behind the development of a cluster. Historically speaking, abundant natural resources seem to be a typical example. In the fastest growing industries today, however, it is the created and advanced factors, that are the sources of competitive strength (see the telecommunications cluster). Often new branches are spin-offs of the existing ones. Especially in the early stages of an industry, the importance of pioneers' personal qualities can easily be seen.

5.2. Potential for new industrial activity

New industrial activity emerges as a cluster strengthens. A major part of industrial innovation takes place in the existing clusters. Spin-off firms are constantly established by existing companies or by personnel leaving their former employer. None of the Finnish clusters is fully developed. Only one of them, forest, has Finnish production in all of the subsegments and identifiable strengths in all of the diamond's corners. A problem of this kind of old and nationally important cluster is that it may become politically powerful enough to obtain protection from competitive forces, and thus start a slow but assured decline. The development patterns of the Finnish cluster are summarized in the table 5.1 below.

Reve and Mathiesen (1994, p. 127) list seven potential areas for new industrial activity:

1. New industrial clusters emerge out of existing non-cluster industries (compare to the discussion in 4.12.2 and to the development of the Finnish telecommunications cluster).

2. Existing dynamic clusters evolve into new industries utilizing an existing knowledge base (compare to the development of the Finnish forest cluster; from wood tar to fine papers, from fine papers to machinery & chemicals).

3. Discovering new business opportunities at the intersections of the existing clusters (the Finnish environmental cluster has found strengths by combining know-how in the metal, forest, and energy clusters).

4. New clusters to satisfy the demand of health and in-person services (Reve & Mathiesen recognize the socio-economic trends discussed above in the context of the Finnish well-being cluster; see box 4.11 - the inevitable growth of the well-being cluster - for review).

5. New industrial enterprises solving increasing environmental problems (maybe the clearest single trend in the market place is the increasing importance of environmental questions - this is apparent in most of the clusters; in the Finnish context compare to the forest and energy sectors in particular).

6. Establishing infant clusters in new industries providing positive externalities to most other industries, e.g. communication technology (Finland and Sweden, are textbook examples - the well-being cluster in particular may be able to profit from the success of the Finnish telecommunication industry).

7. Industrial clusters may be born by promoting entrepreneurship (discussed in chapter 4.12 of enterprises outside established clusters).

Table 5.1 The main sources of competitive advantage in the Finnish clusters

	Previous source of comp. advantage	**Current source of comp. advantage**	**Future source of comp. advantage**
Forest	*Factor conditions:* abundant wood raw material, waterways suitable for transportation	*Related industries:* technological system	*Related industries:* technological system, *Strategy:* customer orientation
Base metal	*Factor conditions:* ore deposits, demanding conditions as a source of mining & metallurgical innovations	*Strategy:* specialization, process & logistics know-how	*Demand:* developments in the regional markets *Factor conditions:* Russian ore resources
Telecom	*Competition* in telecom operation *Strategy & gov:t:* Scandinavian-wide NMT-standard	*Competition* in telecom operation *Factor conditions:* special skills	*Related industries:* applications for instance in health care
Energy	*Factor conditions:* demanding conditions, lack of domestic fossil fuels *Competition* in power generation	*Factor conditions:* technological know-how *Strategy:* product integration	*Strategy:* export of services and increased service content of the existing products
Well-being	*Factor conditions:* combining medical and technical knowledge	*Factor conditions:* know-how	*Demand:* Sophisticated demand of domestic health care services
Environmental	*Demand:* environmental problems of the domestic process industry	*Demand:* environmentally friendly prod. technologies for the process ind.	*Demand:* environmentally friendly consumer products
Transportation	*Demand:* domestic demand of heavy trucks and Russia's need of vessels	*Factor conditions:* specialized skills in building luxury cruisers *Demand:* transit traffic	*Strategy:* developing Finland to a logistic hub between east and west, more emphasis on logistics *Demand:* Baltic Sea traveling & trading
Chemical	*Demand*: domestic demand	*Factor conditions*: process know-how *Related industries:* forest cluster	*Strategy*: environmental business; know-how based products; customer orientation
Construction	*Strategy:* standardized concrete construction, prefabricated houses *Factor conditions:* architecture	-	*Strategy:* customer orientation *Related industries:* connections to other clusters (e.g environmental)
Foodstuffs	-	*Demand:* expanding regional markets	Increased *competition*

Although seeds for new clusters can, and should, be planted by investing in human knowledge and capabilities, the greatest growth potential is in the strengthening of the existing clusters. The periphery of the current centers of excellence is the likeliest place for new spin-offs. The most obvious development needs of Finnish clusters are summarized in table 5.2 below.

Table 5.2 The strengthening and supplementing possibilities of existing Finnish clusters

	Strengthening possibilities of the industrial diamond	**Supplementing possibilities of the clusters existing production**
Forest	Firm strategy: increased customer orientation	-
Base metal	Factor conditions: exploiting regional ore deposits, potential of Keivitsa deposit, re-establishing relations to Russia	Key products: new basic production and refining
Telecom	Specialized factor conditions Related industries: developing new applications	*Related industries: increased number of applications on other fields (e.g. health care)*
Energy	Increased service content	Services: exports of power generation & distribution know-how
Well-being	Demand: more sophisticated demand conditions	Key products: technologically advanced health care equipment
Environmental	Further strengthening connections to other clusters	Key products: environmentally friendly production technologies and consumer products
Transportation	Firm strategy	Key products: tourism, trading, industrial logistics
Chemical	Firm strategy	Key products: know-how based fine and special chemicals; environmental products and businesses
Construction	Demand conditions: need of more sophisticated demand, regional cooperation	Associated services
Foodstuffs	Demand conditions: expanding regional markets	Associated services: trading Key products: specialization and economies of scale

The progress within a cluster can also be negative. The cluster becomes uncompetitive in the long run if it is unable to innovate and upgrade. In the Finnish context the prime examples are the construction and foodstuffs clusters. Domestic demand was not sophisticated enough, local

restrictions and regulations hindered innovativeness, the incentive mechanisms were disturbed, and domestic competition was weak. Table 5.3 summarizes the main reasons for backward development.

Table 5.3 The main reasons for the losing of competitive advantages

– **Deteriorating factor conditions***:* the pool of human capital shrinks or the cluster is unable to compensate for increasing factor prices by innovation and upgrading.
– **Conflicting local needs and global demand:** Domestic demand induces national companies to develop products that will not be suitable for global markets. Biased national legislation or regulations complicate the matter.
– **Unsophisticated domestic demand:** The needs of the nearest customers do not boost innovation.
– **Technological changes lead to severe disadvantages in factor conditions or there are no supporting industries required in the new situation:** old sources of competitive advantages may be outdated due to a 'technological jump'.
– **Chronic underinvestment***:* For some reason sufficient investments on R&D, marketing, human or physical capitals are not made.
– **Adaptability is lost:** Out-of-date management methods, inflexible organizational structures, or regulations hinder innovation.
– **Domestic competition fades away:** As the pressure of competition eases, the remaining companies have fewer reasons to innovate and upgrade.

Source: Porter (1990)

5.3. How to breed clusters

The starting point of a cluster is some form of competitive strength. Business enterprises are established around a special advantage, and under favorable conditions an industry of a few firms ripens into a cluster. It can not, however, be forced to emerge. An excessively convenient environment, on the other hand, is not beneficial either - it is the hardships that make a cluster efficient and durable. After the initial push (e.g. a research project of a promising technology) it develops itself - of course, only if it should. The preconditions of a cluster's birth are listed in table 5.4.

Table 5.4 The preconditions of a cluster's emergence - nine critical success factors of a cluster

It takes

- **Time**. Often, successful clusters date back to relative advantages or disadvantages which were present centuries ago. In any case, it takes time to develop industrial base, customer relations, and brand names.
- **Critical mass**. An industry has to be fairly big before economies of scale and scope can be fully utilized.
- **Entrepreneurs and dedicated people**. Most dynamic clusters contain stories of entrepreneurs who significantly influenced the industry.
- **Demanding international customers.** Cluster studies show that demanding customers are the key source of competitive advantage.
- **Rivalry and cooperation**. Rival companies are the main feature of a cluster. Lucrative companies, however, often cooperate even with their main competitors when necessary and mutually beneficial.
- **Advanced suppliers.** Competitive subcontractors can be a major source of innovations and allow firms to concentrate on their core competencies.
- **Flexible organization and management.** Organizational flexibility is needed especially during periods of excessive turmoil.
- **Continuous knowledge development.** There is no saturation level to cluster innovativeness. Existing competitive strength will be lost if the upgrading process stops.
- **National pride**. Industries that are nationally appreciated attract the best talent in the country.

Source: Reve and Mathiesen 1994, pp. 119-125

6. PROSPECTS FOR THE FUTURE - LOW WAGES OR HIGH SKILLS?

Porter (1990a) shed new light on the traditional definition of competitive advantage. He argued that inherited natural resources were irrelevant in creating long-term competitive strength - it is the created and specialized factors of production (human capital, advanced infrastructure, etc.) that ultimately determine a country's prosperity. National competitive advantage is not inherited - it is (re)created by domestic business enterprises competing in the global arena. The domestic operating environment is set by civil servants and politicians, and international political and economic affairs are increasingly important to companies even in bigger economies than Finland.

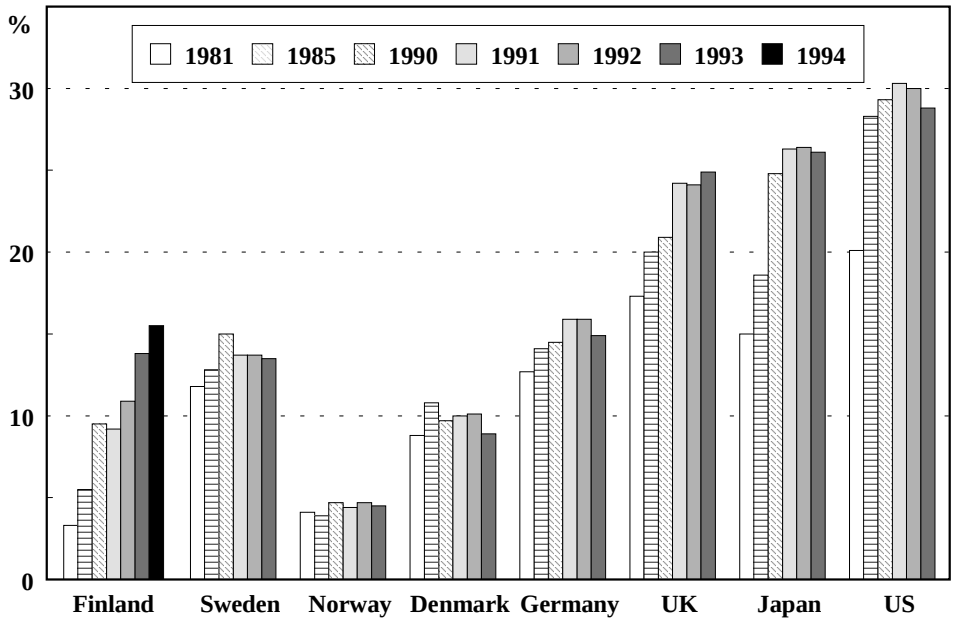
In the Finnish economy the pool of advanced and specialized factors has expanded rapidly during the post-war years. The R&D expenditures have grown and the general educational level improved.

6.1. Technological competitiveness - a late start but speedy growth

Finnish R&D expenditures grew over 10% annually during the 1980s, clearly above the OECD average. The R&D intensity - the relation of the R&D to the value added - almost tripled in a decade, and it is now higher than in Denmark or Norway (figure 6.1). Obviously, rapid growth has been eased by the relatively pale starting point.

Compared to other countries, Finland is relatively specialized the medium-tech and partly to the low-tech industries. In these sectors the country is quite R&D intensive. The Finnish forest industry, for example, carries out considerably more research than the main competitors: in Finland 3% of the value added goes to R&D, in Sweden approximately 2.5%, and in Canada only a scant 1%. Considering the export performance it is surprising that the Finnish foodstuffs industry also invests more in research than its Danish counterpart. When only the medium- and low-technology industries are considered, Finland is among the top countries in R&D intensity.

Figure 6.1 High-tech exports as a percentage of total exports in some industrialized countries



Source: OECD Foreign trade statistics. Board of Customs. 'High technology' as defined by Central Statistical Office of Finland (SVT Tiede ja teknologia 1994:2)

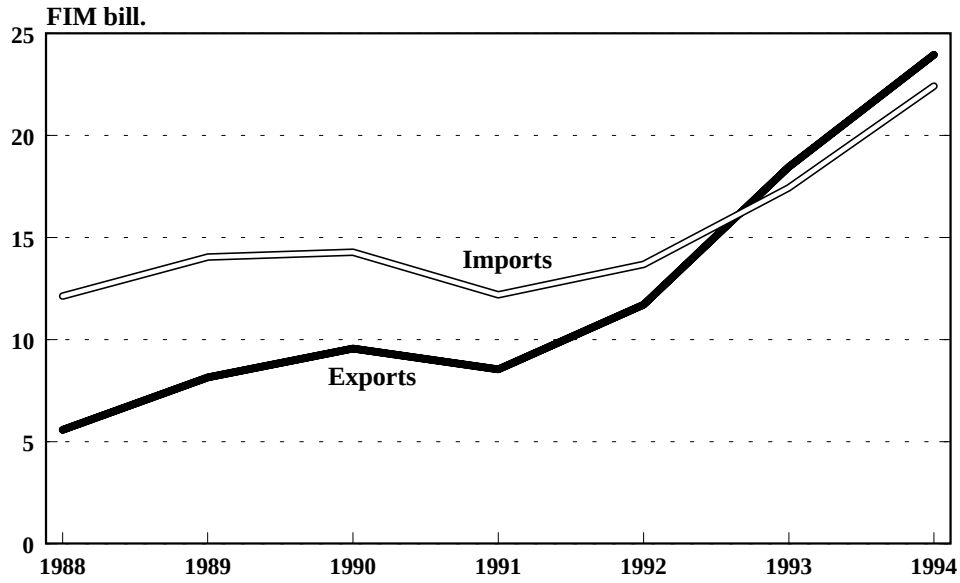
In high technology, Finns have concentrated on a few segments - such as telecommunications and certain medical products. Finland has already surpassed the average R&D intensity of the small industrialized countries. In 1993, high-tech exports overtook imports for the first time (see figure 6.2).

It is particularly interesting to examine how higher stakes in R&D have affected the competitive position of Finnish companies, and how the educational system kept up with the changing needs of business.

6.1.1. The excellence of the Finnish school system - is it just an illusion?

It has been constantly reiterated that the Finnish school system is one of the best ones in the world. Economically oriented voices add that it is has also supported industrial growth. Finnish per capita education expenses are higher than in practically any other OECD country, but surprisingly little is known about the return on this hefty expenditure. It has been hypothesized that human capital spurs economic growth and technological

Figure 6.2 Finnish external trade of high-technology (FIM billion)



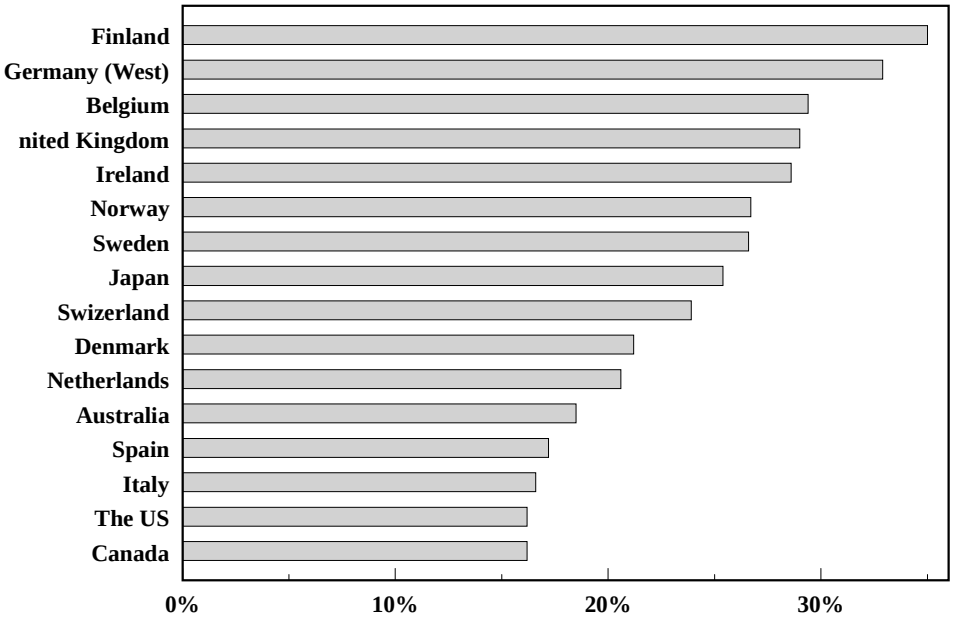
Source: Central Statistical Office of Finland (SVT Tiede ja teknologia 1994:2)

development - exact measures, however, have been hard to come by. Technology itself will not add to national wealth - it has to be transformed into a profitable business. Besides technological competence, organizational, social, managerial, and marketing skills are needed (see Eliasson 1994). Thus macroeconomic growth can be explained by microeconomic conditions.

International comparisons show that Finland has not yet entered the third phase of educational development, in which a majority of the population would have a bachelor's or compatible degree. Most Finns have only a basic education. The main reason is that the baby boom generation (those born right after World War II) is far less educated than the subsequent generation[51)]. In the youngest age groups a college education is a rule - way over 50% of the youth enter institutes of higher education; Finland is next only to the United States. If those completing their schooling are compared, Finland is next to none. The current educational level in Finland is nevertheless moderate but swiftly rising.

51) An OECD-wide comparison shows that the differences in educational level by age group are the highest in Finland.

Figure 6.3 Degrees in engineering and natural sciences as a percentage of all academic degrees, OECD countries



Source: OECD - Education at Glance 1995. Year 1992 figures.

There are three features that are characteristic of the Finnish educational system. *Firstly*, studying times are among the longest in the world, and the average age of a Finnish student is the highest in the OECD countries. *Secondly*, engineering and natural sciences are emphasized. *Thirdly*, research training has increased considerably during recent years.

Finnish industry is demanding increasing quantities of highly trained personnel; according to Leiponen (1995a and 1995b) total employment in industry decreased during the 1980s, but the number of research-trained employees almost doubled. The number of academic degree holders increased by 40%. Industrial training has also increased.

There is clearly the threat that growth will be hindered by an insufficient supply of qualified personnel. The economy may reach a kind of stalemate; growth is dampened by the lack of a specific talent, and at the same time a significant share of the labor force is unemployed. Competition over qualified personnel increases inflation, which combined with the high public debt will raise interest rates. Investments will be lower and economic activity further retarded. This kind of negative spiral should be avoided by improving the functioning of the labor market.

6.1.2. Higher skills as a source of competitive advantage

Many studies agree that in the early 1980s the Finnish industry entered a new phase; the share of high-tech products increased considerably, and technological knowledge became a more noteworthy source of competitive advantage. The export share of high-tech products quadrupled during the 1980s, reflecting the improved educational level. Structural changes in the school system, however, have been more radical than in production. In Porterian terms; the share of advanced and specialized factors of production (human capital) has increased considerably, but they have not yet been fully exploited. An additional problem is the vulnerability of the current success - technology-driven production is quite concentrated. *Nokia* alone accounts for one-fourth of the Finnish high-tech exports.

Engineering know-how is the backbone of the Finnish industries, but to some extent Finns have been unable to transform it into commercial success. Hundreds of case studies made during the *Advantage Finland* project confirm that the development of marketing, financing, and strategic skills did not quite keep up with the expansion of superior technical knowledge.

Finnish industries are still production-oriented. The service content has to be increased. In modern industrial enterprises often less than 20% of the labor costs relate to the actual production. R&D, design, marketing, finance, management, public promotion, communication, and various after-sales activities are the lion's share of the costs (see Eliasson 1992).

6.2. Turmoil on the port and starboard

Finland has faced an unprecedented period of turmoil within the last few years. The collapse of the Soviet Union and membership in the European Union dramatically altered the political scene. International trends in the major export markets caused the Finnish economy to nosedive, and forced Finns to reconsider their strategies for years to come. Domestic socio-economic questions are subjects of debate: baby boomers will exit the labor force gradually and their retirement allowances have to be financed. Additionally, the standard of living and the educational level have risen rapidly, causing conflicts with the old and the young generation, and Finland has shifted from a managed capitalism to a market economy. The

whole nation is in search of its new character between the east and the west.

6.2.1. The effects of the European Union on Finnish industry - increased specialization or uniform prosperity?

One of the central themes in the European integration debate has been its effects on the industrial structure. It has been argued that specialization will increase, and national industrial structures will be one-sided. The versatility of production most industrialized countries have tried to promote would be lost. While this view is supported by the basic theories of international trade, the answer may not be quite this simple.

In the Finnish context it is clear that the role of the forest industry will be altered when devaluation ceases to be used to promote profitability. The companies' dependence on this external adjustment, however, varies greatly. Most of the major companies have chosen an innovation-driven strategy, and are thus less sensitive to international price trends. While choosing the high-tech (and high wage) strategy for a country does not guarantee success, it is the most promising plan as far as market potential is concerned.

Experiences so far suggest that integration increases specialization *within* branches and intra-industry trade will thus increase. Countries trade similar but differentiated products. These products are often sophisticated, and the source of competitive advantage is the personnel in certain companies. Firm-specific knowledge is utilized in the form of foreign direct investments, because traditional exports exploit only a fraction of the accumulated know-how.

Kajaste (1994) states that the membership of the European Union significantly increases competitiveness of the Finnish industry. Particularly the machinery and electronics industries are estimated to gain from the removal of the remaining trade restrictions. On the macroeconomic level, however, the main effect of integration is increased efficiency in the domestic markets.

6.2.2. The collapse of communism - threat or opportunity?

As the European national states are absorbed into the Union, the continent is shaken by the opening of the eastern bloc. Often post-socialist states are considered a threat due to their price competitiveness. It can easily be shown, however, that this argument is on shaky foundations. International trade is not a zero-sum game in which one's gain is another's loss - believing this would take us all the way back to the mercantilist era. Smith and Ricardo's principles of absolute and comparative advantage can be used to show that in the long run everyone benefits from free trade. In the case of Finland, estimated benefits are extraordinarily great, and the developments in Russia and in the Baltic states will improve rather than suffocate Finnish economic growth. (see Borsos 1994)

In any case, adjustments have to be made, and they always involve some sacrifices. The Eastern European countries will specialize according to their comparative advantage; some potential industries are construction materials, furniture, and textiles. During the transition period some protective measure may have to be taken in order to avoid intolerable human suffering.

7. CONCLUSION: TOWARDS A NEW INDUSTRIAL STRUCTURE

The growth prospects vary greatly from industry to industry. Products and industries have their typical phases of development as discussed in Vernon's (1966) life-cycle model. From a firm's point of view it is crucial to be able to evolve into a new line of business as the old one(s) dries up or becomes unprofitable.

This study criticizes traditional industrial analysis for its limited scope. It is argued that by specifying strict boundaries for industries, the bulk of older research fails to take into account the important interconnections and knowledge flows that are typical for a cluster. The growth potential of various fields can not be analyzed by studying separate branches; practically none of them would succeed without sufficient supporting structures.

7.1. Growth depends upon human capital

Instead of subdividing the industry by using the *Standard Industrial Classification (SIC)*, an alternative method can be used; branches of industry can be defined according to their factor base. The branches that use advanced and specialized factors intensively are a country's source of lasting competitive advantage. They are normally in the growth phase of their life-cycle, where demand expands rapidly and relative prices of the final products are high.

Specialization in the growth industries will not guarantee the success of a company or a nation; growth and profitability may not be interconnected. Besides intensive use of advanced and specialized factors, another feature of a new branch is a high level of risk. Investment decisions have to be evaluated with this in mind. On the other hand, sticking to standard products and established industries will automatically mean that some of the growth prospects are given up. On the national level this means that a lower standard of living is chosen in the long run. Eventually, relative export prices (and thus the terms of trade) deteriorate.

According to the *OECD Job Study* the growth of employment has been the most intense in the research intensive (high-tech, high skill, and high wage) industries. Labor intensive (and low skill) branches have had the

lowest employment growth rates. Therefore growth in the industrialized countries has to be based on high technology and skilled labor. In the Finnish context this means that the restructuring that started in the early 1980s has to continue.

Finnish industries have traditionally been capital- and resource-intensive. On the other hand, it can also be argued that Finnish firms are concentrated in the segments that have slower market growth (see, Horwitz 1984, Kajaste 1994b). In the selected markets Finland has had a fair amount of success, and it has been able to increase its market share. The 1980s was a decade of transition in two respects: the educational level increased considerably and R&D expenditures expanded. If the final output is concerned, the shift to knowledge-intensive products happened only partially.

7.2. The outlook of the Finnish industrial clusters

Chapter 4 outlines the Finnish industrial clusters. These clusters are clearly in different stages of their development. Some have established their presence in the global marketplace, while others are only emerging. The development of a cluster can be described by using the stages of industrial evolution introduced in chapter 3.4 (see figure 7.1).

The clusters can be evaluated by using a more traditional market share and market growth matrix. In figure 7.2 relative market share is on the vertical axis and the relative market growth on the horizontal axis. The arrows present the estimated expansion possibilities.

In the figure 7.2 the clusters have been split into three groups. The telecommunications, well-being, and environmental clusters are in the fast growing markets, and each has potential for further expansion. The energy and transportation clusters have average market growth. There are many forces supporting the broadening of the energy cluster. The development of the transportation cluster, however, is two-sided: transit traffic and a few industrial segments are expected to grow, while the trend for the industry as a whole is slightly negative. Other clusters have moderate market growth. The forest and base metal clusters have been able to increase their market share. The construction and foodstuffs clusters have been in a negative spiral for quite some time, and until recently their strategies have been defensive. The fast growing clusters comprise 20% of the total production, the medium and slow growing ones accounting for the rest.

Figure 7.1 The stages of a cluster's development and sources of competitive advantage

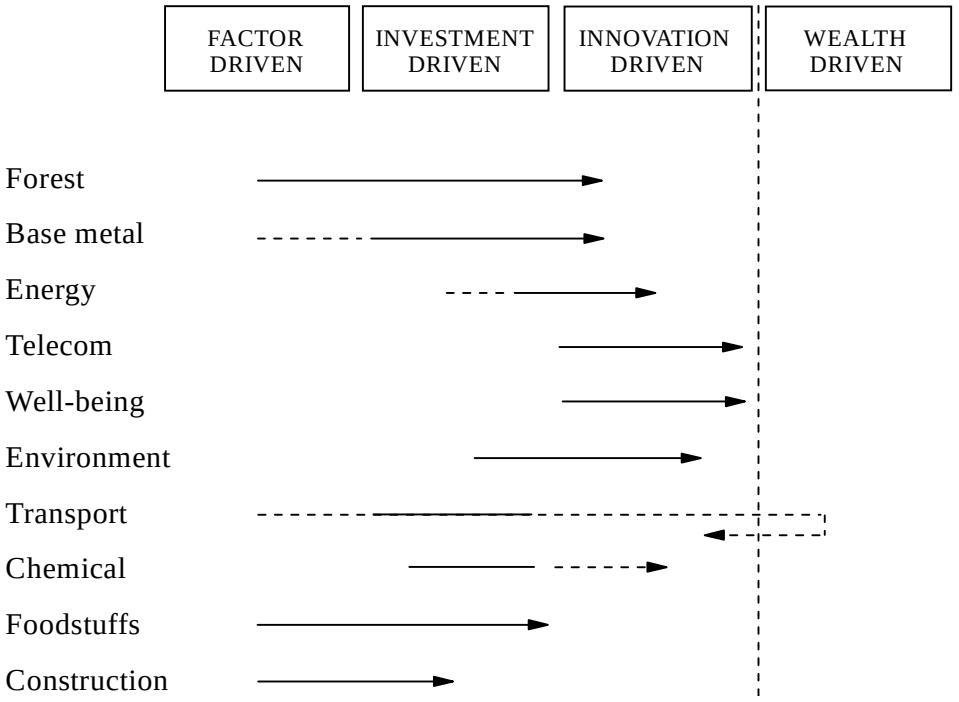
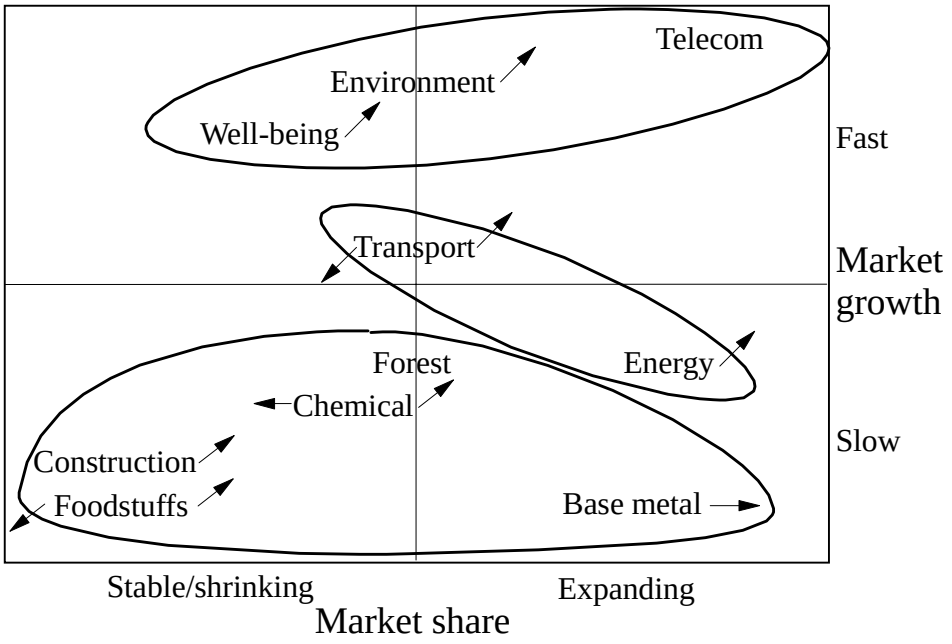


Figure 7.2 The market growth & share of the Finnish clusters



No limits, just clusters

It should be emphasized, that a central feature of economic growth is continuous internal restructuring and reorganization. New organizations and institutions are born, and the existing ones evolve. By establishing firm borders for industries, traditional economic analysis neglects some of the existing dynamism - in order avoid this the clusters are defined rather loosely; they are partly overlapping and the shape changes continuously. The telecommunications cluster, for instance, is transforming into a multimedia-driven information cluster. Nevertheless the clusters should also be quantified with the traditional methods of industrial analysis. Table 7.1 summarizes the basic statistics of each cluster and estimated growth potential until the year 2010.

Table 7.1 Development and growth prospects for the Finnish industrial clusters

	Export growth 1980-94, % p.a.	Export value 1994 Bill. FIM	Growth potential up to 2010, % p.a.
Forest	4	61	3
Base metal	9	17	6
Telecom	14	10	15
Energy	6	8	7
Well-being	7	3	10
Environmental	..	..	10
Transportation	3	15	4
Chemical	6	16	4
Construction	7	27	2
Foodstuffs	7	5	1

As can be seen, the variation of prospects is great. The expected growth of the telecommunications, well-being, and environmental clusters is manifold compared to forest, construction, or foodstuffs clusters.

The telecommunications cluster is rapidly evolving into new areas. Together with related technologies, such as multimedia, it is becoming the heart of the information society, touching practically every part of the economy. The well-being cluster is struggling between the pressures to decrease the cost of health-care and the demand for more sophisticated

cures. The environmental cluster seeks solutions to possibly the greatest socio-economic problem of our times; how to preserve nature without drastically lowering the current standard of living. Environmental standards and public opinion may change rapidly, causing turbulence in the market place.

The new cornerstones of the Finnish economy

Table 7.1 above predicts that there will be a major shift from resource-based to knowledge-intensive production. The telecommunications cluster (or in 2010 probably 'the information cluster') is estimated to be almost as large as the forest cluster is at the moment. In any case, the relative role of the forest industry will diminish, although it will always be significant.

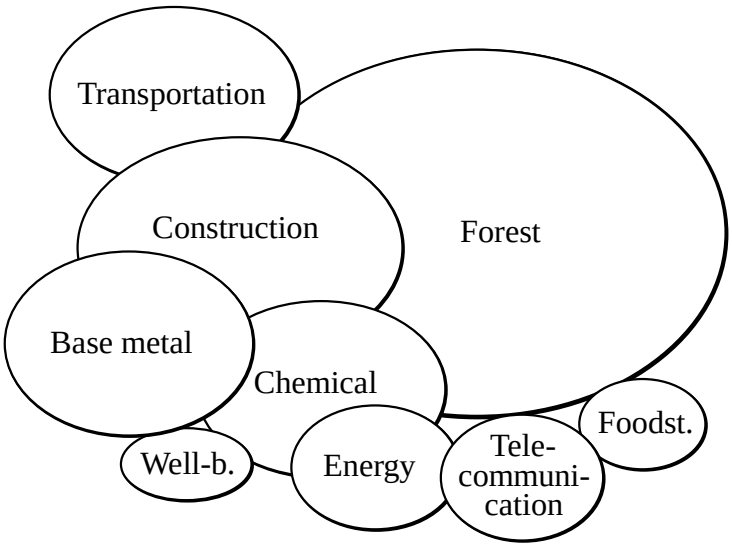
The predicted structural change would be the most significant one in Finland's postwar economic history. While the projected industrial transition may sound radical, there are some facts that make it seem more plausible. Devaluation is no longer in the toolkit of the Finnish policy makers - instead of an external adjustment, (1) internal changes have to be made. The world market is becoming more competitive, and the industrialized countries are removing the existing restrictions on trade; thus (2) global specialization will increase. A historical change of the Finnish factor conditions is taking place; the baby-boomers are followed by a younger generation having a (3) significantly higher level of education.

7.2.1. Challenges of the main clusters

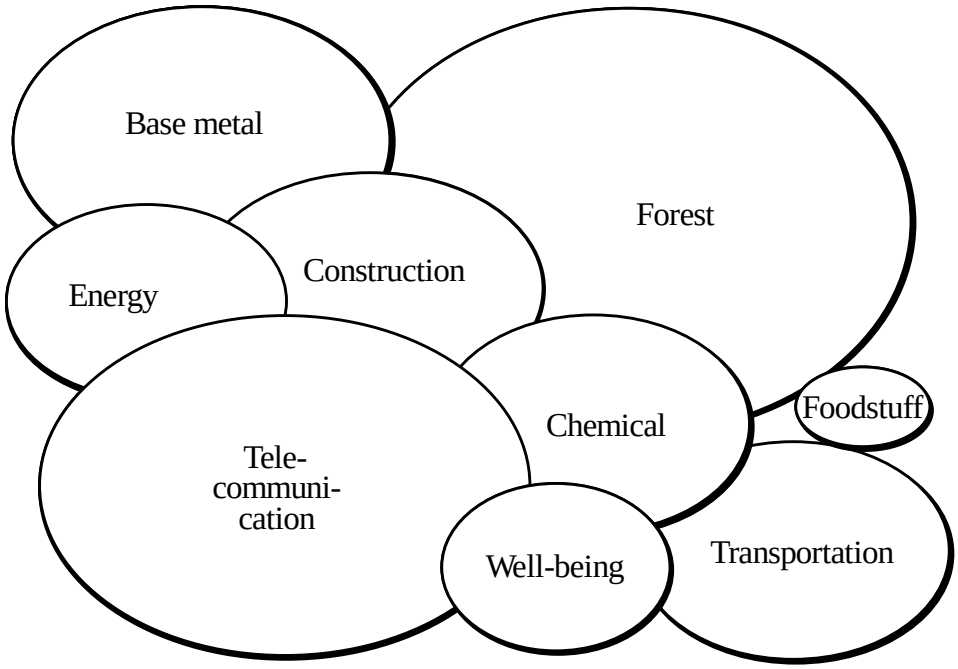
The forest and base metal clusters have been able to drift away from bulk products. They have chosen their production strategies rather wisely, and are technology leaders in many of the selected segments. Unfortunately, both of the sectors are rather matured fields in which market growth is modest. New paths of expansion are needed but hard to find.

So far the growth of the main clusters has been based on heavy investments and increasing productivity. In the current financial markets and in a riskier operating environment companies may not be able to attract enough capital for large long-term investments. New investments have to be on a smaller scale than during the recent decades.

Figure 7.3 The industrial clusters of Finland in terms of the estimated exports share, at the beginning of the 1990s and at 2010



Year 2010



Environmental technology is included in many of the clusters above

7.2.2. Current and future strengths

The weaknesses and strengths of the clusters are often interrelated. Selective disadvantages (e.g. long distances, lack of domestic resources, etc.) have forced companies to innovate, and have thus been a source of competitive edge. Even though each of the clusters has its unique characteristics, some features have come up in most of the cluster studies:

Factor conditions are important in the early stages of development

Often abundance of some basic factor of production, such as a key raw material, is the original impetus behind a cluster's development. This is true in the case of the forest and base metal clusters. Newer clusters (telecommunication, well-being), however, are born around more advanced factors of production - highly qualified personnel and world-class research. User-producer relations have been particularly important in the case of the new clusters.

Finns succeed in business-to-business markets - successful consumer products are almost nonexistent

In the trade of investment goods, technical features and the price-to-quality ratio have key roles. Although many of the Finnish industrial products are 'brands' in their own segments, only a few of the country's consumer products are internationally known. The small size of the home market is undoubtedly one of the reasons.

Project and process know-how is apparent in many of the Finnish clusters

Finnish project management expertise is well-known, especially in the forest industry: Finns have constructed and managed pulp and paper mills worldwide. The energy and construction clusters have also had significant project exports.

Competition boosts and protection hinders innovation

Internationally compared, the telecommunications and energy clusters have had competitive environments. The foodstuffs and construction clusters have been more or less restricted and/or protected. Competition is clearly one of the main driving forces to innovate and upgrade - without it some of the dynamism will be lost.

Improving technological competitiveness

As a whole, Finnish industry entered the innovation driven-stage in the early 1980s. The share of high-tech exports has increased, and domestic production methods of lower-technology products are rather advanced.

Behind in internationalization

Although Finnish companies have internationalized rapidly, foreign contacts are still limited compared to many other small open economies. As the service and R&D content of Finnish exports increases, communication with foreign customers will be increasingly important.

7.3. To the year 2000 and beyond

Finnish society will face many challenges in the near future. The functioning of the labor market should be improved in order to solve the mass unemployment problem. Finnish companies are internationalizing rapidly, and its effects on the domestic economy are somewhat unclear. There have also been major political changes in the nearby regions.

7.3.1. Post-industrial society - decreasing industrial employment

Following the trend in the other OECD countries, industrial employment in Finland decreased by 200,000 persons from 1980 to 1993. The rapid expansion in production since 1993 has increased industrial employment only marginally. There are new positions, but mainly for highly qualified personnel.

As the operating environment changes, new requirements in the labor markets emerge. The expanding knowledge base has created new growth potential. The realization of this factor pool, however, requires that labor and other resources are allocated efficiently. High unemployment among Finnish youth is a sign of misallocations, and it causes not only human agony but is also waste of valuable resources. The malfunctioning of the labor market seriously hinders economic growth.[51)]

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51) For instance the telecommunications cluster screams for qualified personnel. Undoubtedly considerable export revenues have been lost due to mistargeted educational efforts.

Undoubtedly one of the reasons for the high unemployment and long recession has been distorted economic incentive mechanisms. The Finnish taxation and income transfer system has created traps, where increased wage income or (re)entry to the labor force may actually lower disposable income (see Soininvaara 1994).

7.3.2. Globalization - drifting apart from the national heritage

Will the internationalization trend of the Finnish industries continue?

In Finnish industry, large scale internationalization did not start until the 1980s, but since then the pace has been fast. Primarily big firms have internationalized - in Finland the 20 largest companies account for 90% of the total personnel abroad. The returns on foreign direct investments have been modest, although it should be stated that Finns have not sought after high returns - they have, rather, bought access to the main markets or to a raw material source. Many studies argue that the management of Finnish foreign operations have been poor.

The globalization trend of the Finnish industries is likely to continue. This supported by a several facts: *firstly*, internationalization in Finland has not reached the same stage as in many other small, open economies (i.e. Holland, Sweden, Switzerland) and *secondly*, international studies show that knowledge intensive industries are global, *thirdly*, the forest and metal industries will continue foreign direct investments to guarantee their access to raw materials, and *fourthly*, nations will compete for the investments of multinational companies, and Finnish firms will be attracted to invest abroad.

Multinational companies and the role of the home base

The foreign direct investments of multinational companies are guided by a global specialization; firms search for the most favorable location for each activity. The effects of internationalization on a domestic economy are considered mainly positive (see, e.g., Dunning 1993, Swedenborg 1982).

Studies of Finnish industries show that a considerable amount of R&D activities are based abroad: approximately 25% is done in the foreign units. Internationally compared, the figure is high. Finnish companies are not, however, actively moving their research units to the exterior. Foreign R&D has been a part of the firms that the Finnish companies have

acquired throughout the years. In the long run Finland may follow the example of Sweden, where a majority of R&D is done in the home country while an increasing share of the manufacturing is elsewhere.

7.4. New industrial policy [51)]

Subsidies and compensatory policies are not tools of a modern industrial policy maker. Although the old argument of an infant industry has some truth to it, it has been used in many industrial countries mainly to protect established but uncompetitive industries, thus postponing the necessary and natural restructuring.

The goals of the new industrial policy are (1) to guarantee the functioning of a free market, and (2) to create advanced and specialized factors of production. Public market intervention is justified only if there is a clear market failure. Externalities are one of the reasons why a competitive market may not reach a comparatively efficient outcome. Apparent examples are education and basic research; a higher knowledge level increases national wealth as the value-added content of production increases, but these investments are not necessary rational to a business enterprise due to the mobility of labor.

As the factors of production become internationally mobile and international competition is freed, the formulators of industrial policy face a novel problem: *How can Finland be made an attractive home base for internationally competing enterprises?* Industrial policy can be used to improve the operating environment and factor conditions, but the market decides which companies survive.

Porter and industrial policy

The principles of new industrial policy - promoting competition and creating advanced factors of production - are widely accepted in the industrialized countries. The method of implementation, however, is disputed.

Porter's model can be used as a frame of reference. It illustrates the way in which competitive strength is born. One of the main messages of

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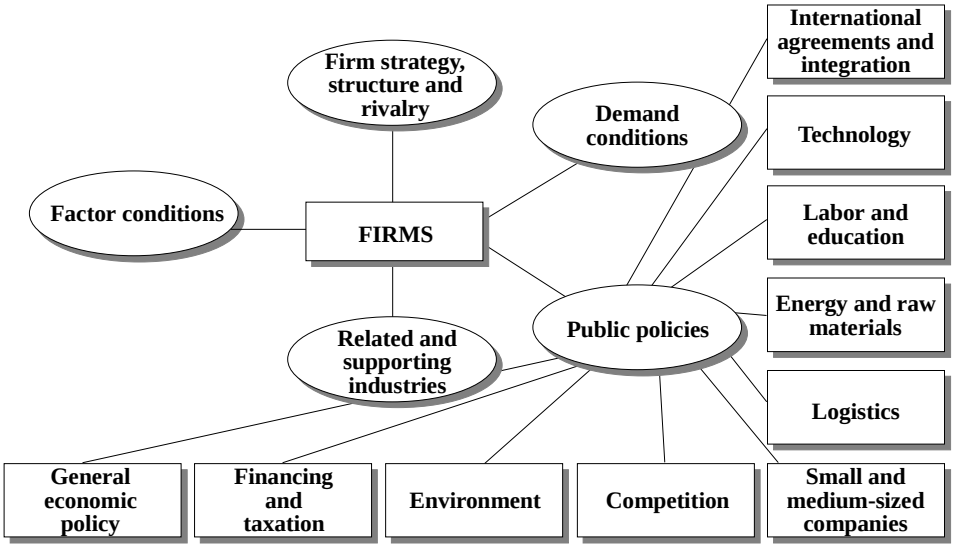
51) *National Industrial Strategy for Finland* (Ministry of Trade and Industry 3/1993) is based on the preliminary conclusions of this project; therefore industrial policy is discussed only briefly.

cluster analysis is that the scope of industrial policy should be broad. It should not involve only industries or business enterprises; it should not only reallocate existing resources, but should also focus on the creation of future factor conditions.

The role of industrial policy is clarified in figure 7.4. The economic and industrial policies set the operating environment of private enterprise. The effects of industrial policy are indirect. Direct subsidies distort competition and are harmful in the long run. The public sector can not create competitive advantage - it can only set favorable preconditions.

Figure 7.4 Determinants of competitive advantage and the Components of economic and industrial policy



Competition policy is used to establish a competitive environment, in which companies formulate their own strategies. Competition is one of the main driving forces behind innovation and upgrading.

Technology and education policies are used to create a pool of advanced and specialized factors, which are the main sources of sustainable long-term growth.

Environment, taxation and *trade policies* have a significant effect on demand conditions. The public sector can act as a demanding, sophisticated,

and anticipatory customer by setting norms and standards and thus boost competitiveness.

Future patterns of industrial policy

The decline of many traditional industries (e.g. construction, agriculture, textiles) and an obvious need for restructuring call for refocused industrial policy. National development in rapidly growing new fields (e.g. information technology, communication, health care) can be accelerated by early public involvement. Policies should be geared towards advanced factor creation and competition should be promoted in every way. The role of the government as an organizer of education, health, and welfare services should be reconsidered; even if the supply of services were publicly supported they do not have to be publicly provided. It would be unrealistic to assume that politicians and/or civil servants could outguess the market in defining future customer needs.

EXECUTIVE SUMMARY

The *Competitive Advantage of Finland* project studied competitiveness of Finland by using Michael Porter's (1990a) so called diamond model.

Theoretical framework

Porter argues that successful companies are seldom alone. Firms and industries are tied together by knowledge and production flows. He coined the term *cluster*. According to him competitiveness originates from these unique combinations of firms and industries - clusters. Their typical features are numerous interconnections between firms, technological spillovers, and positive externalities. The main features of a cluster are the interconnections and the interplay among participants.

Success in a Porterian sense can be defined as a company's long-run profitability and a dominant market share. The means to achieve these goals are continuous innovation and upgrading. Porter's research takes place on a firm and industry level.

The diamond model incorporates forces influencing the firm's ability to sustain and upgrade its competitive advantage. At its best the components of a diamond form a *cluster*, where each part strengthens each other. Unfavorable conditions on some points of the diamond can be compensated by more advantageous conditions on other parts, and often unfortunate shortcomings can be circumvented through innovation.

Setting the context

Accelerated economic growth has been a goal of Finnish national policies during the past 50 years. Typical features have been: economic policies that shore up investments and support industrial activity, a dominant role of government and publicly owned companies, an aim to take exploit domestic resources as efficiently as possible, and a shared option that growth is indeed important. There were also signs of protectionism. The economic slump in the early 1990s revealed the weaknesses of the Finnish economy. Currently the country is in search of an economic structure that would allow it to reach external balance.

Reasons for the crisis are not hard to come by. Structural distortions were accumulated during the years of rather controlled economy. Some errors in the economic policies even magnified the effects of the unavoidable economic downturn. Finland seems to have too few competitive firms and industries to maintain the desired employment level and standard of living.

Industrial clusters of Finland

Clusters were chosen based on export performance and expert opinions. Porter's approach was supplemented by a classification of clusters by their relative strength. Clusters were thought to be either *strong, semi-strong, potential, and latent/defensive*.

Forest cluster (strong, steadily growing)

The forest cluster has developed around the key products of the forest industry: pulp, paper, paperboard, and sawnwood. The production of these has aroused engineering workshops, specialty input producers, chemical firms, as well as service providers. Universities and research organizations have also an important part of the industrial network. Tight interplay among the participants has made the forest cluster a prosperous one.

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, at least as far as market growth is concerned. The close interaction within the cluster is most explicit between paper mills and engineering workshops. In the future forest cluster is 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 fiber may reshape the competitive arena. The cost competitiveness of the Finnish SC and LWC paper producers can be upgraded by ensuring supply of moderately priced energy.

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

Technological superiority of the Finnish forest cluster supports production in Finland. The 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.

Base metal (and steels) cluster (semi-strong, steadily growing)

The Finnish base metal cluster has been transformed from an importer to an exporter of technology and knowledge. Even though significant in the Finnish economy, internationally compared the cluster is small, yet surprisingly versatile. It is resource based, and therefore the basic factors of production are important. The depth of metallurgical and mining knowledge is the only unique advantage the Finnish cluster has.

The end products of the cluster are typically not high technology, but the production methods used are rather advanced - the knowledge is embodied in the processes. The Finnish process control systems are sophisticated. Traditionally Finnish managers have had engineering background and they have had a significant impact in improving the technology. The development of marketing, financing, and strategic skills have not quite kept up with the technological advances. Notable improvements, however, were made in the 1980s, partly due to started internationalization.

Finnish companies have been able to increase the value-added content of the products: non-ferrous metals are sold as semi-products, and iron as specialty steels. Continuing this trend is vital to the Finnish companies. This naturally transfers to an increasing R&D intensity; niche strategy is the key to technological leadership.

Most of the metal products are basic commodities, and markets are rather stable. Knowledge of local customs and legislation give an advantage to the regional producers. Due to high transportation costs neighboring countries are often the only possible export market. The base metal cluster is expected to grow slowly but steadily. The firms within the cluster are relatively competitive and profitable.

Energy cluster (semi-strong, rapidly growing)

The main clusters in Finland, forest and metal, are rather energy-intensive. This and the arctic climate, long distances and a low population density are behind Finland's high per capita energy consumption. Since Finland does not have domestic fossil fuel deposits, dependence on imported sources of energy is great.

The energy technology is an example of fast technological adaptation, diffusion, and eventually own innovation. The cluster is relatively young. Early this century most of the equipment was imported. Then domestic manufactures were made under a foreign license, and not until the 1970s were there significant exports based on own R&D.

It may be somewhat overoptimistic to hope, that the remaining restrictions on the trade of energy technology would be removed shortly. In any case the trend is towards a more open competition.

The changes in the former communist countries may have favorable effects on Finnish suppliers. Energy systems in most the countries in question are in a serious need of remodeling to meet the western efficiency and environmental standards. Many of the central European companies have acquired energy technology companies from these countries. In the long run this might make some markets even more oligopolistic (i.e. turbines).

Telecommunications cluster (potential, rapidly growing)

As an infrastructure industry, efficient telecommunications services are essential in the improvement of other clusters' performance. The telecommunications cluster is the first significant Finnish industrial cluster in which the importance of raw materials is inferior, and where know-how is in a central role.

The key products of the telecommunications cluster are the telecommunications equipment industry, operation, and value-added network services (VANS). The main products of *the telecommunications equipment industry* are switching and transmission systems, terminals, data communications and mobile communications equipment. *Operation* involves planning, construction, and maintenance of networks, as well as running of telephony and data services therein. *VANS*, in turn, utilize operator services as inputs.

There are many factors supporting strengthen of the telecommunications cluster. Behind this scenario there are phenomenal growth in global demand and trade that expands on average faster than production. The critical factors for future success of the telecommunications industry are:

1. *Timely and sufficient generation of advanced input factors, e.g. qualified workers.* The lack of a skilled work force may become a bottleneck for domestic research and production. But, with sufficient and high-quality human resources, Finland may even become a lucrative home base for foreign equipment producers.

2. *Ability to maintain and enhance leading market position.* Competition with big electronics manufacturers requires vast investments in R&D and marketing. In the future the mobile phone, for example, will become a mass product. Success in the future terminal market calls either for large capacity to induce economies of scale, or differentiation.

3. *Challenges at both ends of the value chain.* Expansion and differentiation of the component and outsourcing sectors could further improve the equipment manufacturers' competitive edge, while at the end of the value chain, constant development of new applications is of utmost importance if the achieved position in the global market is to be maintained.

Multimedia offers great possibilities for the Finnish telecommunications cluster. Domestic production of telecommunications technology, television sets, personal computers and other terminals is advanced. Also software production is highly evolved, and the coverage of optic fiber and broadband networks is practically nation-wide, which enables extensive and swift introduction of multimedia and speedy ATM services. The distinction between information technology and telecommunications is becoming increasingly blurred. The three central means of data processing and transmission - i.e. telephone, PC, and television - are converging, which offers tremendous possibilities in application.

In addition to investing in the multimedia market, there is vast potential in more extensive applications; Education, inter-organizational communication, and health care are examples of domains that can greatly benefit from new telecommunications applications. Moreover, today the key words in maintaining and improving competitiveness are *intelligent*

production processes and enhancement of communications, and on the other hand, *development of intelligent and communicating machines*. Finnish industries, like the forest and the basic metals, are already taking advantage of highly evolved intelligent machines - products that could also become successful export items.

Well-being cluster (potential, good but volatile growth prospects)

It has been a widely accepted idea in Finland that every citizen has a right to comprehensive health care, and that public authorities have to promote the health of the population in any conceivable way. In Finland this has meant that most of the services are also publicly financed. So far the principle of free (or nominal fee) treatment has been applied, although it is currently subject of debate. In 1992 Finland spent 9.4% of the GDP on health care services. These services employ 200,000 persons. The annual expenditures reach FIM 50 billion. The health care system is clearly the center piece of the cluster, although this study the focus is on industrial activity - pharmaceuticals and health care equipment & supplies.

A typical feature of the well-being cluster is the significant public involvement in virtually any part of the cluster. Majority of the high quality basic research is publicly funded, and a considerable share of the applied research is supported. Advances in the medical science are naturally the main impetus for new product lines. Many related fields, chemistry, biotechnology, electronics, and automation, are also sources of innovation. The driving force is naturally the needs of health care.

Industries based on medical technology are particularly suited to Finnish conditions, where the technological level is high, the labor force highly trained, and the infrastructure is sufficient, but there are few natural resources. Finnish medical research is globally recognized, and our health care system is envied by many. Finland has been selected as one of the model countries for WHO's *Health for All by the Year 2000* program. In principle the preconditions for exports should be most favorable. The well-being cluster's share of the Finnish exports, however, is only 2% whereas the OECD average is 3.3%.

Pharmaceuticals. Both *Orion* and *Leiras* are exporting about 50% of their production. On the fiercely competitive international markets increased specialization is needed and the stakes are high due to R&D risks.

Medical equipment. In the global scale the Finnish manufacturers have been most successful in diagnostic and radiological devices. In these products predicting the changes in market trends is crucial; thus the role of domestic customers is emphasized. Finnish have also been successful in dental equipment. Aids of home care and minimum-invasive surgery equipment are undoubtedly some of the future growth areas. Compared to other Finnish industries health care equipment is truly unique; the field is filled with small high technology companies that have reached (or has potential to reach) high global market shares. From the view point of the national economy, however, the problem is that each of the markets these companies capture is rather small - possibly less than USD 100 million.

Applications of genetic research are expected to be a big segment of the cluster in the near future. Although commercial applications are limited, Finland is one of the world leaders in the field; for instance links of several genetically transmitted diseases have been discovered there.

The big question in regard to the cluster is, how currently small or medium-sized companies could grow to be larger ones. Many companies have reached a size, that they are major players in the niche they are in, and only way to expand significantly seems to be diversification. Yet the management, often led by the founder, have knowledge of only their own specialty.

Environmental cluster (potential, good growth prospects)

In the late 1980s and early 1990s consumers' environmental awareness increased considerably. In the industrial context pollution control was not only an unnecessary increase in expenditure any longer; environmental consciousness could be a source of competitive edge on the market place. A new line of business, environmental management and technology, emerged. The market potential is great; in the future environmental technology could be one of the cornerstones of the Finnish economy.

The strengths of the Finnish environmental cluster can be found on the subsectors, where the Finnish legislation has been particularly strict. Successful applications can be found for instance in the forest industry and in water pollution control. Many industries - power generation, mining, and the metal industry to mention a few - have also developed quite environmentally friendly production methods.

While Finland has relatively good basic (environmental) research and process know-how, the knowledge base relating to environmentally friendly consumer products could be upgraded. The main, and practically only, resource of Finland, forest, is renewable; this improves the country's environmental balance considerably.

A peculiar feature of the cluster is the seeming randomness in the order of 'environmental' preference. Sometimes environmental activists attack issues that are rather marginal but easy to point out. For instance in the case of the forest industry some issues - first chlorine, then recycling, forest management, and followed possibly by energy - have come up in a surprising order. Systematic life-cycle analysis of environmental effects can nevertheless be a source of competitive advantage.

The emphasis in the Finnish environmental cluster has evolved from 'end-of-pipe' techniques to environmentally friendly production technologies. In the previous stage companies concentrated to clean up the generated pollution; now they try to avoid harmful side effects all together. The demand of process industries has driven the growth of the cluster. Especially requirements of the forest industry are behind many of the currently successful products; for instance *Kemira* is a leading manufacturer of peroxide which has replaced earlier used chlorine in paper production.

Transport cluster (potential, two-sided development)

Finland is far from the main markets, and its exports comprise of rather bulky products. Therefore logistics - transporting, handling, and warehousing of commodities - has been essential for the main industries in Finland. Logistics has sprouted a transportation and transmitting equipment industry. Recently transit traffic through Finland has also grown vigorously.

The transportation cluster is contradictory. While some companies are quite competitive, other are fading away. Transit traffic and emerging Russia market may give new impetus for growth, but there are no signs of 'fresh' industrial activity. Considering the role of logistics in Finland, it is unfortunate that the transportation sector has been merely a driftwood. Even the new possibilities are a consequence of a historical development. Finland has a chance of a life-time to become a major logistic hub in the east-west trade. Unless the Finns act fast the early lead will be lost.

Chemical cluster (potential, two-sided development)

The chemical industry is by far the most important supplier of intermediary inputs for other industries. In Finland its ties are closest to the forest industry and construction.

The Kemira Group and Neste[51)] jointly account for over half of the chemical industry's value-added. Neste has built up a chain from oil refining to oil products, petrochemicals and plastics. It is also active in oil exploration and production, as well as in the gas business. Kemira Group has grown into a multi-product chemical company; it is one of the world's leading producers of fertilizers and titanium dioxide pigments. Also a wide array of other industrial chemicals e.g. in the pulp and paper sector, as well as water treatment chemicals and paints are offered.

Interrelations in the chemical industry are not particularly strong. However, the chemical industry belongs to and strengthens other clusters.

In Finland the share of some kinds of bulk commodities is remarkable. In commodities the focus on cost dominates production, competition from industrializing and oil-producing countries grows and the demand rises merely in accordance with GDP. The Finnish chemical industry has responded to this varyingly. It has through acquisitions gained a critical mass and become a world player. It has through superior process know-how gained cost advantages. It has differentiated products by adding environmental content to them. But most promisingly, the emphasis has turned to specialty and fine chemicals; this is the case in particular in forest and environmental chemicals.

The Finnish chemical industry manifests this need to create competitive advantages based on product differentiation and know-how. Competitively priced factors of production, economies of scale, bulk products or even productivity growth do not as such offer sustainable advantages.

The growth of the Finnish chemical industry will be hindered for some time by its high share of commodity-type products. Some businesses grow slowly or are scaled down and new ones need time to develop. Also the need to internationalize the new segments from the very beginning calls for time. However, as late as it may have happened, the Finnish chemical

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51) Including the parts now in Borealis (a merger of Neste's and Norwegian Statoil's plastics polymer businesses).

industry is slowly turning to advantages based on know-how and slowly gaining a foothold in the more advanced segments of the branch.

Construction cluster (defensive)

At the beginning of the 1990s the construction cluster nose-dived; personnel collapsed from 350,000 to 200,000 in a few years. The core of the cluster, the construction itself, was hit the hardest. The sheer magnitude of the branch spells the importance of a recovery.

Mostly building materials and equipment are exported, although Finns have had varying success in building projects mainly to territory of the former Soviet Union and earlier to the Arabic countries.

The basic problem of the construction cluster is a lack of customer orientation. End-users are not consulted during the designing and construction phases; information about the customer needs is transmitted through a rather weak mechanism of what is bought and sold. Arrogance should be replaced with a willingness to serve.

The Finnish banking sector, and due to its problems also the Finnish tax payers, has supported unprofitable construction firms. By supporting the least competitive enterprises they have destroyed the preconditions of a functioning market. Structural imbalances were maintained too long, and now the bill is being paid.

The former communist block is the most promising market of the Finnish export efforts. The vanguard of the export products has been, and are, successful even in the most demanding markets in the Central Europe. Growth could be found by exploiting the wood raw material in a new form.

Chemical pulp and paper mills, water-treatment plants, and cold-storage systems are export projects having clear links to other Finnish clusters and domestic factor conditions - designing and managing these projects abroad is a strength that could be further exploited.

Foodstuffs cluster (defensive)

Processed foods and refined raw materials are consider the core of the cluster. Agriculture is naturally the main source of raw materials.

The institutional context of the foodstuffs cluster is quite different from the ones discussed above. The interest group of the farmers (MTK) has been one of the ruling powers in the Finnish political scene, and it has managed to arrange heavy public subsidies to its members. Besides direct income transfers, effective import protection was provided. Against this background it is obvious, that the incentive mechanism in agriculture has been somewhat biased. A hefty 80% of the production is directed to the Finnish markets of only 5 million consumers.

The national importance of the foodstuffs cluster is nevertheless significant: the foodstuffs industry employs 40,000 people, and there are an additional 150,000 persons in agriculture. The cluster has been caught in a negative spiral - the functioning of the determinants supporting competitiveness has been hindered or their development neglected.

As Finland became a full member of the European Union, a new era started in the foodstuffs cluster. Competition has increased especially in the processed foods, whereas the Union is not pushing for a rapid restructuring of agriculture itself.

At the same time it is obvious, that the Finnish economy can not maintain the agricultural sector in its current form for much longer - the costs are simply intolerable. Eventually increasing competition will shake of the fat, and leave the companies and entrepreneurs that are capable of finding true competitive advantages. Understandably the pace of the restructuring has to be sluggish in order to avoid excessive personal costs.

Dynamics of the Finnish industrial clusters

Comparative advantages in factor conditions are often the initial impetus behind the development of a cluster. Historically speaking, abundant natural resources seem to be a typical example. In the fastest growing industries today, however, it is the created and advanced factors, that are sources competitive strength. Often new branches are spin-offs of the existing ones. Although seeds for new clusters can, and should, be planted by investing in human knowledge and capabilities, the greatest growth potential is in the strengthening of the existing clusters. Brims of the current centers of excellence are the likeliest places for new spin-offs. The most obvious development possibilities of the Finnish clusters are summarized in the table I below.

Table I The main sources of competitive advantage in the Finnish clusters

	Previous source of comp. advantage	**Current source of comp. advantage**	**Future source of comp. advantage**
Forest	*Factor conditions:* abundant wood raw material, waterways suitable for transportation	*Related industries:* technological system	*Related industries:* technological system, *Strategy:* customer orientation
Base metal	*Factor conditions:* ore deposits, demanding conditions as a source of mining & metallurgical innovations	*Strategy:* specialization, process & logistics know-how	*Demand:* developments in the regional markets *Factor conditions:* Russian ore resources
Telecom	*Competition* in telecom operation *Strategy & gov:t:* Scandinavian-wide NMT-standard	*Competition* in telecom operation *Factor conditions:* special skills	*Related industries:* applications for instance in health care
Energy	*Factor conditions:* demanding conditions, lack of domestic fossil fuels *Competition* in power generation	*Factor conditions:* technological know-how *Strategy:* product integration	*Strategy:* export of services and increased service content of the existing products
Well-being	*Factor conditions:* combining medical and technical knowledge	*Factor conditions:* know-how	*Demand:* Sophisticated demand of domestic health care services
Environmental	*Demand:* environmental problems of the domestic process industry	*Demand:* environmentally friendly prod. technologies for the process ind.	*Demand:* environmentally friendly consumer products
Transportation	*Demand:* domestic demand of heavy trucks and Russia's need of vessels	*Factor conditions:* specialized skills in building luxury cruisers *Demand:* transit traffic	*Strategy:* developing Finland to a logistic hub between east and west, more emphasis on logistics *Demand:* Baltic Sea travelling & trading
Chemical	*Demand*: domestic demand	*Factor conditions*: process know-how *Related industries:* forest cluster	*Strategy*: environmental business; know-how based products; customer orientation
Construction	*Strategy:* standardized concrete construction, prefabricated houses *Factor conditions:* architecture	-	*Strategy:* customer orientation *Related industries:* connections to other clusters (e.g environmental)
Foodstuffs	-	*Demand:* expanding regional markets	Increased *competition*

The progress within a cluster can also be negative. The cluster becomes uncompetitive in the long-run, if it is unable to upgrade and innovate. In the Finnish context the prime examples are the construction and food-stuffs clusters. Domestic demand was not sophisticated enough, local restrictions and regulation hindered innovativeness, the incentive mechanisms were disturbed, and domestic competition was weak.

The Finnish position in the future

In the Finnish economy the pool of advanced and specialized factors has expanded rapidly during the postwar years. The R&D expenditures have grown and the general educational level improved.

There are three features that are characteristic to the Finnish educational system. *Firstly*, studying times are among the longest ones in the world, and the average age of the Finnish students is the highest in the OECD countries. *Secondly*, engineering and natural sciences are emphasized. *Thirdly*, research training has increased considerably during the recent years.

Compared to other countries, Finland is relatively specialized the medium-tech and partly to the low-tech industries. In the high technology Finns have concentrated to a few segments - such as telecommunication and certain medical products. Finland has already surpassed the average R&D intensity of the small industrialized countries. In 1993 the exports of high-tech overtook the imports for the first time.

The Finnish industry is demanding increasing quantities of highly trained personnel; the total employment in industry decreased during the 1980s, but the number of research trained employees almost doubled. There is clearly a threat that growth will be hindered by insufficient supply of qualified personnel. The economy may reach a kind of stalemate; growth is damped by the lack of a specific talent, and at the same time significant share of the labor force is unemployed. Competition over qualified personnel increases inflation, which combined with the high public debt will raise interest rates. Investments will be lower and economic activity further retarded. This kind of negative spiral should be avoided by improving the functioning of the labor market.

The structural changes in the educational level, however, have been more radical than in production. An additional problem is the vulnerability of the current success - technology-driven production is quite concentrated.

Engineering know-how is the backbone of the Finnish industries, but to some extent Finns have been unable to transform it to commercial success. Hundreds of case studies made during *The Competitive Advantage of Finland* project confirm that the development of marketing, financing, and strategic skills did not quite keep up with the expansion of technical knowledge.

The membership of the European Union significantly increases the competitiveness of the Finnish industry. Particularly the machinery and electronics industries are estimated to gain from the removal of the remaining trade restrictions. On the macroeconomic level, however, the main effect of the integration is the increased efficiency in the domestic markets. The developments in Russia and in the Baltic states will accelerate Finnish economic growth.

Towards a new industrial structure

This study criticizes traditional industrial analysis for its limited scope. It is argued that by specifying strict boundaries of industries a bulk of the older research fails to see the important interconnections and knowledge flows that are typical for a cluster. The growth potential of various fields can not be analyzed by studying separate branches; practically none of them would succeed without sufficient supporting structures.

The growth depends on human capital

According to *OECD job study* the growth has been the most intense in the research intensive (and high skill) industries. Labor intensive (and low skill) branches have had the lowest growth rates. Therefore growth in the industrialized countries has to be based on high technology and skilled labor. In the Finnish context this means that the restructuring that started in the early 1980s has to continue.

The Finnish industries are traditionally investment and resource intensive. On the selected markets the country has had fair amount of success, and it has been able to increase its market share. The 1980s was a decade of transition in two respects: the educational level increased considerably

and own R&D expanded. As far as the final output is concerned, the shift to knowledge intensive products happened only partially.

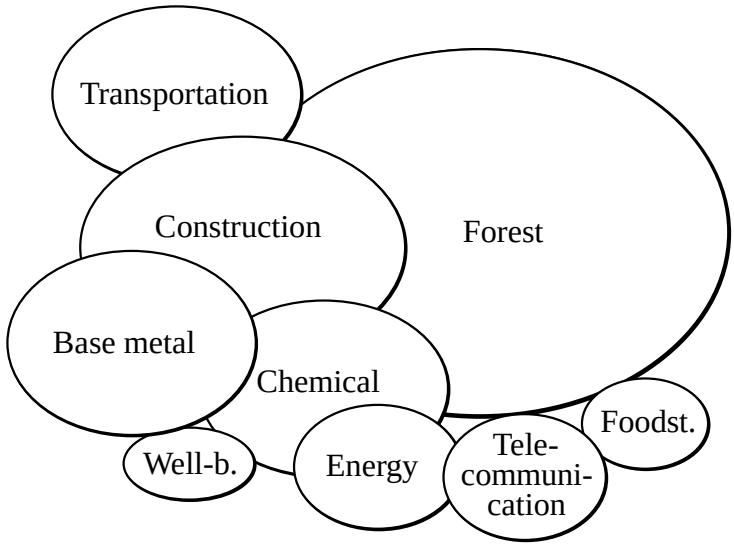
Table II The development and growth prospects for the Finnish industrial clusters

	Export growth 1980-94, % p.a.	Export value 1994 Bill. FIM	Growth potential up to 2010, % p.a.
Forest	4	61	3
Base metal	9	17	6
Telecom	14	10	15
Energy	6	8	7
Well-being	7	3	10
Environmental	..	..	10
Transportation	3	15	4
Chemical	6	16	4
Construction	7	27	2
Foodstuffs	7	5	1

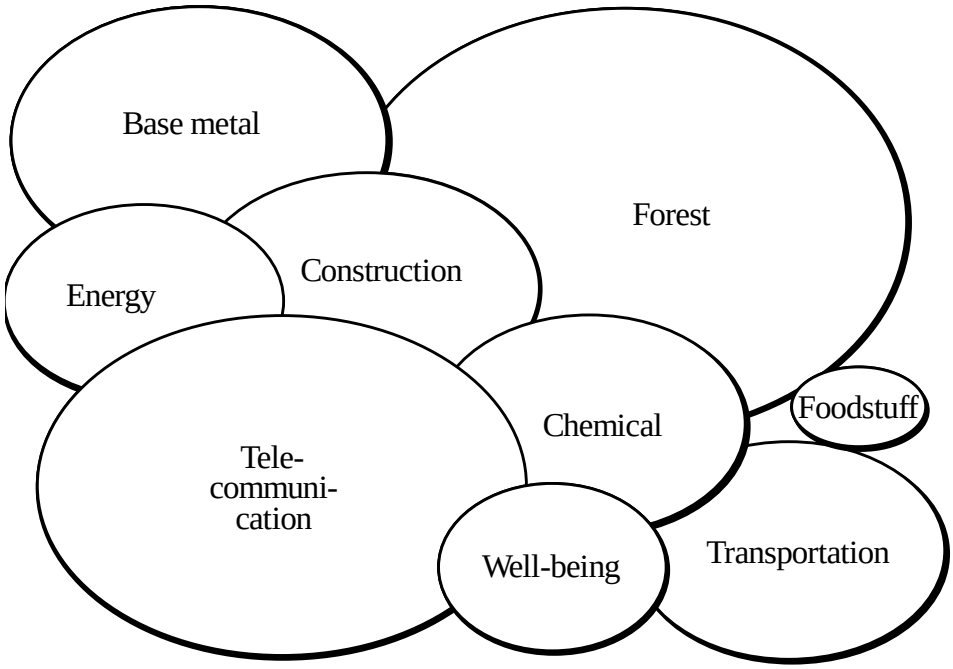
The outlook of the Finnish industrial clusters

The telecommunications, well-being, and environmental clusters are on the fast growing markets and each has potential for further expansion. The energy and transportation clusters have medium market growth. There are many forces supporting the broadening of the energy cluster. The development of the transportation cluster, however, is two-sided: transit traffic and a few industrial segments are expected to grow, while the trend for the industry as a whole is slightly negative. Other clusters have moderate market growth. The forest and base metal clusters have been able to increase their market share. The construction and foodstuffs clusters have been in a negative spiral for quite some time, and until recently their strategies have been defensive. The fast growing clusters comprise 20% of the total production, the medium and slow growing ones accounting the rest.

Figure I **The industrial clusters of Finland in terms of the estimated exports share, at the beginning of the 1990s and at 2010**



Year 2010



Environmental technology is included in many of the clusters above

The new cornerstones of the Finnish economy

This study predicts that there will be a major shift from resource- to knowledge intensive production. The telecommunications cluster is estimated to be almost as large as the forest cluster is at the moment. In any case the role of the forest cluster will diminish, although it will always be significant.

Post-industrial society - decreasing industrial employment

As the operation environment changes, new requirements on the labor markets emerge. The expanding knowledge base has created new growth potential. The realization of this factor pool, however, requires that labor and other resources are allocated efficiently. High unemployment of the Finnish youth is a sign of misallocations, and it causes not only human suffering but also waste of valuable resources. The malfunctioning of the labor market seriously hinders economic growth.

Internationalization trend

The globalization trend of the Finnish industries is likely to continue. This supported by a couple facts: *firstly*, internationalization in Finland has not reached the same stage as in many other small open economies (i.e. Holland, Sweden, Switzerland) and *secondly*, international studies show that knowledge intensive industries are global, *thirdly*, forest and metal will continue foreign direct investments to guarantee their access to raw materials, and *fourthly*, nations will compete on the investments of multinational companies, and also Finnish firms are attracted to invest abroad.

New industrial policy

The goals of the new industrial policy are (1) to guarantee the functioning of a free market, and (2) to create advanced and specialized factors of production. A public market intervention is justified only if there is a clear market failure. Externalities are one of the reasons why a competitive market may not reach a pareto efficient outcome.

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APPENDIX 4: CURRENCY CONVERSION TABLE

Average annual exchange rates:
FIM/Foreign currency and Foreign currency/FIM

FIM	/USD	/DEM	/JPY	/CHF	/GBP
1960	3.200	0.762	0.0089	0.732	8.964
1961	3.200	0.793	0.0089	0.732	8.964
1962	3.200	0.800	0.0089	0.732	8.964
1963	3.200	0.800	0.0089	0.732	8.964
1964	3.200	0.800	0.0089	0.732	8.964
1965	3.200	0.800	0.0089	0.732	8.964
1966	3.200	0.800	0.0089	0.732	8.964
1967	3.450	0.863	0.0096	0.789	9.530
1968	4.200	1.050	0.0117	0.960	10.072
1969	4.200	1.065	0.0117	0.960	10.072
1970	4.200	1.148	0.0117	0.960	10.072
1971	4.184	1.199	0.0120	1.012	10.180
1972	4.146	1.300	0.0137	1.086	10.365
1973	3.821	1.429	0.0141	1.207	9.365
1974	3.774	1.458	0.0129	1.267	8.818
1975	3.679	1.496	0.0124	1.425	8.139
1976	3.864	1.535	0.0130	1.546	6.937
1977	4.029	1.735	0.0150	1.676	7.031
1978	4.117	2.049	0.0196	2.303	7.887
1979	3.895	2.125	0.0178	2.342	8.252
1980	3.730	2.052	0.0165	2.226	8.674
1981	4.315	1.909	0.0196	2.197	8.665
1982	4.820	1.986	0.0194	2.374	8.427
1983	5.570	2.182	0.0235	2.654	8.439
1984	6.010	2.112	0.0253	2.557	7.992
1985	6.198	2.105	0.0260	2.523	7.956
1986	5.070	2.335	0.0301	2.818	7.434
1987	4.396	2.446	0.0304	2.948	7.183
1988	4.183	2.382	0.0326	2.859	7.443
1989	4.291	2.282	0.0311	2.623	7.023
1990	3.824	2.366	0.0264	2.753	6.792
1991	4.044	2.436	0.0300	2.820	7.132
1992	4.479	2.867	0.0354	3.186	7.858
1993	5.712	3.456	0.0514	3.865	8.564
1994	5.218	3.217	0.0511	3.818	7.982

/FIM	USD	DEM	JPY	CHF	GBP
1960	0.313	1.312	112.5	1.367	0.112
1961	0.313	1.260	112.5	1.367	0.112
1962	0.313	1.250	112.5	1.367	0.112
1963	0.313	1.250	112.5	1.367	0.112
1964	0.313	1.250	112.5	1.367	0.112
1965	0.313	1.250	112.5	1.367	0.112
1966	0.313	1.250	112.5	1.367	0.112
1967	0.290	1.159	104.3	1.268	0.105
1968	0.238	0.952	85.7	1.041	0.099
1969	0.238	0.939	85.7	1.041	0.099
1970	0.238	0.871	85.7	1.041	0.099
1971	0.239	0.834	83.5	0.988	0.098
1972	0.241	0.769	73.1	0.921	0.096
1973	0.262	0.700	71.1	0.828	0.107
1974	0.265	0.686	77.4	0.789	0.113
1975	0.272	0.669	80.7	0.702	0.123
1976	0.259	0.652	76.7	0.647	0.144
1977	0.248	0.576	66.6	0.597	0.142
1978	0.243	0.488	51.1	0.434	0.127
1979	0.257	0.471	56.3	0.427	0.121
1980	0.268	0.487	60.8	0.449	0.115
1981	0.232	0.524	51.1	0.455	0.115
1982	0.207	0.504	51.7	0.421	0.119
1983	0.180	0.458	42.6	0.377	0.118
1984	0.166	0.474	39.5	0.391	0.125
1985	0.161	0.475	38.5	0.396	0.126
1986	0.197	0.428	33.2	0.355	0.135
1987	0.227	0.409	32.9	0.339	0.139
1988	0.239	0.420	30.6	0.350	0.134
1989	0.233	0.438	32.2	0.381	0.142
1990	0.262	0.423	37.9	0.363	0.147
1991	0.247	0.410	33.3	0.355	0.140
1992	0.223	0.349	28.3	0.314	0.127
1993	0.175	0.289	19.5	0.259	0.117
1994	0.192	0.311	19.6	0.262	0.125

Source: OECD National Accounts, The Bank of Finland Monthly Bulletin

APPENDIX 5: TOP 70 INDUSTRIAL ENTERPRISES IN FINLAND IN THE ORDER OF NET SALES IN 1994

	Enterprise	Industry	Net sales, MFIM	Person-nel	Net re-sult, MFIM
1	**Neste***	Oil production and refining	49201	9017	960
2	**Nokia***	Telecommunications	30177	28043	3115
3	**Repola***	Forest and engineering	28622	27378	1463
4	**Kymmene***	Forest	18883	17551	851
5	**Enso-Gutzeit***	Forest	17711	14747	1362
6	**Outokumpu***	Base metals	16683	15920	857
7	**Metsäliitto***	Forest	14429	13331	848
8	**Kemira***	Chemicals	11698	11156	282
9	**Ahlström***	Engineering, forest	10841	13479	48
10	**Metra***	Metal products and engineering	10108	11676	319
11	**Suomen PT***	Posts and telecommunications	9801	34511	1000
12	**Valmet***	Metal products and engineering	8328	12107	157
13	**Huhtamäki***	Food, plastic products	8285	11341	357
14	**Kone***	Metal products and engineering	7662	21553	261
15	**Rautaruukki***	Metal products and engineering	7613	9444	606
16	**Imatran Voima***	Energy	7602	5458	229
17	**Asko***	Furniture, plastic products	6823	8521	146
18	**Amer***	Sports equipment	6711	5360	219
19	**Cultor***	Food	6395	5304	423
20	**ABB-yhtiöt***	Metal products and engineering	6291	7971	451
21	**Partek***	Building products, minerals	6166	8128	41
22	**Veitsiluoto***	Forest	6062	4587	325
23	**Finnair***	Transport and forwarding	5892	9721	108
24	**Borealis Polymers***	Construction	4891	1164	131
25	**Sisu***	Metal products and engineering	4588	4564	178
26	**EffJohn***	Transport and forwarding	4137	7565	-144
27	**ICL Finland***	Information technology	3945	2430	34
28	**Orion***	Chemicals	3856	5092	448
29	**Fazer***	Food	3600	6992	98
30	**Raision Yhtymä***	Food	3518	1958	136
31	**LSO***	Food	3333	3345	56
32	**Puolimatka***	Construction	3300	2518	-138
33	**YIT-Yhtymä***	Construction	3244	4145	45
34	**Tampella***	Metal products and engineering	3226	4447	-280
35	**Lemminkäinen***	Construction	3000	2484	1
36	**Rettig***	Heating, beverages	2939	3693	177
37	**Sponsor***	Conglomerate	2838	2260	75
38	**Pohjolan Voima***	Energy	2760	1022	-136

Top 70 industrial enterprises ... continued

	Enterprise	Industry	Net sales, MFIM	Person-nel	Net re-sult, MFIM
39	**Atria***	Food	2510	2092	105
40	**Fiskars***	Metal	2324	3811	160
41	**Polar***	Construction	2276	1746	-50
42	**Kvaerner Masa-Yards**	Metal products and engineering	2075	4489	177
43	**Instrumentarium***	Health care equipment	2008	2351	143
44	**SF Line***	Transport and forwarding	1884	2745	183
45	**Helsingin Teleph.***	Telecom operator	1879	3656	20
46	**Hackman***	Metal products and engineering	1873	3362	-40
47	**Finnlines***	Transport and forwarding	1805	1331	222
48	**Teollisuuden Voima**	Energy	1762	506	67
49	**Sanoma***	Printing, media	1647	3692	112
50	**KCI KoneCranes***	Metal products and engineering	1626	2890	72
51	**Scansped Group***	Transport and forwarding	1567	1393	125
52	**Hartwall***	Food	1457	1897	21
53	**Suomen Unilever**	Food, chemicals	1428	1143	0
54	**Vapo***	Forest, energy	1387	1040	170
55	**Aamulehti***	Printing, media	1329	2827	57
56	**Pöyry***	Forest industry consulting	1329	2548	3
57	**Lassila & Tikanoja***	Multi business	1167	2910	80
58	**KWH Group***	Plastic products	1140	1591	78
59	**Ensto***	Electrical equipment	1139	1476	58
60	**Ingman Foods***	Forest	1133	684	80
61	**Kyro***	Forest	1092	991	101
62	**Saarioinen***	Food	1059	1670	56
63	**Huolintakeskus***	Transport and forwarding	1039	740	42
64	**Normilk**	Food	1025	641	23
65	**Paulig***	Food	1009	728	90
66	**Tetra Pak***	Packaging	986	457	66
67	**Tietotehdas***	Information technology	980	1740	43
68	**Karjaportti***	Food	972	970	14
69	**Ericsson***	Telecommunications	970	791	29
70	**Helsinki Media Company**	Media	958	1124	27

Based on the database "Financial statements and key figures of top 500 corporations in Finland" by the business magazine "Talouselämä". For information contact Etlatieto Ltd. Groups are indicated by an asterisk. Exceptional financial years: Ensto 18 months, Lemminkäinen 16 months, Cultor 13 months, KCI-Konecranes 9 months, Normilk 6 months

APPENDIX 6: SELECTED FOREIGN SUBSIDIARIES OF TOP FINNISH ENTERPRISES

Enterprise	Subsidiary	Country
Neste		
	Neste Canada Inc.	Canada
	Neste Oxo AB	Sweden
	Neste Resins Corp.	USA
	Neste Resins B.V.	Netherlands
	Neste Petroleum A/S	Norway
Nokia		
	Nokia Unterhaltungselektronik GmbH	Germany
	Nokia Mobile Phones (HK) Ltd	Hong Kong
	TMC Company Ltd	South Korea
	Nokia Telecommunications Ltd	Great Britain
	Nokia Mobile Phones Produktionsgesellschaft mbH	Germany
	Nokia Electrionics Bochum GmbH	Germany
	Nokia Mobile Phones Manufacturing (USA) Inc.	USA
	NKF Kabel B.V.	Netherlands
	Nokia Satellite Systems AB	Sweden
	Nokia Kabel GmbH	Germany
	Kaiser Kabel GmbH	Germany
Repola		
	Sunds Defibrator Industries AB	Sweden
	Timberjack Inc.	Canada
	Shotton Paper Company plc	Great Britain
	Stracel S. A.	France
	Neles-Jamesbury, Inc	USA
	Raflatac S.A.	France
	Nordberg Inc.	USA
	Raflatac Ltd	Great Britain
	Raflatac Walki GmbH	Germany
Kymmene		
	Nordland Papier AG	Germany
	Chapelle Darblay	France
	Papeteries de Docelles	France
	Caledonian Paper plc	Great Britain
	Wisapak Mertens GmbH	Germany
	Schauman Panels Ltd	Great Britain
	Wisapak Multicoate	Denmark
	Malvaux	France
Enso-Gutzeit		
	Sachsen Papier Eilenburg GmbH	Germany
	Berghuizer Papierfabriek N.V.	Netherlands
	Enso Espanola S.A.	Spain
	Papeteries R. Soustre & Fils S.A.	France
	Pakenso Sweden	Sweden

Foreign subsidiaries ... continued

Enterprise	Subsidiary	Country
Outokumpu		
	Outokumpu American Brass Inc.	USA
	Outokumpu Copper S.A.	Spain
	Outokumpu Copper AB	Sweden
	Outokumpu Copper B.V.	Netherlands
	Outokumpu Copper Inc	USA
	Tara Mines Ltd	Ireland
Kemira		
	Kemira Kemi AB	Sweden
	Kemira Agro U.K. Ltd.	Great Britain
	Kemira Agro Holding B.V.	Netherlands
	Kemira Danmark A/S	Denmark
	Kemira Pigments Inc.	USA
	Kemira S.A./N.V.	Belgium
	Kemira Pigments B.V.	Netherlands
	Kemira Coatings Ltd.	Great Britain
Ahlström		
	Ahlstrom Kamyr Inc.	USA
	A.Ahlstrom GmbH	Germany
	Ahlstrom Sumiju K.K.	Japan
	Elektrokontakt EKT AB	Norway
	AB Åkerlund & Rausing	Sweden
	Bosso Carte Speciali Spa	Italy
	Ahlstrom Filtration Inc.	USA
Metra		
	Stork-Wärtsilä Diesel BV	Netherlands
	Keramag Keramische Werke AG	Germany
	Wartsila SACM Diesel S.A.	France
	Allia SA	France
	Wärtsilä Diesel AB	Sweden
	Ifö Sanitär AB	Sweden
	Wärtsilä Propulsion A/S	Norway
Valmet		
	Valmet-Karlstad AB	Sweden
	Valmet Inc./Charlotte Division	USA
	Valmet Inc./Appleton Division	USA
	Rotomec S.p.A.	Italy
	Valmet Automation (USA) Inc.	USA
	Valmet Canada Inc/Montreal Division	Canada
Huhtamäki		
	Leaf Holland B.V. Group Headquarters	Netherlands
	Polarcup Services S.A. Group Headquarters	Netherlands
	Leaf Inc	USA

Foreign subsidiaries ... continued

Enterprise	Subsidiary	Country
Kone		
	Montgomery KONE Inc.	USA
	Montgomery KONE Elevator	Canada
	KONE Belgium S.A.	Belgium
	KONE Starlift B.V.	Netherlands
	KONE Lifts Ltd.	Great Britain
	Fiam S.r.l.	Italy
	Sabiem S.r.l.	Italy
	Société Francaise des Ascenseurs KONÉ	France
	KONE Hissar AB	Sweden
	KONE Aufzug GmbH & Co KG	Germany
	KONE Elevator India Ltd	India
	KONE Elevators Pty. Ltd.	Australia
Rautaruukki		
	Carl Froh GmbH Co	Germany
	CCB-Gruppen	Norway
	Nordisk Simplex A/S	Denmark
	Wirsbo Stålrör AB	Sweden
Asko		
	Asko Cylinda AB	Sweden
	Uponor Anger GmbH	Germany
	Hewing GmbH	Germany
	Uponor AB	Sweden
Amer		
	Wilson Sporting Goods Co.	USA
	MacGregor Golf Co.	USA
	Atomic Austria GmbH	Austria
	Koflach Sport GmbH	Austria
Cultor		
	Svenska Foder Group	Sweden
	Ewos AB	Sweden
	American Xyrofin Inc.	USA
	Leibur AS	Estonia
Partek		
	Partek Cargotec AB	Sweden
	Partek Insulation AB	Sweden
	Partek Beton Nederland B.V.	Netrherlands
	Spenn-Gruppen A.S.	Norway
	Hiab AB	Sweden

APPENDIX 7: OUTLOOK ON MAJOR FINNISH INDUSTRIES[64)]

Table of Contents

64) This is a shortened version of the semiannual report *Profitability by Branch in Finland* by the Research Institute of the Finnish Economy

FOOD MANUFACTURING INDUSTRY

The output of Finnish FOOD MANUFACTURING will rise swiftly compared to the historical growth of this branch of industry. Output will be boosted by increasing consumption. Consumption will rise due to wage increases, tax returns and improving employment. Even though consumption of foodstuffs is not very income-elastic, rising income will shift private consumption to more expensive, high value-added products with higher profit margins.

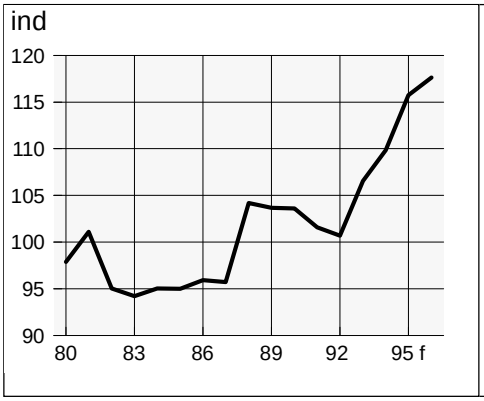
The competition in the domestic markets for foodstuffs will grow keener. The Finnish EU membership removed barriers limiting imports of foodstuffs and the price controls on the food industry's raw materials. Increasing imports shifts supply upward and cuts companies' margins, especially in the previously sheltered sectors. The share of imported foodstuffs within final consumption will increase threefold during the next few years.

Domestic manufacturers are trying to adapt to the new competition by increasing their efficiency and productivity. Productivity is improved by shifting production to larger units, lengthening of production series and reducing product assortment. Improving utilization of capacity will also rise efficiency and profits.

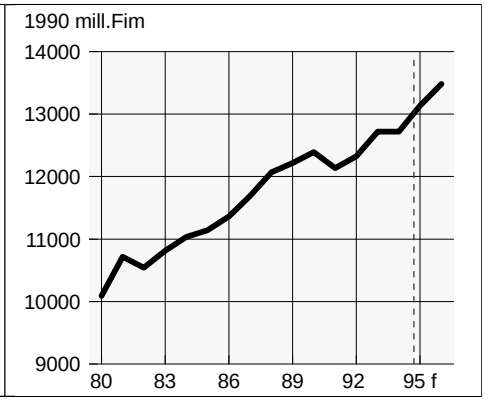
In the years 1993-94 food exports have risen fast. The difficulties in exports to Russia curbed growth in 1995. In the long term the export intensity of the industry will have to be increased because of the rising competition in the Finnish markets. Improving efficiency eases Finnish companies' possibilities in export competition. In addition removal of import barriers makes it possible to import foreign raw materials at competitive prices. Also the prices of domestic raw materials have fallen closer to the international price level. From now on Finnish companies can compete at even terms with foreign companies for example at the Russian markets.

In 1995 the food manufacturing industry's profitability rose due to improving efficiency. In 1996 also exports will contribute to the branch's profits. Relative to sales profits will rise higher than in the 1980s but relative to assets the development is not so favorable.

Capacity Utilization Indicator



Production Volume



TEXTILE, WEARING APPAREL AND LEATHER INDUSTRIES

The output of the Finnish TEXTILE, WEARING APPAREL AND LEATHER INDUSTRIES fell in 1995. The appreciation of the markka reduced the competitiveness of exports and domestic demand grew slowly. The swift rise of consumption was reflected merely in rapidly increasing imports. Falling output, however, did not imply a similar drop in profits.

Private consumption of clothing and footwear rose by some six percent in 1995 and by four percent in 1996. The market share of the imported clothing and footwear is almost 50 percent.

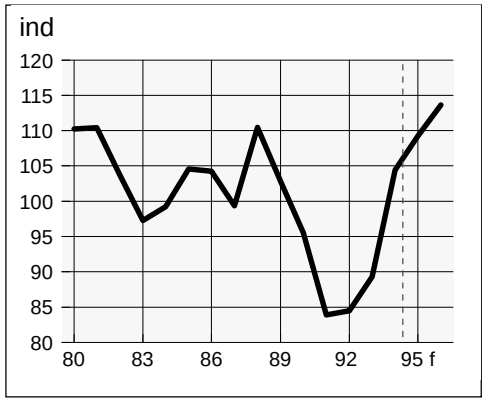
Despite the falling output, profits will stay at 1995 level. The bright prospects are due to favorable trends in capacity utilization and productivity. During the recession the capital stock of the industry has been adjusted to closer to the level of demand. Overcapacity has been reduced both through divestments and decreasing net investments. Reduced capital stock is reflected also in the improved profit-to-total-assets ratio.

The rise in profits reflects also the change in the production chain. Labor-intensive parts of the process are increasingly carried out abroad, in countries where labor costs are lower than in Finland. Finnish-based production concentrates on those stages of production which use more high technology and skilled workforce, and create more value-added.

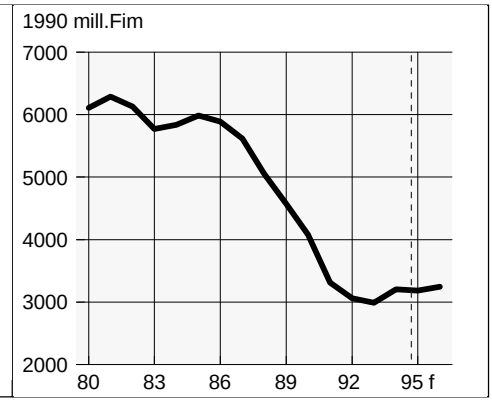
The profitability of the branch is weakened by the rise of raw material prices. The price of cotton increased in 1995 due to growing demand and the poor harvest of the major producing countries. In 1996 cotton prices will stabilize. The price of other synthetic fibers will rise in tandem with other chemical raw material prices. The price of leather has risen quickly since the second quarter of 1994.

Industrial demand for textiles remains brisk in the near future. Consumption of clothing will increase but imports will rise by the margin or even more. The export growth of recent years will not be reached with the strong markka. Russian export demand makes the outlook brighter especially for the leather industry.

Capacity Utilization Indicator



Production Volume



WOOD INDUSTRY

The profitability of the Finnish WOOD INDUSTRY will fall in 1995. The industry's profits peaked in 1994 rising from the very low level of 1991 after being in the red for years. There are several reasons behind the backslash in profits.

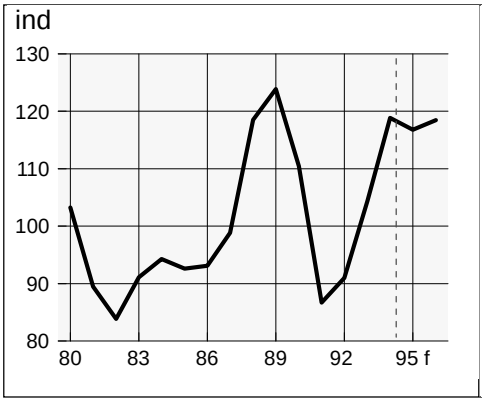
The demand in the main export markets is growing steadily. The problems stem from the supply. Good profitability prospects have spured investment in this sector especially in 1994. The speed of new capacity formation exceeded the healthy growth of demand creating overcapacity on the markets. Overcapacity undermined the possibilities to raise prices of the products, and increased the demand for and prices of timber.

Timber prices have risen considerably in the years 1993-94. In the year 1995 prices rose by some 10 percent on average. The rise in the price of the wood industry's raw wood has, however, started to slow down reflecting the downturn in demand.

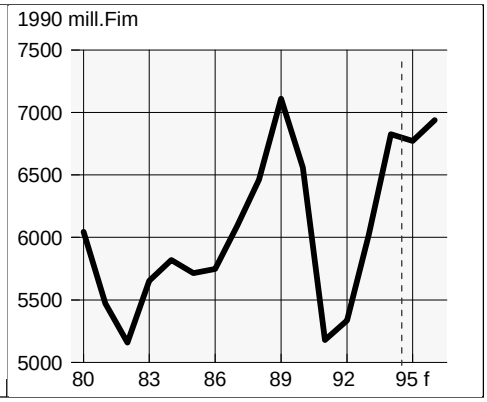
The domestic markets for sawn goods are still in a slump. On the supply side markets are dualistic: there are few, even on a European scale, very large producers, while there are a number of very small sawmills. The large producers are forced to continue sawing despite the low profitability in order to keep their market shares. An additional reason to continue sawing is the fact that sawdust and woodchips are primary raw materials of paper manufacturing. As a result the adjustment of capacity takes place among small producers.

The recession continues in the manufacturing of wooden construction materials and prefabricated wooden houses. Domestic housing construction remains sluggish, and export competitiveness is eroded due to the appreciation of the markka and rising raw material and labor costs.

Capacity Utilization Indicator



Production Volume



PAPER AND PULP INDUSTRY

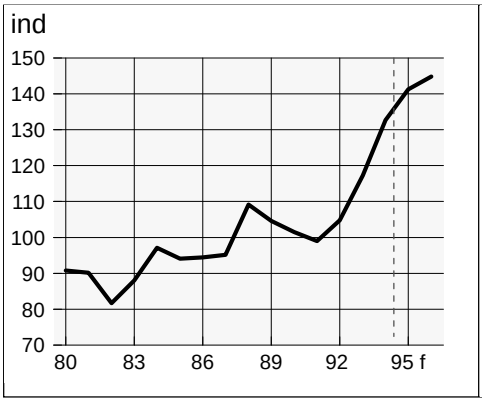
The profitability outlook of the Finnish PAPER AND PULP INDUSTRY could not be better in the short term. Bright prospects are due to increasing demand for paper and rises in the prices of pulp and paper. The price of pulp will continue to rise during the next spring. In 1996 the price of pulp will be around USD 1000. The price of paper will follow the upswing in the pulp prices. Rising demand together with low investment activity in the early 90s have lifted the output close to the full capacity utilization levels. In the long term sound profitability and a strong market position can easily be eroded with domestic costs.

High profits and bright prospects have encouraged companies to initiate new investments. New capacity will come on line in Finland in 1996 and thereafter. New capacity is not expected to create overcapacity in the markets. Therefore the price level in not endangered by oversupply. Another factor is how North-American exports to Europe develop. The growth is stabilizing in the USA, which will curb the growth rate of paper consumption. As a result Canadian paper and pulp exports to Europe will increase. However, the consumption of paper is expected to grow faster than European capacity during the years 1996-97.

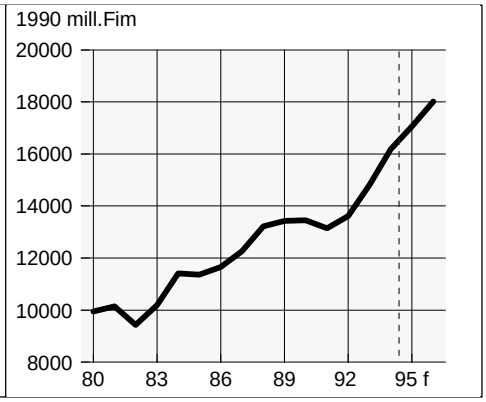
Rising profits will result also in the prices of production inputs: labor, wood, energy and other raw-materials. Wood prices will continue to rise rapidly in the near future. In 1995, the price of wood used in pulpmills rose some 15-20 percent. Increasing timber imports from Russia, however, will stabilize somewhat the price rally. In addition, problems may arise from the difference in demand for logs and pulpwood. Decreasing demand for logs reduces their price, which could limit also the supply of pulpwood.

Labor costs are rising faster than in the rival countries. Higher wages are compensated with the efficiency of the production and high productivity. Other raw materials like pigments and chemicals are increasingly important in pulp production and paper manufacturing. The general economic growth has boosted the demand and prices of raw materials but so far the appreciation of the Finnish markka has mitigated the rise in terms of markka.

Capacity Utilization Indicator



Production Volume



CHEMICAL INDUSTRY

The growth rate of the Finnish CHEMICAL INDUSTRY will return to a normal level. In the year 1994 output rose by over one tenth boosted by rapid increase of exports. In the year 1995 the growth of exports is expected to remain clearly slower.

The output and profitability prospects of the chemical industry differ greatly across the various subbranches of the industry. The demand for industrial chemicals is growing swiftly due to the high season of the Nordic forest industry and rising base metal production. The upswing of other engineering industries is reflected also in the demand for plastic products. The domestic demand for pharmaceuticals is stable. Finnish firms' market shares have fallen in Finland due to foreign competition so the growth is sought after in the export markets.

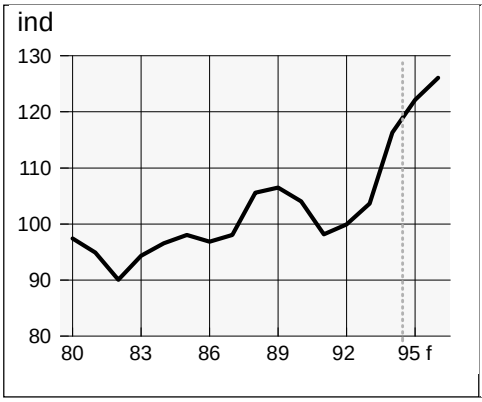
Construction and civil engineering activity remained sluggish in 1995 and in the year 1996 dampening the outlook of the related chemical industry. The demand for fertilizers will remain stable in the next few years but the domestic markets for animal fodder will diminish as a result of EU membership.

The demand for fuel increases as the output of transport rises. On the other hand, the tightening of taxation will raise the prices of fuels which will reduce the demand. The demand for petrochemicals and plastics will grow, but the profitability outlook of these two branches varies.

A common factor for all sub-branches is that domestic demand remains sluggish or grows only slowly. The driving force behind growth expectations are exports, the performance of which is eroded by an appreciating markka.

The profitability-to-sales ratio of the branch will remain roughly at the same level as in 1994. Relative to employed capital, profits will rise. Rising profits are primarily attributable to improving capacity utilization as well as the favorable trend of productivity. The production prices are not rising any faster than unit labor costs thus mitigating the upswing in profits. Increasing profitability, however, is reflected in falling indebtedness of the companies reducing the sensitivity to fluctuation in demand. Rising expenses will cut profits e.g.. in plastic products manufacturing. Petrochemicals will benefit from stable oil prices.

Capacity Utilization Indicator



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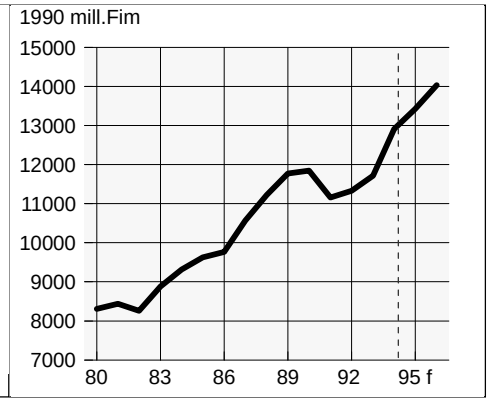


NON-METALLIC MINERALS INDUSTRY

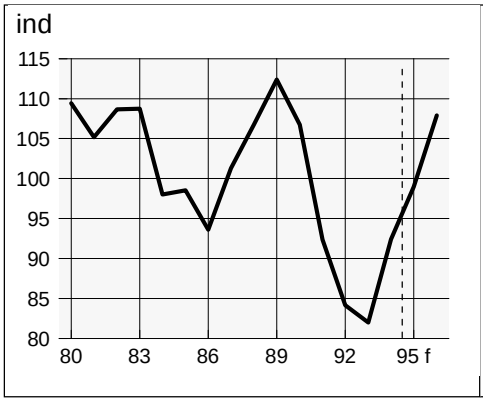
The Finnish NON-METALLIC MINERALS INDUSTRY is still waiting for the upturn in construction activity. In the year 1995 construction fell short of earlier projections. In fact, domestic construction activity remained quite sluggish. This concerned especially the construction of new dwellings, non-residential housing was already picking up but this did not help the non-metallic industry's situation much.

The output of the industry slowed down in 1995 as exports growth was less than that of 1994 and the revival in construction activity was postponed. Exports' direct contribution to non-metallic minerals demand is small. In the last few years during the recession Finnish companies have increased their exports to compensate for poor domestic demand. European construction activity is growing steadily, which is reflected for example in Swedish construction exports.

In contrast with minerals whose demand is based on construction, the profitability of the manufacturing of industrial minerals will rise. This is especially true for the forest industry's coatings and pigments. The current strong upswing in paper manufacturing improves the profitability outlook for pigment manufacturers.

Despite an appreciable rise, branch's profits will stay low compared to the record heights of the 1989. Many of industry's problems originate from the late 1980s. High profits encouraged the building of new capacity to meet the rising demand of booming construction. During the recession construction activity about halved and the non-metallic minerals industry's profits fell in tandem with capacity utilization and the number of employees. In the last few years the capacity of the branch has been downsized in the Nordic countries. The reduction of capacity was reflected in the capacity utilization indicator's upturn last year and branch's profitability rose clearly. The rise in profits is attributable also to improving productivity. During the recession the number of employees fell by some 40 percent and no increase is expected.

Capacity Utilization Indicator



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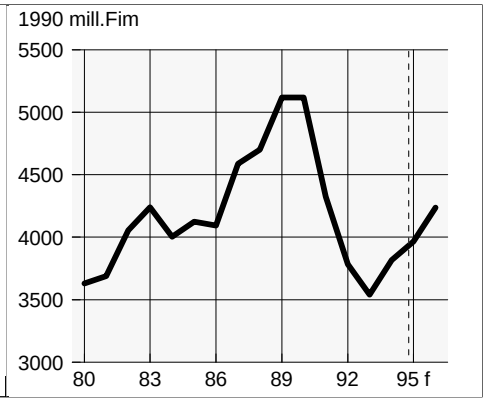


BASE METAL INDUSTRY

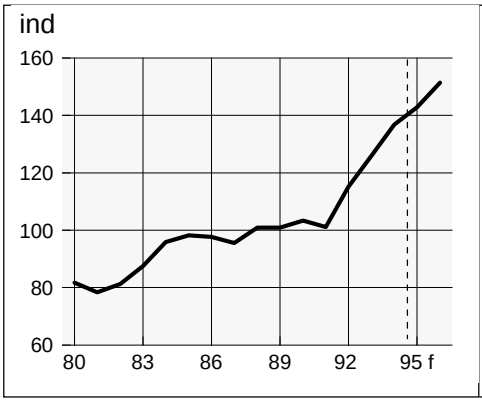
The growth of the output of the BASE METAL INDUSTRY slowed in 1995. The slowdown was attributable to the high capacity utilization rates of the Finnish manufacturers. The output of base metals is very dependent on the available capacity. New capacity comes on line the year 1995 and the years 1996-97. In 1996 the growth will accelerate again as the full benefit is gained from the new capacity and the demand for metal remains to be brisk.

The upswing in the output of metals is due to good export performance. Domestic demand stems from other branches of the metal industry, like machinery and shipbuilding. Construction activity remains low.

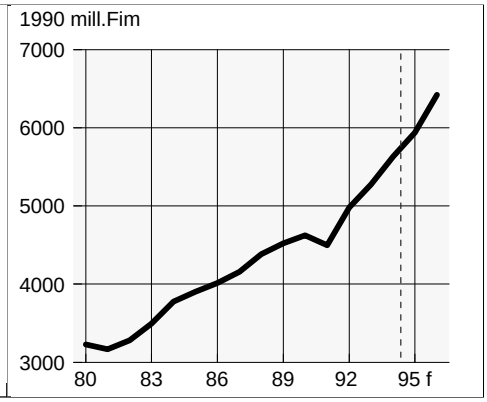
The profitability outlook for the Finnish base metal industry is good. The prices of metals important to Finnish producers rose in 1995. In 1996 the price increases will be slower reflecting the declining economic growth in the industrialized countries. In 1994 part of the increase in prices was due to speculative demand, but in the years 1995 and 1996 the rising prices are based on real demand. On the other hand, in 1995 the Finnish markka did not appreciate much more, therefore the rise in currency denominated world market prices improved Finnish manufacturers' income. However, the costs of inputs, will rise, which will undermine the favorable trend.

The main contributor to the rising profits is stainless steel. Steel markets have revived rapidly from the deep recession. Demand is rising both in the Western markets and in the East Asia. In 1996 demand is expected to slow down somewhat, but prices will remain high. The rising demand of stainless steel has increased nickel consumption. The stocks of nickel have decreased while its price has boomed. Despite the rise in demand and reduced output zinc prices will rise only slightly due to large stocks. Copper prices are expected to remain high due to low level of stocks.

Capacity Utilization Indicator



Production Volume



METAL PRODUCTS AND MACHINERY INDUSTRY

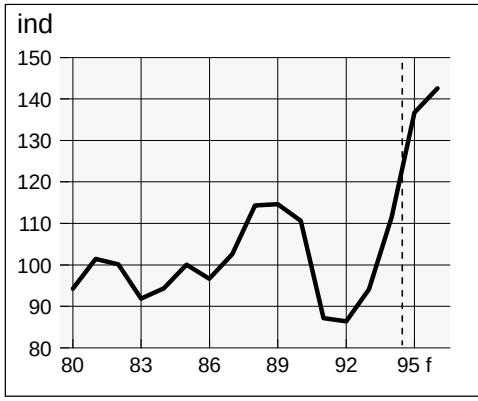
The prospects for the MANUFACTURING OF METAL PRODUCTS AND MACHINERY remain two-sided. Metal-products' demand is dependent on the domestic markets. Especially the volume of construction is important. Machinery output depends heavily on the manufacturing industries' investments and exports. The volume of construction was even lower than earlier expected in 1995. Machinery and equipment investments, in contrast, will gain momentum.

The output of the branch revived strongly in the year 1995. The growth was primarily attributable to the machinery industry's upswing. The rise in the machinery output was largely due to domestic demand. The growth in machinery and equipment investment of Finnish firms has been reflected more strongly than anticipated in the output of the machinery industry. A large part of the machinery investment's growth stems from the forest industry which are largely of domestic origin.

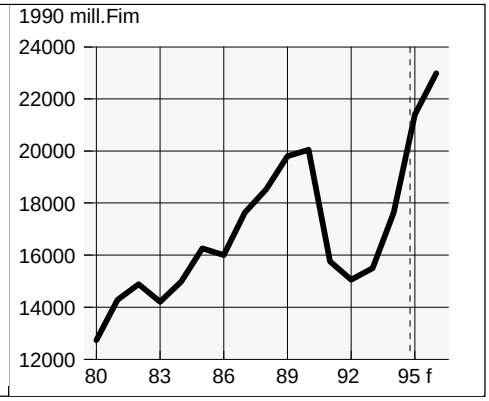
The profitability outlook is not especially bright for the overall branch. The profitability of the companies differs greatly within the industry. Export-oriented machinery manufacturers rose their profits in 1995 despite the rising wages and metal prices. Companies strongly dependent on construction activity will not improve their profits notably. Nevertheless, part of the good export performance will spill over to the domestic subcontracting industry. This applies, for example, to subcontracting for shipbuilding.

In the year 1996 construction activity will speed up, but the profits will then be undermined by a further rise in wages and diminishing export demand.

Capacity Utilization Indicator



Production Volume



ELECTRICAL PRODUCTS INDUSTRY

The MANUFACTURING OF ELECTRICAL PRODUCTS is another branch with two-sided profitability prospects. The excellent performance is attributable to manufacturing of telecommunication products and related subcontracting. Other subbranches of the industry are not performing as well.

The branch is one of the most export-oriented in the Finnish industry. The volume of the exports will continue to grow swiftly during 1996-97. Export prices, however, are expected to remain quite stable. Finnish telecommunication equipment manufacturing companies' position on the markets is strong. The demand is not expected to contract in spite of the appreciation of the Finnish markka.

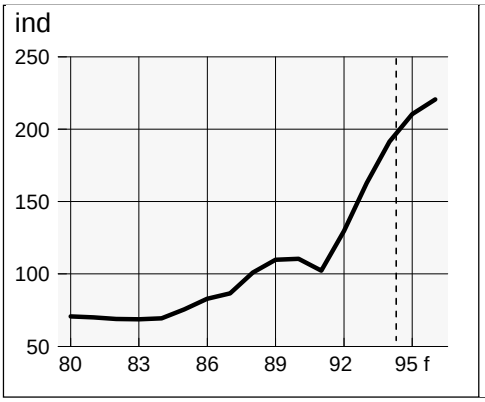
The case is different in the heavy electro-technical industry. In recent years the growth of output has originated from exports especially to East Asia. Favorable export performance has been supported by the cheap markka. With a strengthening markka export demand will decline somewhat. European investment-related demand will gain more emphasis in heavy electronics' exports.

The profitability of the electrical machinery industry will fall slightly from the current high level during the years 1996-97. The large exporting companies' profitability will remain high. The small subcontracting industry's situation is not as good. The rivalry between subcontractors is keen and extraordinarily high profits will decline rapidly. Competition will keep the prices of the subcontractors in check.

Although the concept of capacity is vague in the electronics industry, the utilization rate is expected to rise. If capacity shortages arise the number of working shifts will simply be increased. Investments on fixed capital will remain modest compared to the growth rate of the output. Therefore profitability improves relative to capital employed. High profitability will reduce branch's indebtedness.

The telecommunications sector has also some risks in sight. In the short term, a shortage of skilled labor will pose a risk to continuation of brisk growth. The scarcity of skilled workforce also rises the price of labor. The telecommunications sector is expanding rapidly also globally, which may create production bottlenecks and raise prices of crucial inputs.

Capacity Utilization Indicator



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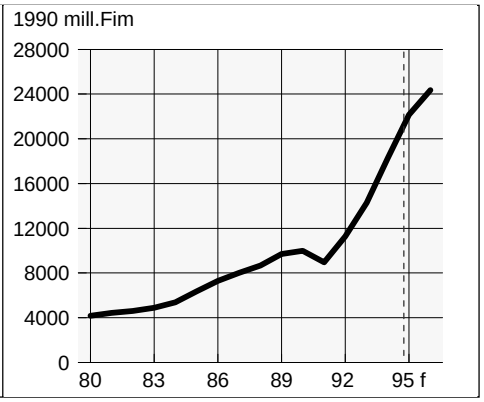


TRANSPORT EQUIPMENT INDUSTRY

The output of the Finnish TRANSPORT EQUIPMENT INDUSTRY will continue its strong upswing. The output of shipbuilding will rise swiftly as orders received after the floating of the markka are in process. The volume of passenger car production increased in the year 1995. Also other branches of transport equipment manufacturing like train cars and airplane construction are improving their performance in terms of output.

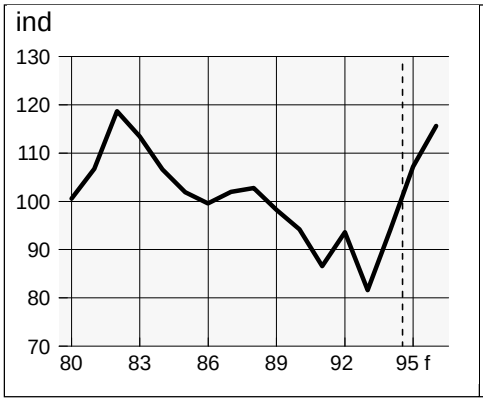
The capacity utilization of the shipbuilding industry is high. If new orders were received they would come into production in the year 1996 or thereafter. The order influx has, however, slowed down considerably while the Finnish markka has appreciated. The current backlog was acquired with the help of a cheap markka. Nevertheless, the profitability of the orderstock has so far been satisfactory.

The profitability outlook of the shipbuilding is gradually becoming gloomier. Finnish markka appreciated strongly during the years 1994-95 reducing the cost competitiveness of the industry. A strong markka will make it more difficult to obtain new orders in the future. In addition, the appreciation of the markka will cut the markka-denominated export revenues or at least increase the costs of hedging. In the future a strong and stable markka does not mitigate the effect of international price increases in raw materials and especially that of metals.

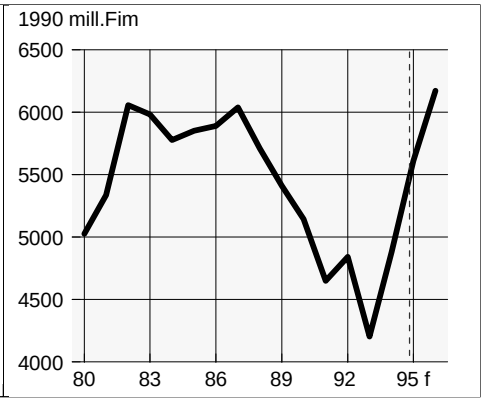
Finnish car manufacturing benefits form the overall economic growth and especially the rising demand in Europe. Rising output improves capacity utilization and reduces unit labor costs. The basic pattern of the car manufacturing, however, is still insecure as a significant share of the production depends on only two car models. Also car manufacturing profits are burdened by a rise in raw material prices.

Other transport industry's profits will increase due to improving utilization rates. The volume of the production is still very low.

Capacity Utilization Indicator



Production Volume



CONSTRUCTION INDUSTRY

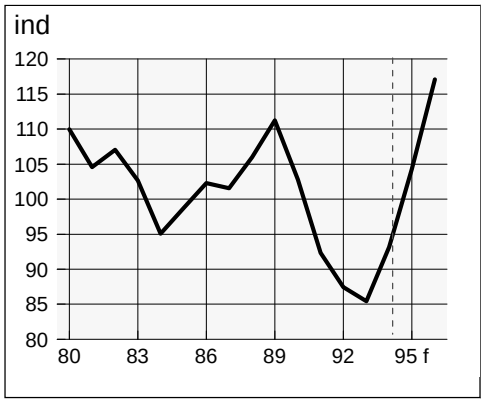
The CONSTRUCTION INDUSTRY's decline in output is beginning to come to a halt. A turn for the better is nevertheless taking place more sluggishly than previously estimated. In 1995 construction activity grew by some 3 percent and in the year 1996 by almost a tenth. The level of construction will nevertheless remain well below the average level in the 1980s.

Construction will pick up especially with respect to industrial buildings. On the other hand, construction of residential buildings will pick up very slowly. The construction of dwellings will expand slightly in the year 1996. Renovation construction, on the other hand, is already increasingly swiftly. The emphasis in residential construction is on state-subsidized dwellings. Very little privately financed housing will be built. Construction of dwellings is expected to pick up toward the end of the decade, but output will remain permanently lower than the average of the 1980s.

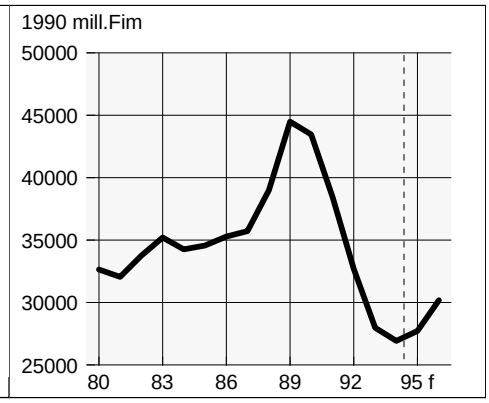
There are several reasons for the sluggish recovery in construction of residential buildings. The prices of old dwellings are often lower than new ones. Households are uncertain regarding their own financial situation. Unemployment is high among young persons, thereby lessening their willingness to purchase housing. Real interest rates are high and the indebtedness of households relative to the market value of dwellings is still high.

Profitability of construction remained very low in 1995 and will remain low also in 1996. There is excess capacity in the construction industry and several large construction companies have been placed in the receivership of Finnish banks. The streamlining of this overcapacity exposes the banks to risks from credit losses.

Capacity Utilization Indicator



Production Volume



APPENDIX 8: PUBLICATIONS IN THE 'COMPETITIVE ADVANTAGE OF FINLAND' -PROJECT

Hernesniemi, Hannu - Lammi, Markku - Ylä-Anttila Pekka: The Competitive Advantage and Future of Finnish Industry; Kansallinen kilpailukyky ja teollinen tulevaisuus (in Finnish). Helsinki 1995. ETLA B 105

Forest Cluster

LAMMI, MARKKU: The Success Story of Paper, Machines and Knowhow - the Competitive Advantage of the Forest Cluster; Paperin, koneen ja osaamisen menestystarina - Metsäklusterin kilpailukyky. (in Finnish with English summary) Helsinki 1994. ETLA B 99.

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