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THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
Lönnrotinkatu 4 B 00120 Helsinki Finland Tel. 609 900 Telefax 601 753
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Laura Paija - Pekka Ylä-Anttila

THE IMPACT OF STRUCTURE AND COMPETITION ON EMPLOYMENT IN THE TELECOMMUNICATIONS CLUSTER CASE FINLAND

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ABSTRACT: The development of employment in the Finnish telecommunications sector is examined over the period 1987 - 94 that experienced full liberalisation of the market. The boundaries of the study have been extended to cover the whole telecommunications cluster which embodies the telecommunications equipment industry, operation, and value-added network services, as well as the input industry, related services, and associated industries. Moreover, the concept of telecommunication competition has been defined to incorporate the equipment industry, as well.

The study shows that the employment in the telecommunications cluster grew rapidly at the same time when it was decreasing in whole economy. It was approximated that in the cluster of operation, equipment industry and distribution, alone, the amount of jobs increased by 13 % over the period studied, while in the whole economy employment fell by 16 %.

KEY WORDS: Telecommunications cluster, competition, employment, industrial and technology policies, Finland

TIIVISTELMÄ: Tutkimus tarkastelee työllisyyden kehitystä telekommunikaatiosektorilla vuosina 1987 - 94, jolloin telekilpailu vapautettiin Suomessa lähes kokonaisuudessaa. Teleklusteri määritellään tutkimuksessa laajasti. Se sisältää teleoperoinnin, telekommunikaatiolaitteiden valmistuksen, lisäarvopalvelut sekä sektorille panoksia tuottavat toimialat ja liittänäistoimialat. Kilpailua ja markkinoiden vapauttamista tarkastellaan sekä laitevalmistuksessa että operoinnissa.

Tutkimuksen mukaan koko teleklusterin työllisyys parantui merkittävästi tutkimusajanjakson aikana, vaikka työllisyys koko kansantaloudessa heikkeni tuntuvasti. Työllisyys heikkeni myös teleoperoinnissa, mutta kasvoi muissa klusterin osissa hyvin nopeasti.

AVAINSANAT: Teleklusteri, kilpailu, työllisyys, teollisuus- ja teknologiapolitiikka, Suomi

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Laura Paija and Pekka Ylä-Anttila

The Impact of Structure and Competition on Employment in the Telecommunications Cluster - Case Finland

SUMMARY

We have examined the development of employment in the Finnish telecommunications sector over the period 1987-94 that experienced full liberalisation of the market. The boundaries of the study have been extended to cover the whole telecommunications cluster which embodies the telecommunications equipment industry, operation, and value-added network services, as well as the input industry, related services, and associated industries. Moreover, the concept of telecommunication competition has been defined to incorporate the equipment industry, as well.

It was approximated that in the cluster of operation, equipment industry and distribution, alone, the amount of jobs had increased by 13% over the period 1987-94, while in the whole economy employment fell by 16%. It was observed that the employment did not fall below the 1987 level in any of the subsequent years.

The fall in the direct operator employment, owing to the restructuring process, was more than compensated in the boosting equipment industry. Behind the success of the equipment industry lies the long tradition in competitive domestic market conditions. The positive multiplier effect was manifested in the input markets, especially in the electronics and electrical industry.

Value-added network service provision has grown yearly by 20-25% in the 1990s. This sector employs an ever increasing group of people, whose number is ultimately difficult to estimate. But the turnover from value-added services will exceed that accrued in basic services in the near future, and the sector contains notable employment potential.

The Finnish evidence strongly supports liberal market conditions in all the industries of the telecommunications cluster. Generally speaking, technical progress saves human work, but development in telecommunications seems to rather create new job opportunities. Their materialisation depends, however, crucially on competitive market conditions, and investments in technology and education.

Hence, it is not the liberal market conditions and competition enhanching policies only that matter. The study indicates that the rapidly growing telecommunications cluster is an outcome of various co-operative ventures based of explicit or implicit contracts between private and public agents. Competitive clusters of firms and industries seem often to emerge as parts of (national) innovation systems. These are

characterised by reduction of transaction costs due the internalisation of transactions involving external economies. From the point of view of industrial and technology policies it is important to recognise innovation activity as a process of systemic nature. As technological knowledge is to a large extent tacit, much of the communication and diffusion of technological knowledge takes place in various kinds of networks. It is the task of public policies to enhance the kind of institutional set-up that promotes the formation of networks.

1. INTRODUCTION

1.1 Background of the study[1]

Recent international discussion concerning the necessity and effects of telecommunications liberalisation has devided opinions. Introduction of competition in network operation, for example, has been seen as a threat to employment as incumbent state monopolies are important employers in many regulated countries.

Finland has one of the most liberal telecommunications market which owes to a gradual but complete liberalisation process since 1985. Actually, Finnish telecommunications market structure has been exceptional since the early beginning, allowing a great number of independent local operators. In the telecommunications equipment industry, national manufacturers have always been exposed to foreign competition.

Today, the Finnish telecommunications sector[2] is characterised by a cluster of specialised, interactive organisations, and the market is among the most developed in the world in terms of technology, service variety and price efficiency, as well as regulatory freedom.

Against this background, this study was carried out in order to determine the net employment impact of the opening of competition in network operation, when explicit consideration was given on the structure and relations of the whole telecommunications cluster.

1.2 Objectives and limitations of the study

In this study, we have looked beyond the narrow delineation of the telecommunications industry containing exclusively telecommunications operation. The objective of the study is to make an empirical assessment of the employment

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[1] This paper is based on the study by Price Waterhouse (1995), "The effects of competition on employment in the telecommunications industry: Case Finland", in which Laura Paija was the main researcher.

[2] In this paper, an industry is defined as an entity of firms providing substitutes. The telecommunications sector, in turn, is understood as a larger entity comprising equipment and service industries involved with telecommunications.

effects of structure and competition in the telecommunications sector, when the perspective is extended from network operation to the telecommunications equipment industry, value-added network service provision, outsourcing industries, related industries, and associated services. The entity of these inter-related industries is defined as the telecommunications cluster. This approach owes to Porter's (1990) model. However, this study does not analyse the telecommunications industries' operational environment within Porter's diamond model, but utilises the model *exclusively* in the determination of the Telecommunications Cluster Chart that defines the boundaries of the study.

The research period covers the years 1987-1994 (with reservation to data availability) which has witnessed gradual but complete liberalisation of telecommunications network services in Finland. In short, the objective of the study is to assess the *net* employment effect of liberalisation in telecommunications cluster framework.

Moreover, we have looked into changes in educational structure of the employed in the telecommunications. Despite the fact that competition has direct bearing on service prices - which reduces the cost of companies' telecommunications bills, and thus, makes creation of jobs with telecommunications access less costly, which in turn indirectly improves employment opportunities - explicit study on price changes is excluded in this study.

Owing to the vast size of the cluster, the boundaries of the empirical study have had to be compressed. For instance, the examination of related industries and associated services of the cluster is based on selected industries. In addition, statistical limitations have determined the extent and accuracy of the study. Accurate data was available only for few industries, and for the remaining ones judgement sampling was utilised. But even in this concise form, the study gives a good idea of the multiplier effect that liberal competitive conditions in the cluster have.

The purpose of the theoretical background of Chapter 2 is not to be an exhaustive examination of the vast literature concerning network economics, but to glance some competing approaches explaining networking of firms, which, in turn, is relevant in justifying the cluster approach used in this study.

2. ECONOMIC THEORY OF NETWORKS

Along with the growing role of information and communications technology traditional economic theories and the related conventional ways of producing and analysing statistical data have been challenged and numerous new approaches have emerged in the theory of industrial organisation. The concept of network, a system of interrelated organisations, is emerging ever more frequently in this context, and has generated a vivid interdisciplinary discussion about the factors underlying the phenomenon. This has been a reflection of the need to define an intermediate organisational form between markets and hierarchies, which would better explain new forms of industrial organisation encountered frequently in modern economies.

The purpose of the following discussion is to provide a general perception of some alternative approaches in the recent literature, and to focus on the motives and conditions under which firms may find interactive operation advantageous.

The role of externalities in the theory of networks

Ultimately, as stated by Antonelli (1992), the concept of networks attempts to integrate the consequences of externalities and interdependence - through cooperation, coordination and competition - on the behaviour of firms. "Network firms can be considered as the intermediate institutional model, comprised between markets and hierarchies, *elaborated to selectively internalise the wide range of externalities* generated in the economic system" (p.21). To be sure, price mechanisms cannot be relied on as an efficient signalling system when externalities matter, and consequently, other means of information acquisition must be applied[3]. Networks are seen to perform this task.

By externalities we understand consequences for welfare not fully mediated by prices or the market mechanism. Antonelli classifies externalities as follows:

i) *Consumption externalities* refer to the effect that one consumer's behaviour has on others' utility;
ii) *Technical externalities* relate to unpaid factors, generated by a third party, that enter the production function of other firms;
iii) *Adoption externalities* are engendered by the reduction of search costs and market prices of complementary inputs; and maintenance and skills induced by the growth of the stock of innovated goods already adopted. Adoption externalities play a crucial role in the interdependence of users (actual and potential) and diffusion of innovated goods.
iv) *Pecuniary externalities* arise when the profit function of each firm depends on the activities of other producers that affect the market prices of inputs.[4]

To summarise, Antonelli suggests that an industry - especially when characterised by growth and change - adheres to dynamic efficiency[5], i.e. generation and introduction of technological and organisational innovations. This requires intertwining of cooperation and competition (to wit, networking), without which an innovative industry, like telecommunications, may end up with a myriad of incompatible configurations. Clusters of industries emerge around the externalities spilling from core technologies, and are likely to improve productivity and competitiveness of the firms interacting in the flows of exchange of products and information.

[3] "In conditions of disequilibrium, a premium is paid for the acquisition of information from sources other than the prices and quantities" (Arrow, 1959, p.47). See Antonelli (1992, p. 9) for a discussion about prices as an inefficient signalling system when externalities matter.
[4] Antonelli refers to transaction costs as a special form of negative pecuniary externalities.
[5] As opposed to static efficiency that involves efficient allocation of given resources to given economic functions.

Transaction cost approach

Differences in the explanations of the motives of networking arise from differing perspectives and points of emphasis. Technology has traditionally been seen as a driving force in the determination of industrial organisation. Today, it is indeed hard to belittle the role of information technology in the organisation of production processes and management practices. However, Williamson (1985) brings down the "technological determinism" by submitting that only rarely are there an exclusively superior production technology, or that any chosen technology would entail a unique organisation form. And further, John R. Commons advanced the idea that economic organisation is not merely a response to technological features but has the purpose of promoting continuity of relationships by devising specialised governance structures (Williamson, 1985, p.3).

Indeed, Williamson's transaction cost theory has probably been the most popular in the attempt to explain networking; transacting is ultimately what networking is all about. Transaction, which differs in attributes, is seen as a basic unit of analysis. The central idea of the transaction cost approach is that it defines a firm as a governance structure rather than a neo-classical production function. Nevertheless, the two approaches are akin in insisting that cost minimising is the driving force in economic organisation, but in the newer approach the neo-classical marginal analysis is supplanted by express provision for organisational innovation. Nevertheless, Williamson (1990) admits that both the neo-classical and the contracting theories are relevant depending on the *objectives* of a study.

Transactions take place in the Williamsonian framework when a product is transferred across sequential stages of a production process. Planning, adapting and monitoring of task completion under alternative governance structures incur costs. These costs originate from the combined ramification of the *human behaviour* of contractual man (bounded rationality and opportunism), and the level of *asset specificity* required by the contract, which has been regarded as the most important determinant of organisational form. Other dimensional attributes determining the nature of transactions are *uncertainty* about successful completion of contract, and *frequency* of transactions between two firms.

Efficiency in transaction cost economising involves proper matching of governance structures to the attributes of transactions. Alternative governance structures combining asset specificity and transaction frequency are represented in Figure 2.1. Market procurement is the likely form in non-specific asset transactions, while the optimal choice moves towards vertical production as asset-specificity grows.

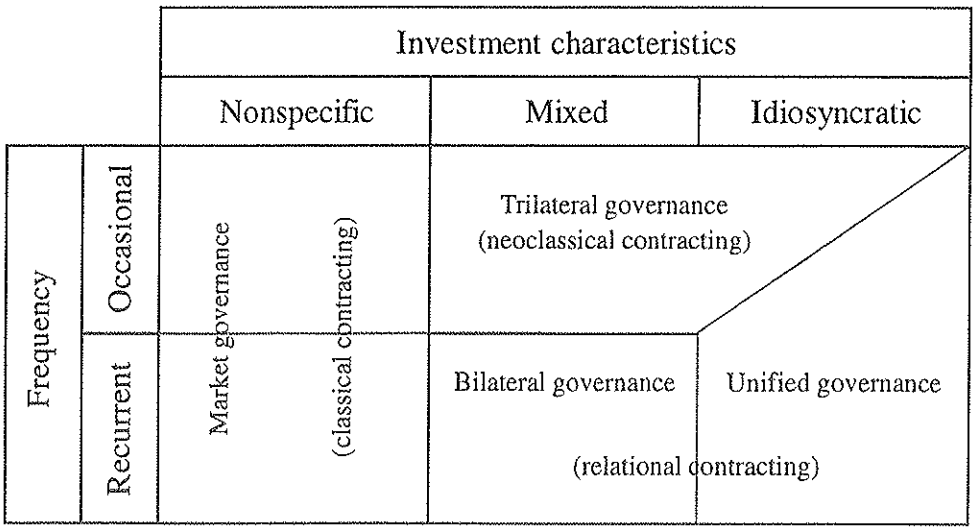

Figure 2.1 Efficient governance
Source: Williamson, 1985

The extreme ends of industrial organisation continuum, to wit, market and hierarchies, involve trade-offs between which optimisation decisions are weighed. Against contracting costs, market procurement involves high-powered incentives (profit maximisation) and potential economies of scale and scope in case of aggregate demands of several buyers. Integrated production, in turn, brings about adaptability and economies in contract governance costs which may be offset by low-powered incentives of supplier stage, bureaucratic features, and loss of potential economies of scale and scope.

Williamson makes special reference to the organisation of process or product *innovation* procurement - that, to be sure, is relevant in the context of an innovative industry like telecommunications. This perspective complicates the assignment of transactions to markets or hierarchies. Various additional problems arise in issues like incentives and fair benefit division between the supplier and the user of innovation, notwithstanding the form of organisation. These problems are likely to deepen as the innovative potential is important. Still, non-integration is advocated due to incentive disabilities involved in vertical integration of supply stage; efforts to transform high-powered incentives into integrated production turns out to be "delusional", thus networking is implied by the transaction cost theory in innovative industries.

Dynamic transaction cost theory

The transaction cost approach has met criticism since the pioneering work of Coase (1937) who proposed that the mode of economic organisation depends on the transaction cost faced by firms[6]. Most of the critique has been directed towards the static nature of the approach. Among others, Ciborra (1992) points out that the transaction approach is too a static way in explaining institutional arrangements as it

[6] See Williamson (1975 and 1985) for the antecedents and critics of the transaction cost theory.

does not take into account changes in environment, and moreover, it fails in explaining *why* an alliance is set up in the first place.

Ciborra, in turn, emphasises minimisation of *transition costs* as the driving force behind setting up networks. Transition costs relates to drastic restructuring to meet new challenges and implement new strategies. Traditionally, learning has been described as a smooth and evolutionary process (learning by doing). However, the amount, quality and rate of increase of knowledge are seen as critical factors in high tech firms, thus the traditional smooth knowledge accumulation does not serve efficiently firms in highly competitive and fast changing environment. It is this kind of *"radical learning" process that is seen as the main source of transition cost*, and *alliances are used as a device to cut down these costs*. Hence, alliances are seen as the outcome of two simultaneous failures: of markets in transferring knowledge and of internal organisation in accumulating it at a fast pace (Ciborra, 1992, p. 94). Cooperation provides a short-cut to radical change through new perception and successful restructuring of organisational problems.

Also Langlois and Robertson (1995) extend the static perspective of Williamson's theory by distinguishing between the short and the long term transaction costs. They refer to Carl Dahlman by pointing out that all transaction costs are at base information costs, and that with time, transacting parties will develop arrangements that mitigate the sources of transaction costs (p.29). Moreover, in a static environment contracts are expected to become self-enforcing and the evolution of norms and reputation is likely to moderate opportunism. In other words, in stable conditions, repetitive transactions become a routine that requires less and less governance, and in the long run, transaction costs might be expected to approach zero. A straightforward (though not excludable) implication of this rationale would indicate non-integration of successive production stages in the long run, and the opposite in the short run.

With this consideration the authors want to bring out the neglected roles of *learning as a dynamic process* and *rapid change in environmental factors* in the reigning transaction cost theories, which actually explains the above mentioned difficulties in the treatment of innovation in the Williamsonian approach.

Langlois and Robertson point to the complementarity of the resources of individual firms, and that the relative costs of acquiring complementary products under alternative organisational forms determines (to a large extent) the boundaries of the firm. According to the steady-state assumption, the boundaries could be expected to be determined by the resources of firms relative to those of the market. But, with time, the quality of resources (notably knowledge) of the firm and the market are expected to improve as, for example, innovations diffuse. Now, consider a firm with enhanced level of knowledge (resources) with which it could improve the quality of its products. It will have to decide on the organisation of the new production stage. Thus, while static transaction costs arises from governance costs with the *available* resources, *dynamic* transaction costs, as the authors define it, are the costs of not having the capabilities you need *when* you need them. In other terms, the firm will incur costs in persuading, negotiating, coordinating, and teaching a supplier to manufacture developed inputs (p.35).

In their so called "Swedish network approach", Forsgren et al. (1995) also emphasise *heterogeneity*[7] *of firms as the critical factor explaining emergence of networks*. This follows from firms' need to develop comparative advantage by specialisation in a limited number of activities. Forsgren et al. point out that asset specificity induced by contracts enhances the degree of heterogeneity, and on the other hand, relationships (market position) are themselves investments that involve differentiation of the market. In short, heterogeneity assumption calls for the consideration of transaction costs, and moreover, consideration of systems of firms instead of an individual firm when analysing competitiveness - or any other phenomenon concerning the firm.

Cluster approach in assessing employment and growth effects

Porter has done influential work in the operationalising of the network concept in the context of competitiveness analysis. By combining established theories of growth, economic development, and networks he has constructed a framework giving important new insights on the study of competitiveness.

Porter focuses his analysis on firm networks, or clusters that are argued to be the source of competitiveness, owing to inter-firm actions and externalities. In his diamond model (Porter, 1990), he delineates the roles of and relative relationships between different environmental factors influencing the preconditions and competitiveness of the cluster. Four main factors are defined: factor conditions; demand conditions; related and supporting industries; and firm strategy, structure and rivalry. The external factors shaping the operating environment are government, chance, and international business activities[8] .

Among the main contributions of Porter's model is the so called Cluster Chart, a methodological device that assembles the traditional key industries and their related and supporting industries, input industries, and customers. This approach allows a more flexible study of an industrial sector without artificial industry or firm boundaries. The boundaries of the cluster may be seen as the theoretical outcome of transaction cost minimisation considerations. Allowing for various degrees of inter-firm transactions, the cluster concept fills up the "grey area" between the classical extreme ends of institutional organisation continuum.

Regardless of the fierce and extensive criticism concerning, for example, non-rigorous construction of the framework, and the foundations of assumptions[9], Porter's approach has inspired numerous empirical studies due to its appealing and operational properties[10] . Porter's Cluster Chart provides an opportune tool also for this study.

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[7] According to Forsgren et al., heterogeneity have origins in production techniques that are developed to use particular inputs; the vintage of capital; the combination of fixed and human capital; raw material quality; physical location; etc.

[8] Inclusion of international business activities owes to Dunning (1993).

[9] For a more extensive overview of the critique, see e.g. Penttinen (1994) or Hernesniemi, Lammi and Ylä-Anttila (1995).

[10] See for example, Hernesniemi, Lammi and Ylä-Anttila (1995), Porter, Sölvell and Zander (1991), Crocombe, Enright and Porter (1991), Reve and Mathiesen (1994), Bellak and Weiss (1993), Peneder (1994).

The telecommunications cluster

Economic theory of networks seems to provide an appealing and logical explanation to the evolution of the Finnish telecommunications cluster. The intense interaction between parties makes the whole cluster sensitive to changes in any one industry, or in external factors to the cluster. Deregulation, which is in the focus of this study, is indisputably such an external change that can be expected to affect the whole construction, not only operation itself. By the same reasoning, ignorance of the role of the prevailing market structure in *all* sectors of the cluster would restrict complete assessment of the effects of liberalisation in network operation.

Figure 2.2[11] illustrates the construction of the telecommunications cluster. The organisations producing the telecommunications **key products** form the core of the

[11] Construction of the Cluster Chart has been influenced by Porter, Sölvell and Zander (1991) and Mäenpää and Luukkainen (1994).

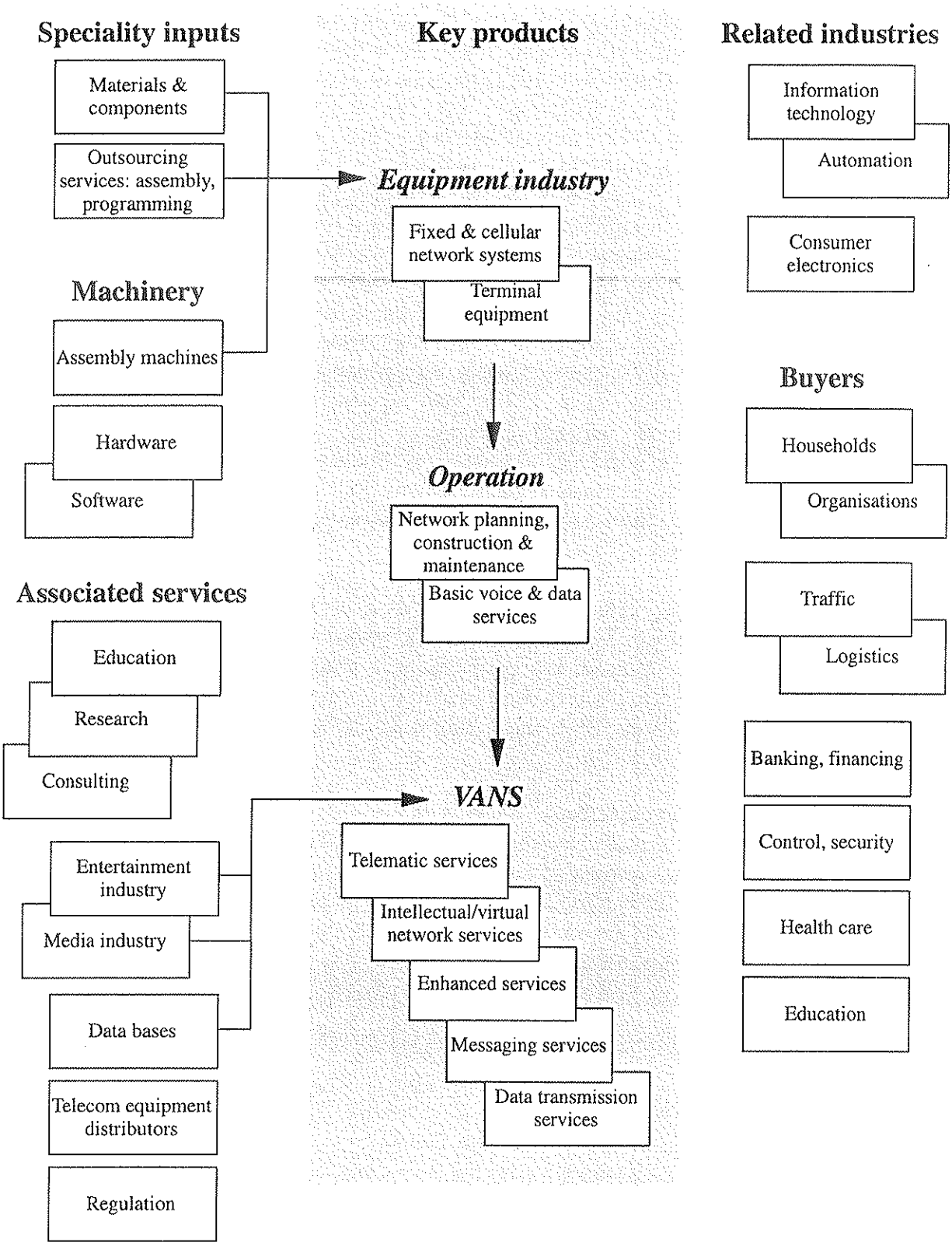

Figure 2.2 Telecommunications Cluster Chart

cluster. Key products are classified as 1) telecommunications equipment, 2) operation, i.e. planning, construction and maintenance of networks as well as running of voice and data services (basic services) therein, and 3) value-added network services (VANS). The three industries are highly interdependent forming a telecommunications value chain, where cooperation and coordination are vital to guarantee interface compatibility.

The core functions, notably equipment industry and operation, are crucial customers for the markets providing **special inputs** and **machinery.** Along with the outburst of the Finnish telecommunications sector in the early 1990s, there has been a rapid growth in the number of highly specialised and customer-oriented subcontractors. The electric and electronics component industry has become one of the fastest growing. Behind this outgrowth is the equipment manufacturers' increased concentration on strategic core products and R&D, and consequent outsourcing and market procurement of more standard components that would require, if integrated, significant investments and loss of economies of scale. Moreover, network operators have outsourced to an increasing extent traditional carrier operations, like construction and maintenance, to the equipment industry, and make use of outside consultation services in planning.

Associated services consist of a variety of different sectors of the economy. Government regulation forms the framework within which the whole key product sector operates. In Finland, the education and research sectors (universities and research institutes) work in very close cooperation. A wide range of organisations, not only those in media and entertainment, take use of the telecommunications network in providing VANS.

Finally, the telecommunications cluster is dependent on the buyers of end products. Distinction has to be made between the end-users, and the application sectors that use telecommunications services as intermediate inputs to carry out their business. The utilisation of innovative telecommunications services is extending fast to new fields of application, which has greatly improved efficiency, but simultaneously decreased the need for human effort.

3. THE FINNISH TELECOMMUNICATIONS MARKET

3.1 Brief history outlook[12]

The foundation for the Finnish telecommunications network and legislation was set the 1880s. The establishment of telephone companies were carried out by domestic equipment suppliers. Foreign suppliers were involved in this new business, too. In the 1930s, the number of operators was at its highest at 815. The substantial number of different terminals was a challenge to interconnection and automation of exchanges. The State intended to nationalise and harmonise the network in order to promote

[12] Based on S. Luukkainen and K. Mäenpää (1994), and Ministry of Transport and Communications (1994a).

interconnection and technical progress. However, nationalisation proposals were fiercely rejected by the Parliament. Nevertheless, by acquisition and even expropriation of private companies, the public Posts and Telegraphs (P&T) intensified its own position in the market.

In order to resist P&T's expansion and take-overs, in 1921, the private companies combined their forces by founding the Association of Telephone Companies. Its members intensified technical development of networks, merged smaller units, and gave public annotations against centralisation and expropriations, which made it more difficult for P&T to continue such arbitrary measures. In fact, the private companies were more successful in technical development than the public operator. In long-distance services P&T took the dominant position in 1935.

In the 1960s, the Finnish telecommunications equipment industry was still insignificant, and foreign manufacturers, like Ericsson, Siemens and Alcatel competed in the market. In the mid-1980s, Nokia Ltd adopted the strategy of diversification in new telecommunications technologies.

By 1980, the entire national network had been automated. Optic fibre cables and digital exchanges brought cost efficiency, which made the construction of competing networks economically sensible. Monopolies could no longer be justified by the natural monopoly paradigm.

In 1987, the new Telecommunications Act invalidated statutory monopoly rights and telecommunications operation was made subject to licence granted by the Council of State. The Act was applied to P&T in 1990 when it was changed from a state agency to an independent state-owned business enterprise giving it equal status with other operators.

Until 1988, P&T had an ambiguous role in being both a powerful actor in the business, as well as the regulatory body having full discretion in granting new licences to and exercising control over other operators. But the Act separated these functions, transferring the telecommunications control and administration to the Telecommunications Administration Centre, a new executive body under the Ministry.

In 1990, P&T was changed to a public corporation and was no longer entitled to budget financing. In 1994, the main business activities of the Posts and Telecommunications of Finland were separated, and organised under a holding company. The new subsidiary, Telecom Finland Ltd, became a stock-holding company. On the private sector, in turn, local carriers have established the Finnet Group, an association to intensify cooperation and coordination between independent operators.

According to the decision of principle in 1992, the local and long-distance call provision was to be opened to full competition in 1.1.1994. In July 1994, international telecommunications were liberalised, too. This completed the gradual liberalisation process started in 1985.

3.3 Telecommunications legislation and regulation

Today, there are some 70 telecommunications operators (TO) in Finland. Normally, all licences include the right for self provision of network. There are several overlapping national trunk and mobile telephone networks as well as international networks in the country. Also competitive networks for local telecommunications have been built. In addition, there are eight service providers without the right for self provision of network. Value-added network services have never been under licensing requirement and switched data network services are under notification procedure.

The obligation to lease subscriber lines to competitors is under debate in the Finnish telecommunications policy. According to the principles of the legislation, an operator has no obligation to lease its network to those operators which have the right for self provision of the same kind of network. On the other hand, every subscriber has always the right to use the subscriber line for services provided by other operators. The provider of the subscriber line shall give equal and non-discriminatory access on reasonable conditions to all other operators and their services. The alteration in the Act anticipated in 1996 will prescribe the rights and obligations of service providers in the Law. This will guarantee these new actors fair access conditions to the public network. Altogether, the revisioned Act of 1996 will bring the telecommunications closer to ordinary business activity.

All networks have full relevant interconnection obligation. Interconnection agreements are made according to decades old practices on commercial basis regulated by principles of equality and cost orientation given by the Ministry of Traffic and Communications. According to Finnish legislation, there exists an obligation for interconnection even if the competitors cannot reach an agreement on it. If this happens, the Ministry can have the interconnection done and collect the expenses back from the operators. This has not happened in practice.

In Finland, an interconnection fee is charged straight from the customer. Thus, when the subscriber line is used for services of some other operator than the provider of the line, the service operator charges the user. There are some rules concerning the price of this kind of charge in local loop.

In 1992, EU stipulated a cost accounting system to determine fair service prices in liberalised telecommunications markets. In Finland, however, the Ministry has let the market to determine the price level, and has interfered only in case of disputes between competitors. Nevertheless, the Act requires the pricing of services to be non-discriminatory, reasonable, and sufficient to cover costs of the company.

In many European countries, liberalisation of telecommunications is seen problematical for universal service, including service provision in unprofitable marginal areas. In Finland, however, the users have the right to be connected to public switched telecommunications network, thus, each operator is obliged to serve all customers within its license area at a reasonable and cost oriented price. According to the Finnish legislation, there is no obligation for operators to serve everybody at a same price not related to costs. In fact, prices differ a lot in different parts of the

country. In spite of that, a recent study made by the Ministry indicates that all users have profited from the full competition.

The terminal equipment supply is deregulated, but all apparatus has to be type-approved by the Telecommunications Administration Centre, if they are not equipment accepted under the procedure of mutual recognition of type approvals.

3.4 The structure of the Finnish telecommunications market

Since the Telecommunications Act of 1987, several new licence applications have been approved. However, in fixed and cellular network operation, there are only two unlimited licensees: the Finnet Group (a business group formed by private local carriers) and Telecom Finland Ltd. Other carriers´ turn-over from network services has been preset by their licence. Of the total telecommunications turnover in 1994, Telecom accounted for 52%, the Finnet Group for 44.5%, and the others for 3.5%. Next, the different business areas in the telecommunications will be briefly introduced.

Local networks

Despite the large number of local operators - amounting to 46 today - until 1994, competition had been ruled out by monopolistic concession areas. With few exceptions, the private companies are owned by consumers as shareholders. The companies do not pursue profit but aim at cost efficiency which is reflected in local consumer prices. Thus, local companies could be described as a mix of stock holding and cooperative companies.

The number of local operators is expected to decrease with likely mergers in the near future. Traditionally, the local companies have operated in cities and densely populated areas while Telecom has been in charge of more remote and scarcely populated regions. Local companies have a 70% share of subscribers.

Liberalisation has not induced any notable increase in competition in local services for households as construction of new fixed networks in small and saturated local markets provide seldom profitable business opportunities for entrants. Fierce debate is under way as to the lease conditions between TOs. Another limitation to free competition has been number transferability, which, to date, has not been technically practicable.

However, along with new radio technology under development new entrants have already penetrated local markets, for example, by taking advantage of the Digital European Cordless Telecommunications (DECT) network. New techniques are being developed to make economical entry possible. The Ministry is also assessing the need for temporary administrative measures to encourage new entrants.

In 1988, Telecom, with some major business customers, founded Yritysverkot (Business Networks) Ltd to provide corporate customers with direct connections to the trunk network, thus by-passing the services of local networks, and reducing

business telephone costs. Since the full liberalisation of business telecommunications services in 1990-91, the competition of business customers has become increasingly fierce. Companies have been able not only to cut their telecommunications bills, but also to improve their effectiveness and customer service.

Trunk telephone networks

Until the liberalisation in 1994, the trunk network used to be the monopoly of Telecom, with the exception of limited license of Telivo Ltd granted in 1992. Since then, one new licensee, Kaukoverkko Ysi Ltd owned by the Finnet Group, has been granted unlimited licence. As a subsidiary of Imatran Voima Ltd, a national power producer, Telivo takes advantage of the existing optic fibre network of the parent company, and is thus able to provide network services at low cost.

Consumers choose the operator by dialling respective carrier access code. Calls without a code will be charged the highest prevailing price, and the proceeds are credited between the operators in accordance with their market shares. Consumers may sign a service contract with an operator for automatic long-distance connections in its network, but even then a subscriber is always free to choose another carrier by dialling appropriate access code.

Since the opening of competition in domestic long-distance calls in 1.1 1994, consumers have benefited from substantial price cuts. Total turnover has fallen by 40% despite increased volumes. The market share of Telecom has come down from 93% to 46% between 1993 and 1994.[13]

As to international telecommunications services, six limited licence applications were approved in 1993, but were cancelled in 1994 in connection with the new licences. The major competitors of Telecom in international telephony are Finnet International Ltd, an affiliate of the Finnet Group, and Telivo Ltd. Moreover, six new service providers have been licensed to operate in leased circuits.

Unlike in domestic long-distance calls, competition in international services (since 1.7.1994) has not notably affected Telecom's turnover or market share. Lower call charges and (insignificant) loss in market share have been compensated by increased volumes.

Cellular networks

Finland has been among the pioneers in the technological development and adaptation of cellular telecommunications. As of 1.5.1995, mobile penetration had attained 15,3% which ranked Finland the third in international comparison. Several factors explain Finland's rapid development in this sector: demanding geographic conditions; geographically scattered population; high educational level and enthusiasm towards new technical innovations; the equipment industry that has been exposed to foreign

[13] Ministry of Traffic and Communications, 1989-1995

competition; but above all, free and public system specifications of the cellular networks.

The Finnish history of commercial mobile communications started in 1971 with the introduction of the ARP (Auto Radio Telephone) network. During the 1980s, two NMT (Nordic Mobile Telephone) networks using different frequencies, were constructed. Telecom holds monopoly in these networks because of low capacity in frequencies, saturated market and growing interest in GSM have dumped new licence applications. However, along with further liberalisation in 1996, access to these networks by competitors is anticipated

GSM network operation, in turn, has been under accelerating competition since 1990. The GSM market is devided between Telecom and Radiolinja which is owned by the Finnet Group and some business organisations[14]. In the early 1995, Telecom held some 60% of the market.

Data transmission

In the mid-1980s, the first step towards full liberalisation of telecommunications services was taken. The 100-year-old Imperial Telephone Decree failed to give guidelines concerning provision of new telecommunications services, i.e. telefax and data transmission, and eventually, free development in these services was allowed by alterations in the Decree

In 1985, this act towards liberalisation led to the foundation of a new data service provider, Datatie Ltd, by private telephone companies and some of their business customers. The new company set up the construction of the first private network parallel with the public. After the partial liberalisation in 1988, the provision of data transmission services have been totally liberalised, and is subject to mere notification since 1992. To date, there have been 24 new notifications.

In 1994, Telecom was the first in the world to launch commercial ATM services[15]. Local operators introduced their service later in the same year. The operators have estimated that, owing to the ATM technique, telecommunications traffic volume will be ten-fold in two years[16]. Both Telecom and the Finnet Group have recently launched Internet connection services.

Value-added network services (VANS)

The combination of information technology and telecommunications networks has created a fast growing new service sector which has added value to the existing telecommunications network. Free entry since 1987 has both encouraged new service

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[14] Åland Mobiltelefon Ltd serves a small group of GSM subscribers in the island and surroundings of Åland.
[15] Telecom Finland Ltd (1994)
[16] Talouselämä 28/1994.

providers as well as invention of a large variety of services. In Europe, Finland ranks second in the relative consumption of data services.

Most of the telematic services utilise a public data network, Telmo, which has been developed in cooperation between the Ministry, the operators, and service providers. Telmo has made possible a uniform and equal supply of data services across the country. Telmo-services are available through service systems provided by Telecom and the Finnet Group. VANS are provided also by domestic and foreign private companies, such as data service centres and specialised VANS companies.

Telecommunications equipment market

The large number of independent operators has nurtured the equipment sector throughout the Finnish telecommunications history. Had there been only one carrier the equipment supply would have probably been the privilege of one or few manufacturers, which has been the case in many countries.

There are numerous reasons behind the Finnish equipment manufacturers' leading position in international markets, both in terms of technical progress and market shares. First, the domestic market has always been open to foreign competition, which has required constant investment in development and maintenance of competitiveness. Second, Finnish operators have been exacting customers demanding technology that has anticipated future demand. And finally, the domestic ARP and NMT system specifications have been open for all manufacturers to develop and provide new terminals in the market. In other words, in Finland, network suppliers have not been able to monopolise the terminal market as in some other countries.

Nokia Ltd is the indisputable dominant player in the Finnish telecommunications equipment industry. Behind Nokia´s unprecedented growth lies the liberalisation of the global telecommunications market. New operator licences and intensifying global competition and demand for mobile services have boosted Nokia´s performance. In fact, the Finnish market accounts only for 11% of the Group's turn-over. Born in a small, unprotected market like Finland, the company has been obliged to look abroad at an early stage, which has given it an advantage in new foreign markets that are looking for experienced suppliers. Despite the large share of international activities, 70% of R&D and 60% of production takes place in Finland [17].

In the Finnish market, Nokia competes practically with the same foreign manufacturers as in the international arena. There are also several national manufacturers that have focused on a smaller range of products like advanced telecommunications systems, equipment, components, and customised applications. These companies play an important role as subcontractors of Nokia and the operators. Moreover, Benefon Ltd is one the leading manufacturer of NMT phones in the world, controlling a 20% market share of the global market. The gross value of telecommunications equipment and parts production has risen from FIM 1 752 million in 1985 to FIM 13 520 million in 1994.

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[17] Talouselämä 1/1995.

4. DEVELOPMENT OF EMPLOYMENT IN THE FINNISH TELECOMMUNICATIONS MARKET

4.1 Methodology

Empirical estimation of the employment changes over the research period was complicated by statistical impediments. Most importantly, statistics do not recognise telecommunications-related jobs in other industries as "telecommunications employment". Today, separate networks and other intra-organisational telecommunications systems and services employ an ever increasing group of workers. Also, the employment effect of the outsourcing sector in the telecommunications cluster is growing rapidly, but the present statistical documentation fails to distinguish telecommunications input manufacturing from other production in the sector. Moreover, the VANS as a new - and admittedly complicated - service industry has not yet attained statistical status.

Owing to limitations of this kind an integral or comprehensive study of the theoretical telecommunications cluster, as defined in Figure 2.2, was not applicable. Consequently, the study had to be broken down into a sector-specific mapping which led to notable differences in the accuracy of data. The employment in the telecommunications equipment industry, equipment distribution and operation has been explicitly documented[18] while the other industries of the cluster were examined by judgement sampling and interviews.

The following empirical analysis begins with a study of the changes in the telecommunications equipment industry, equipment distribution and operation for which a *complete* time series was available for the period 1987-1993. The data for 1993 is preliminary and likely to underestimate real labour volumes, and figures for 1994 are estimates. In this context, the group of these industries are referred to as the "tele-cluster", which, to note, is not to confuse with the theoretic telecommunications cluster. The two groups of the "tele-cluster" are defined as:

Equipment industry and distribution:	- Telecommunications equipment (switching and transmission systems, terminals and other equipment)[19] - Wholesale of telecommunication terminal equipment, exchanges, systems, and surveillance equipment; - Resale of terminal equipment[20]
Operation:	- Telephony services in fixed and cellular networks (VANS excluded), and paging services - Data transmission, telegrams and facsimile transmission, and other basic services - Other supporting telecommunications services by network operators (e.g. leasing, installing and maintenance, and sale of private networks).

[18] Regional Employment Statistics provided by Statistics Finland

[19] Includes also production of radio and television sets, microphones and loudspeakers.

[20] Includes also resale of PC s and software to households, and full-time resale of office equipment.

4.2 The impact of structure and competition on employment in the telecommunications cluster

The "tele-cluster"

As illustrated in Table 4.1 and Figure 4.1 the "tele-cluster" experienced a 4% net increase in employment over the period 1987- 93, while the estimate for 1994[21] indicates a growth of as high as 13% for the period 1987-1994. In other words, the 20% reduction in direct TO employment was more than compensated by the phenomenal growth in the equipment industry, which mounted to 105%. It is noteworthy that despite the liberalisation the employment volume has not fallen to or below the 1987-level in any of the subsequent years. It is reminded that these figures omit the other industries of the telecommunications cluster, which will be discussed in the following sections.

	1987	1988	1989	1990	1991	1992	P1993	E1994
Telecom equipment production	5 438	7 011	8 294	8 983	7 657	8 106	8 897	11 655
Equipment wholesale	1 151	530	637	1 002	1 576	1 589	1 492	1 522
Equipment resale	229	398	661	856	864	787	797	813
Operation	18 498	19 756	19 680	17 511	18 657	16 233	15 190	14 695
Total	**25 316**	**27 695**	**29 272**	**28 352**	**28 754**	**26 715**	**26 376**	**28 685**

Table 4.1 The number of employees in the "tele-cluster" by sector (P=preliminary, E=estimate)
Source: Statistics Finland

Figure 4.2 depicts labour mobility concerning the "tele-cluster" over the observation period. It is noteworthy that mobility within the "tele-cluster" has been surprisingly modest representing an average of 0.3% of the total cluster labour. In other words, the boom in the equipment sector has not benefited the discharged in the operation sector.

[21] Growth rates are based on R. Hienonen and A. Lehtinen (1995), which has reported 31% and 2% growth in the equipment industry, and distribution, respectively. Figures for operation provided by TOs.

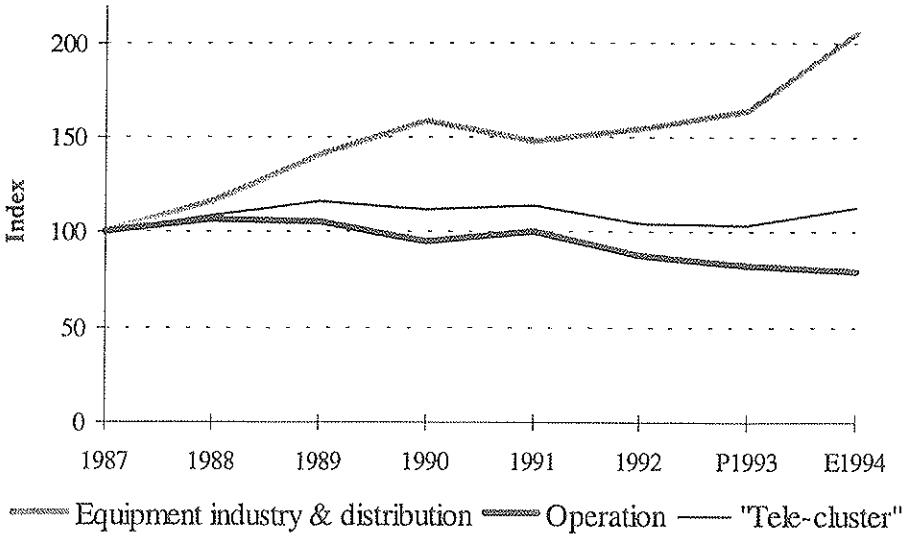

Figure 4.1 Employment growth indices in the telecommunications (estimate for 1994)
Source: Statistics Finland

A macro-level comparison (Figure 4.3) reveals the striking fact that, in relative terms, the "tele-cluster outperformed the economy in employment over the research period, with the exception of 1990. The same phenomenon is manifested in the comparison with manufacturing and trade sectors.

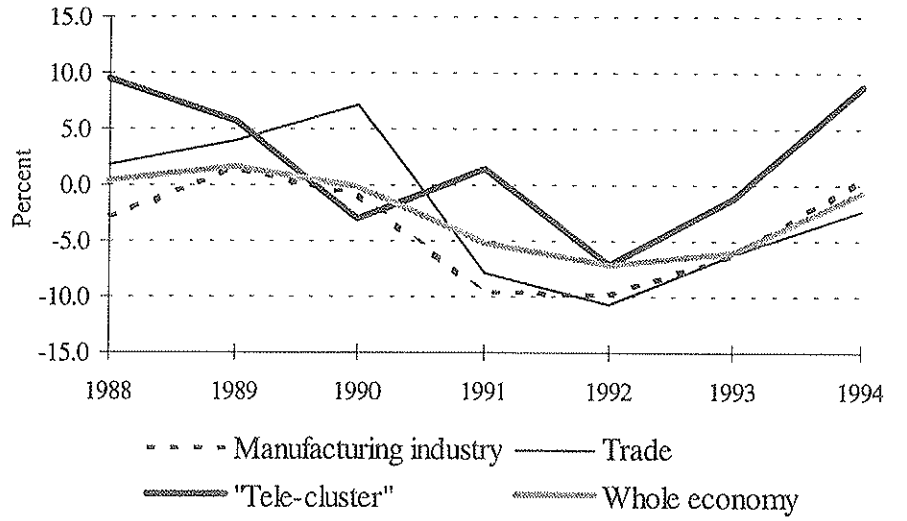

Figure 4.3 Yearly employment growth rates 1988-1993
Source: Statistics Finland

These growth rates mirror several economic incidents of the period. Foremost, the Finnish TOs prepared themselves for the liberalisation which could not have been faced without substantial employment restructuring procedures. Unfortunately, this coincided with the deep general economic slump that had already produced mass-unemployment.

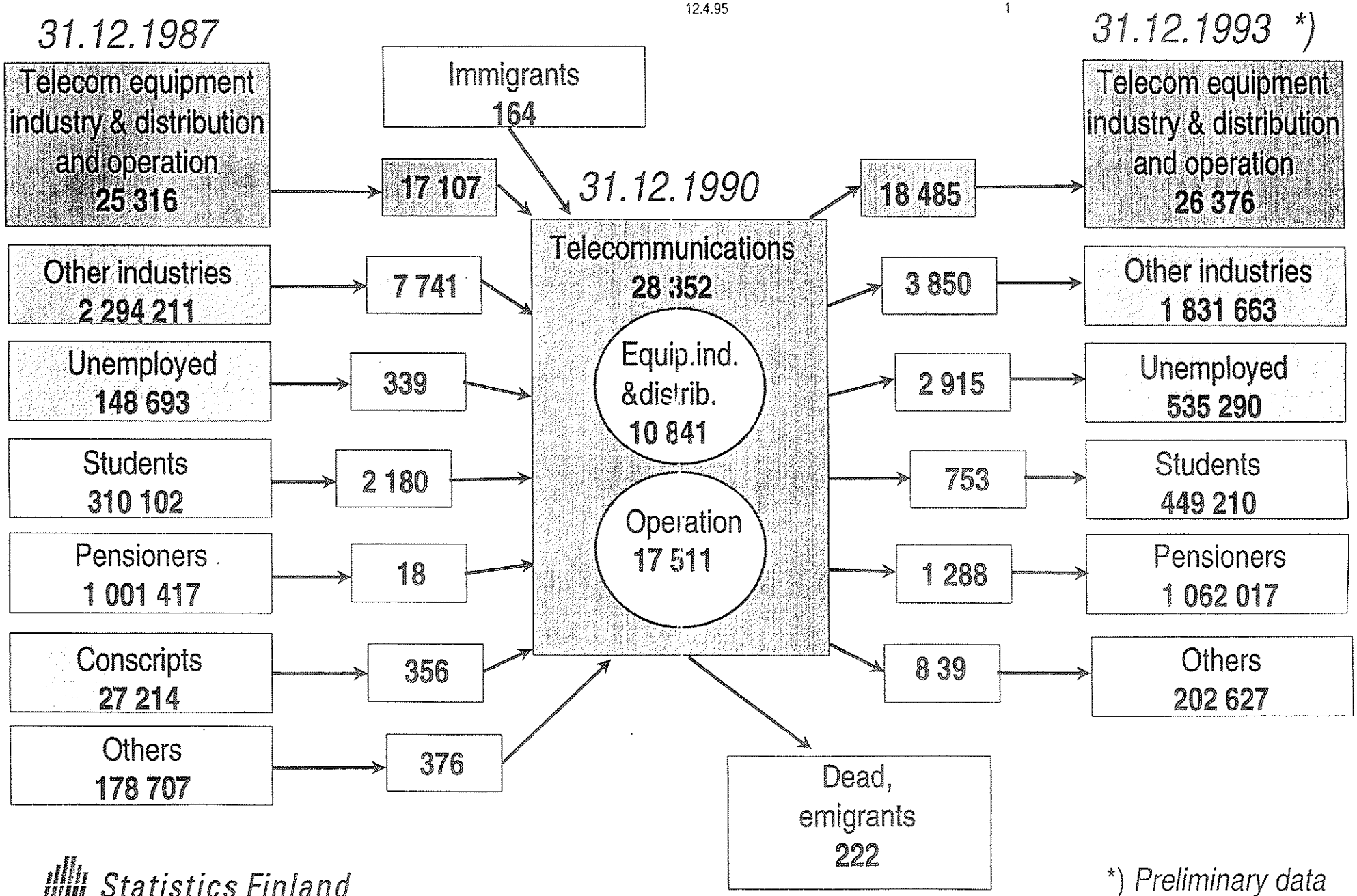

Figure 4.2 Labour mobility within the telecommunications cluster

During the same period, the collapse of the Soviet Union caused a significant downfall in Finland's foreign trade. Also, the strong Finnish markka, supported by the monetary policy, eroded the national competitiveness. However, in 1991, markka became subject to international speculation that led to the decision to let markka float in 1992. By 1993 the national currency had lost 45% of its pre-floating value.[22] Although the recessionary global demand responded to the devalued markka with a year lag, the improved competitiveness gave a boost to the telecommunication equipment industry.

To conclude, regarless of the ill-suited timing of the TO restructuring, the "tele-cluster" as a whole not only relatively outperformed other sectors of the economy as employer but even managed to *improve* employment. In the actual fact and paradoxically, during a period of record unemployment all sectors of the telecommunications cluster have been struggling with insufficient supply of qualified labour, which has been seen as a threat to the exploitation of the full growth potential in the sector. The lack of skilled labour has already necessitated transfers of operations abroad.

Equipment industry

The Finnish telecommunications equipment production is highly concentrated on Nokia, which is the only national telecommunications manufacturer with international significance. As such it is the most important employer in the industry with some 29 000 workers. In 1994 alone the personnel was increased by 21%[23]. Other telecommunications equipment manufacturers are small or medium-sized firms whose employment power come far behind that of Nokia's.

Figure 4.4 reveals the striking improvement in labour productivity in the industry. Until the economic relapse in the turn of the decade, the level of employment varied in line with production. But thereafter, the industry stressed by dismal economic conditions was obliged to cut expenses. Between 1991 and 1993, the volume of labour augmented by 16% against the phenomenal 140% growth in production, thus the unprecedented growth of the industry was generated by greatly improved labour productivity.

The Figure illustrates also the dependence of the industry on exports. It is evident that without the aid of the depreciated markka an equivalent boom in the industry would not have materialised in the highly competitive international equipment market. But on the other hand, the long history and strong experience in the progressive development of telecommunications equipment was a precondition to the competence in international markets. The small and open Finnish market has served as a testing field and has prepared the industry for the demands of gradually opening global arena.

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[22] Over the research period 1987-1995 the average rate of the Finnish markka was approximately ECU 0.18, which was also the average rate in 1995 alone.

[23] These figures include employees in foreign units while the data provided by Statistic Finland contain exclusively those employed in domestic units.

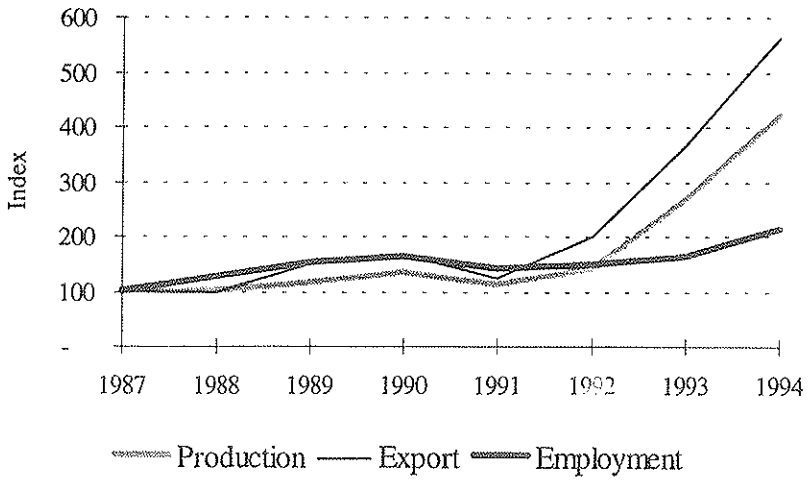

Figure 4.4 Employment growth indices in the telecommunications equipment industry Source: Hienonen and Lehtinen, 1995; Statistics Finland

The infrastructure competition has also had a positive impact on the manufacturing industry, not only in the form of new network investments but also through increased supply of network services that induce new demand for terminal equipment.

Also the equipment distribution sector has experienced a marked improvement in productivity. The number of mobile subscriptions grew 5.4-fold between 1987 and 1994[24] against the 70% increase in personnel in terminal distribution[25].

Operation

The beginning of the 1990s was an era of heavy lay-offs as Finnish TOs underwent fierce restructuring in view of full liberalisation due from 1994. Highly automated and digitised systems underlied the necessity to reduce human resources, and had there not been the threat of competition, the rationalisation process could have been carried out in more favourable economic conditions and in looser schedule.

After the change into a state enterprise in 1990 the restructuring was feasible as Telecom Finland was no longer constrained by the security of tenure of civil servant employees. Between 1985 and 1993 Telecom's work force declined by 47% to 6445 (Figure 4.5). The lay-off process was smoothened by a re-employment programme aimed at promoting the employment of the redundant.

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[24] Ministry of Transport and Communications (1989-1995)

[25] It is noted that full-time telecommunication equipment resale personnel cannot be distinguished from these figures as electronics resale outlets often provide telecommunication terminals with other household and office electronics equipment.

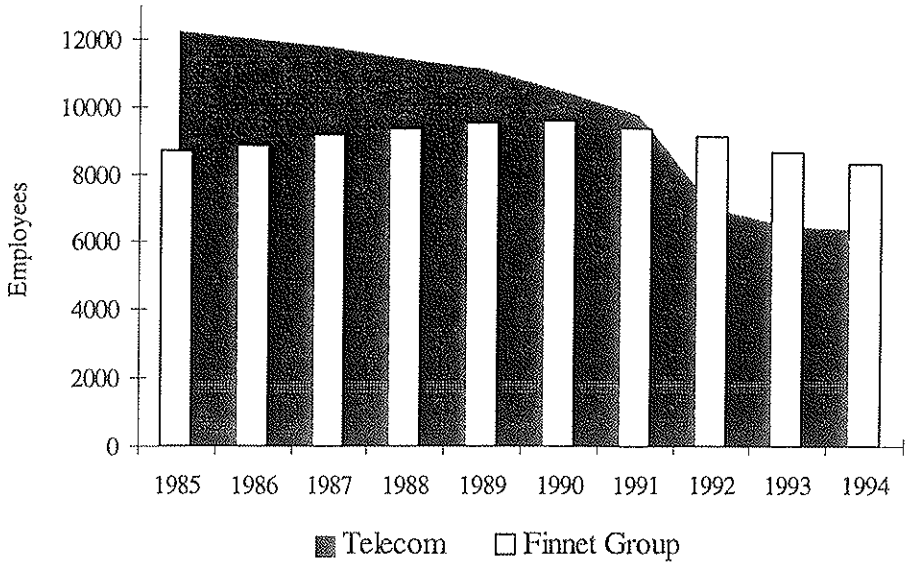

Figure 4.5 Staff volumes in Telecom and the Finnet Group
Source: Ministry of Transport and Communications,1989-1994; Telecom Finland Ltd; The Finnet Group

Consisting of "leaner" private organisations, the Finnet Group underwent a reorganisation with less dramatic lay-offs. Between 1985 and 1993 there was practically no change whatsoever, but over the period 1990-1993 the reduction represented a total of 10%. Shedding of employees continued in 1994, but was expected to level down in the coming years.

The positive direct employment effect of new operators has been surprisingly insignificant. The most important new licensees, such as Datatie (data transmission), Radiolinja (mobile services), Kaukoverkko Ysi (long-distance telephony), Finnet (international telephony), and Telivo (all basic services) employ directly some 130-150 persons in total. New advanced networks require less and less human input in the provision of basic services, whereas VANS provision will gradually generate new labour demand in the telecommunications.

Input markets

Increasing networking has characterised the development of the telecommunications market as intensifying competition has compelled organisations to concentrate on products with strategic importance or comparative advantage. In fact, Finnish competitiveness in international equipment market is regarded to base on outside acquisition of semiconductors. As an important customer in the market Nokia has the most advanced semiconductor technology at its disposal. For a small manufacturer like Benefon, in turn, own production of semiconductors would be an excessive burden. To an increasing extent, contracts are made with specialised suppliers that carry out part of the design and assembly of end-products (contract manufacturing).

Electronic and electrical industry is becoming one of the main manufacturing industries in Finland owing to the prosperity of the telecommunications equipment industry, which has driven the component sector to an equitable rise. In 1994, the yearly growth rate in both industries attained 55%. The equipment industry uses up to 70% of the production of the electronic component sector. It is estimated that in 1995 the telecommunications equipment production will grow 35% boosting the electronics component industry by an equal percentage[26]. By 2000, the growth rate is estimated to stabilise at 10%.

To estimate the employment changes in the telecommunications input industry the 66 most important electronics and electrical companies[27], and the six main suppliers in the plastic component industry[28] were selected. Examination of structural metal products manufacturers is excluded due to lacking data. Likewise, the large number of software companies supplying the equipment industry goes unfortunately undocumented as the employment effect is estimated to be meaningful[29].

Over the period 1988-1993 employment in the electronics component and contract manufacturing industry has doubled to some 5000 persons. The recession cut the employment growth trend in the turn of the decade, but the improved competitiveness, supported by the devalued currency, pushed the industry to a new upswing. The employment in the *whole* electronics and electrical industry is estimated to double by the year 2000, to 80 000 employees[30].

In the plastic industry, in turn, the growth in labour force was only 3% between 1988-1994, amounting to 2837 employed. Like in the equipment industry, the growth of production volume has not generated an equitable development in employment during the recessionary years, which has improved labour productivity.

Value-added network services (VANS)

VANS provision has been growing yearly by 20-25%, and it is estimated that operators' proceeds in this industry will exceed those generated in basic services in

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[26] Hienonen, R. and Lehtinen, A. (1995)

[27] End-product manufacturers (like Nokia, Benefon and Teleste) have been excluded.
The data, provided by Statistics Finland, has the following shortcomings: There are diversified companies who do not supply exclusively the telecommunications sector. Some 65% of the component manufacturing of the electronics and electric industry is estimated to go to the telecommunications sector, which percentage has been used here to estimate the employment in the industry. Some companies may have changed the product line during the period, and the data ignores organisational changes of firms.

[28] These six companies produce some 90% of the total plastic component supply. Data provided by The Finnish Plastics Industries' Federation

[29] The share of software designers in the equipment (end-product) industry represented 29%, growing yearly by some 20% in 1994 and 1995 (R. Hienonen and A. Lehtinen (1995)

[30] Telecommunications equipment represents 40%, and the component and contract manufacturing 14% of the whole electronics and electrical industry (R.Hienonen and A. Lehtinen (1995). Estimates made in the industry (SETELI).

the years to come. In 1994, there were over 3000 service addresses generating a turnover of FIM 300-400 million.

Several statistical complications[31] makes the estimation of the employment in this industry almost impossible, but according to some prudent professional opinions, the business employs today some 1000-1500 full-time workers. With the rapid growth in the capacity of transfer lines and the convergence of television, telephone and PC, the future growth of VANS will depend rather on consumer adaptation and imagination of service providers than on technological restrictions.

Behind the rapid and continuous growth of VANS lie the liberal regulation (since 1988) that does not impose competitive restrictions on service provision. To date, however, the direct effect of network competition on VANS prices or employment has been immaterial.

Education and research

In Finland, education in telecommunications technology is given in four universities and 13 vocational and professional institutes. As noted earlier, supply of skilled labour is insufficient in the telecommunications cluster, which has put pressure on the education sector. As an example, the Federation of Finnish Electrical and Electronics Industry has set up a committee bringing together representatives of the industry and the education sector to design an educational programme that would insure sufficient and appropriate labour supply in the future. In addition, in the early 1995, the Council of State published a decision of principle stipulating e.g. the educational objectives to comply with the growing needs of information and communications industry.

Despite the consequent measures taken in the education sector there has not been any marked increase in the number of new graduates. Technical subjects rank nowadays quite low in the preferences of the young generation, and on the other hand, in the lack of skilled workers, advanced students are often recruited in the industry before graduation, which hampers in many cases later finishing of the degree. On the other hand, however, the public education sector, dependent on (diminished) state budget appropriations, has had difficulty in recruiting qualified professors as the boosting industry has been able to make more competitive job offers.

The technological progress and success of the Finnish telecommunications sector is built on advanced R&D. The universities, the Technical Research Centre of Finland (VTT), the operators and the industry work in close cooperation. But the lack of proficient researchers is a bottleneck also in this field, and has lead to internationalisation of some of the R&D activities.
Due to weak documentation, express employment examination was not applicable. Inquiries in the universities and research institutes gave, however, a clear indication of the positive effect that the rapid growth in the telecommunications has had on the

[31] For example, enhanced services do not typically require full-time labour input, and the number of service providers change continuously.

employment in the education and research sectors[32]. Nevertheless, as suggested above, both stringent state budgetary considerations and deficient labour supply has undoubtedly thwarted many employment opportunities. It can be pointed out, once again, that the improved employment potential in the research and education sectors can be attributed to the liberal equipment market conditions that have contributed to the development of the high-technology that requires progressive and constant investments in R&D and education.

4.3 The structure of telecommunications employment

Digitalisation along with other progressive technical applications has had an important effect on the structure of the telecommunications work force augmenting the required skill level in low-skill jobs. On the other hand, the fast developing and highly competitive industry requires high-grade knowhow in R&D. All this has naturally augmented the level of education required in all levels of the industry: The share of telecommunications employees with educational qualification has increased from 61% in 1987 to 75% in 1993 (Figure 4.6).It has been estimated that by the year 2000 in electronic and telecommunications industries, the share of technicians will decrease by 8%, while the portion of engineers, and employees with graduate or doctorate degree will go up by 19% and 31%, respectively[33].

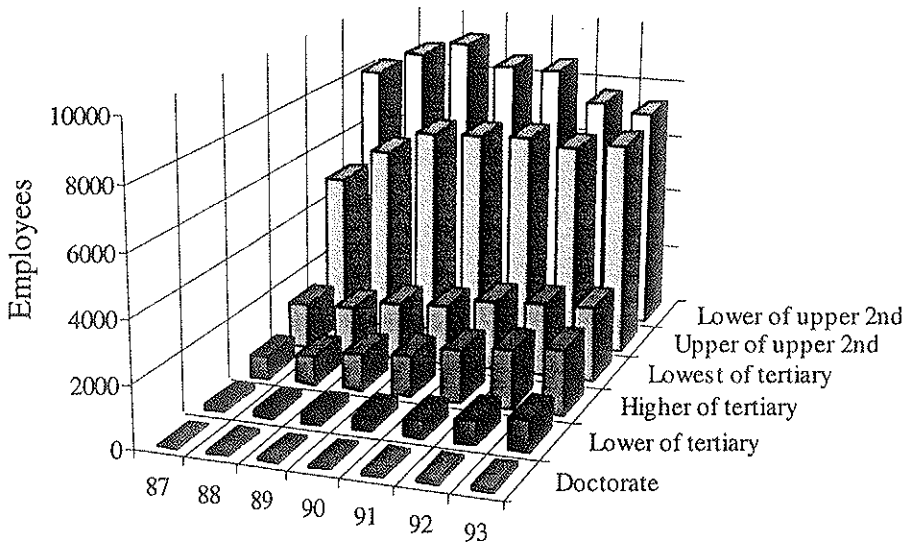

Figure 4.6 Structure of education level in the "tele-cluster"[34]
Source: Statistics Finland

[32] It was estimated that the number of education personnel in the four universities had augmented by some 65% during 1987-94, while the number of researchers had grown manifold in those institutions where data was available. The total number of employed in these sectors today is approximated to represent 200-300 persons.

[33] STAT (Employer organisation of electronic and telecommunications industries)

[34] Lower level of upper secondary: 10-11 years, vocational education institutions
Upper level of upper secondary: 12 years, vocational education institutions
Lowest level of tertiary: 13-14 years, professional education institutions
Lower-degree level of tertiary: 15 years, undergraduate level
Higher-degree level of tertiary: 16 years, graduate level

5. CONCLUSIONS AND POLICY IMPLICATIONS

Recent proposals concerning liberalisation and restructuring of the telecommunications markets has met opposition advocated by the potential deterioration of employment that such measures would induce in incumbent network operators. In the same context, the role of technological progress behind the need - and the possibility - to decrease TO employment is ignored. This is momentous because developed technology calls for restructuring irrespective of decisions concerning liberalisation policies. Introduction of competition will most likely entail staff reductions in the incumbent monopolist carrier, but in the assessment of the net impact of liberalisation on the economy, a wider perspective needs to be adopted.

Both on theoretical and empirical grounds, the Finnish telecommunications seem to represent a good example of a sector that has been able to take advantage of firm specialisation and networking. The high degree of interdependence within the cluster justifies the examination of the effects of changes in one industry on the whole cluster. In this study the focus was on the impact of deregulation on cluster employment.

Liberalisation opens up new business opportunities not only for entrants in network operation, but also in many other sectors connected to the core business. Moreover, liberal conditions in the telecommunications market accelerate invention and adoption of new technology and services, as well as new investments. Competition in network services will also induce price efficiency and enhance the level of services, which in turn have direct bearing to all sectors of the economy. As industrialised economies are increasingly dependent on telecommunications, all these repercussions of liberalisation are likely to outweigh the negative employment effect that TO restructuring is likely to cause at the first place.

There has been evidence of this kind of development in the three OECD countries with longest experience in competition in the telecommunications (United Kingdom, USA, and Japan). It has been observed that the markets with greatest competition are the most significant new employers. In Japan, for example, the number of lost jobs in the restructuring programme of NTT in 1980 has been totally compensated by new jobs in other telecommunication sectors.[35]

The competitive Finnish telecommunications cluster improved employment

Liberalisation of the Finnish telecommunications operation was executed during 1985-1994. The Finnish market structure was quite exceptional to start with, having 60 independent local network monopolies, and the state monopoly being the exclusive trunk network operator. All entry barriers were demolished and competition has begun in all segments of telecommunications.

The OECD study discussed above supports the Finnish evidence. In the telecommunications operation, equipment industry and distribution (referred to as the "tele-cluster"), alone, the employment improved by approximately 13% over the

[35] OECD (1995a and 1995b)

period 1987-1994, which covers the time of TO restructuring process. It is also noteworthy that the level of employment did not fall to or below the 1987-level in any of the following years.

It should be stressed that the period witnessed an unprecedented recession with record unemployment - reaching 20% - that burdened all sectors of the economy. However, employment in the "tele-cluster" suffered less than in many other sectors, or in the economy as a whole. The drop in TO employment was more than compensated by the growth in telecommunications equipment manufacturing. For the equipment industry, the long tradition of liberal market conditions has been a prerequisite for the success both in national and international markets, and it has lifted the industry among the most important ones, both in value and employment potential.

Growth in the telecommunications industry pushed input sectors

The "tele-cluster" ignores the effects of competition on other important industries of the telecommunications cluster, like input markets, associated services, and related industries. Owing to the vast dimension of the cluster, the effects of competition on selected industries were examined.

The growth of the telecommunications has greatly benefited companies supplying inputs to the industry. For example, in 1994, the electronic component industry grew by 55%, which followed exactly the growth rate of the telecommunications equipment market. It was estimated that the employment in the electronics outsourcing sector had even doubled over the research period 1988-1993, and may be reduplicated by the end of the century. In the plastic component industry, in turn, it was assessed that employment had grown only by 3% over the six-year period, as the recession hit harshly on the plastics industry. However, over the same period, the value of production grew fast, indicating strong improvement in labour productivity. Also, the amount of software companies supplying the equipment industry has been in a notable rise, but appropriate statistics were not available.

Sufficient supply of qualified labour becoming a challenge

While the documentation of the volumes of employed has been scattered and scarce, forecasts about the future needs are abundant, which follows from the incongruity between labour demand and supply in the whole telecommunications cluster. Against the record high unemployment figures, this has meant innumerable wasted job opportunities. The role of education is crucial in solving the problem, and thus, the industry, the Government, and the education sector have started cooperation to be better prepared for the challenges in the future.

Value-added network services involve notable employment potential

The growth in VANS provision has kept yearly at 20-25%, and the value of VANS will exceed that of basic services in the years to come. The importance of VANS

provision as a new employer has been generally acknowledged, but the quantitative effect is undocumented. However, in 1994, there were some 2800 chargeable and 3500 toll-free numbers, which gives some indication of the employment potential in the sector.

Competitive telecommunications services improve employment potential of an economy

Any all-inclusive figure of the total employment development in the telecommunications cluster, based on the data of this study, would underestimate the actual evolution since many important sectors have not been quantitatively covered. But with the existing data it has become evident that, regardless of automation of processes, the telecommunications cluster has been able to improve national employment over the research period. And on the average, the telecommunications cluster seem to have coped with the recession better than the economy as a whole.

Policy considerations - towards information society

Liberal market conditions and competition enhancing policies have had a clearly positive bearing on the high growth performance and increased employment of the Finnish telecommunications cluster. It is not, however, only the competition policies that matter. As indicated by the analysis above the fast growing telecommunications cluster is also an outcome of different co-operative ventures based on explicit or implicit contracts between private and public agents.

Competitive clusters or agglomerations of firms seem often to emerge as parts of (national) technological or innovation systems. These are characterised by reduction of transaction costs due to internalisation of transactions involving external economies. As suggested by new growth theories positive externalities might matter - especially in the case of knowledge-intensive industries - much more than traditionally thought.

The task of industrial and technology policies is to strenghten the common knowledge base and thus correct market failures implied by the the existence of external economies. Innovation and technology systems - and industrial clusters as parts of these systems - can be seen as entities with built-in market failure corrections mechanisms (cf. Carlsson and Jacobsson 1993, and Ylä-Anttila 1995). Sound competition policy is a cornerstone of public policies enhancing industrial growth but it can not, nevertheless, hinder the creation of cooperative linkages of a network economy. From the point of view of industrial and technology policies it is important to recognise the innovation activity as a process of a systemic nature. As technological knowledge is to a large extent tacit, much of the communication and technology transfer takes place in various kinds of networks. It is the task of public policies to to enhance the kind of institutional set-up that promotes the formation of networks. These are the guidelines for new, information society-linked, industrial policies as a contrast to traditional industrial policies with factor subsidising, protecting from (international) competition and trying to create "national champions".

Countries specialise in international trade more and more according to differences in knowledge base and less and less according to differences in inherited factor endowments. That is important because it indicates that changes in trade specialisation are affected by increasing returns and falling marginal costs (see Lundvall, 1995). There is growing empirical evidence that, during the last couple of decades, countries showing high growth performance have been increasingly specialising in knowledge-intensive products in IT industries (see, e.g., Lundvall 1995).

Economic growth depends on the capacities of economies to efficiently use and produce scientific and technological knowledge. Approaches based on industrial networks, technological or innovation systems or industrial clusters increase our undestanding about how cumulative learning is taking place. This study demonstrates how important it would be to improve the statistical base of both national economies and international organisations to better understand the linkages between various parts of the networks and to make careful empirical analysis about the role of learning and use of knowledge within the networks.

REFERENCES

Antonelli C, 1992 The economic theory of information networks. In Antonelli C. (ed.), The Economics of Information Networks. Amsterdam: Elsevier Science Publishers B.V.

Arrow, K J, 1959 "Toward a theory of price adjustment". In Abramovitz M. et al. (eds.), The Allocation of Resources. Stanford, California: Stanford University Press, pp.41-51.

Bellak C and Weiss A, 1993
"A Note on the Austrian "Diamond". In Management International Review Special Issue, vol.33, pp.109-118.

Carlsson B. and Jacobsson S, 1993
Technological Systems and Economic Policy: The Diffusion of Factory Automation in Sweden, Research Policy, 23(3), 235-248.

Ciborra C U, 1992 Innovation, networks and organizational learning. In Antonelli C. (ed.), The Economics of Information Networks. Amsterdam: Elsevier Science Publishers B.V.

Coase R H, 1937 The nature of the firm. Economica N.S., 4 (1937), pp.386-407.

Crocombe G T, Enright M J and Porter M E, 1991
Upgrading New Zealand's Competitive Advantage. Oxford: Oxford University Press.

Dunning J, 1993 Internationalizing Porter's Diamond. Management International Review, Special Issue, vol. 33, 1993:2, pp.7-15.

Forsgren M, Hägg I, Håkanson H, Johanson J and Mattson L-G, 1995
Firms in Networks - A New Perspective on Competitive Power. Uppsala: Acta Universitatis Upsaliensis (Studia Oeconomiae Negotiorum 38).

Hernesniemi H, Lammi M and Ylä-Anttila P, 1995
Advantage Finland - The Future of Finnish Industries. Helsinki:Taloustieto Oy

Hienonen R and Lehtinen A, 1995
Elektroniikka- ja sähköalan kehitysnäkymät 1995...2000 (Electronic and electrical business in Finland - Forecast 1995...2000). Helsinki: VTT Automation

Kyheröinen T I, 1994 Teletoiminnan kansallinen kilpailukyky (National Competitiveness of the Telecommunications Operator Industry). Helsinki: ETLA (Discussion Papers No 479).

Langlois R N and Robertson P L, 1995
Firms, Markets and Economic Change. London: Routledge.

Lundval B-Å, 1995
The Global Unemployment Problem and National Systems of Innovation, in : P. O'Doherty (ed.) Globalisation, Networking and Small Firm Innovation, London: Graham & Trotman.

Ministry of Transport and Communications, 1989-1995
Televiestintätilastot (Telecommunications Statistics). Helsinki: Painatuskeskus.

Ministry of Transport and Communications, 1994a
Telecommunications in Finland. Helsinki: Ministry of Transport and Communications (MTC).

Ministry of Transport and Communications, 1994b
Lisäarvopalvelut (Value-added Network Services). Publication No 59. Helsinki: Painatuskeskus.

Mäenpää K and Luukkainen S, 1994
Teletekniikasta monimuotoiseen viestintään - Teleklusterin kilpailukyky (From Telecommunications Technology to Multimedia Communication - the Competitiveness of the Telecommunications Cluster). Helsinki: ETLA.

Nokia Group, 1994 Annual Report

OECD, 1992 ICCP Reviews of Information and Communications Policies: Finland. Paris: OECD.

OECD, 1995a Communications Outlook. Paris: OECD.

OECD, 1995b Restructuring in Public Telecommunications Operator Employment. OECD Working Papers, vol.3, no.67. Paris: OECD.

Peneder M, 1994 Clusteranalyse und sektorale Wettbewerbsfähigkeit der österreichischen Industrie. Wien: WIFO.

Penttinen R, 1994 Summary of the Critique on Porter's Diamond Model. Porter's Diamond Model. Porter's Diamond Model Modified to Suit the Finnish Paper and Board Machine Industry. ETLA Discussion Papers No. 462, Helsinki.

Porter M E, 1990 Competitive Advantage of Nations. London: MacMillian Press.

Porter M E, Sölvell Ö and Zander I, 1991
Advantage Sweden. Stockholm: Nordstedts.

Price Waterhouse,1995
The Effects of Competition on Employment in the Telecommunications Industry: Case Finland. Helsinki: Price Waterhouse.

Putus A, 1994 Matkapuhelinverkkojen kehitys ja alan kotimaisen teollisuuden kilpailukyky (Development and Competitiveness of the Finnish cellular Network Industry). Helsinki: ETLA (Discussion Papers, No 528)

Reve T and Mathiesen L, 1994
European Industrial Competitiveness. SNF-report 35/94. Bergen: SNF.

Sähkö-ja elektroniikkateollisuusliitto SETELI (Federation of Electrical and Electronics Industries), 1993
Koulutuspoliittinen ohjelma (Education-political Programme). Helsinki: SETELI

Telecom Finland Ltd Annual Report 1994

Williamson O E,1985 The Economic Institutions of Capitalism. New York: Free Press.

Williamson O E,1990 The firm as a nexus of treaties: An introduction. In Aoki M, Gustafsson B, and Williamson O E (eds.), The Firm as a Nexus of Treaties. London: Sage Publications Ltd.

Ylä-Anttila P. 1995
National systems of innovation and internationalization of industrial firms. Paper presented at the 21st Annual Conference of EIBA, 10-12 December 1995, Urbino, Italy.

ELINKEINOELÄMÄN TUTKIMUSLAITOS (ETLA)
THE RESEARCH INSTITUTE OF THE FINNISH ECONOMY
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