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# The Making of a Local Information Economy and the Role of Universities: Tampere Region, Finland

Paper prepared for the APDR conference in Faro, Portugal, 16–18 September 2005



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## Introduction

For a long time, researchers have tried to understand why and how economic growth tends to concentrate in some exceptionally dynamic regions. To answer this question, most researchers refer to the concept of agglomeration economies. Such an economy is characterised as the accumulation of economic activities of the same kind, particularly the accumulation of companies belonging to the same branch or industry and related industries. Sometimes also the significance of institutional thickness is mentioned as an important aspect of agglomeration economies (Amin and Thrift 19995). Institutional thickness or density means that regions have a variety of different institutes such as research institutes, educational institutes, technology transfer institutes, trade associations, regional administration authorities and others which, by supporting local firms, contribute to the economic success of the region. Recently researchers have become more interested in why some new regions have managed to catch up with leading regions and even bypass them while some of the leading regions have lost competitiveness and have fallen behind.

This paper aims at given an answer to the question, why some regions have been able to forge ahead and to establish themselves in the league of the most successful regions. The paper will refer to the current debate on path dependency and path creation (Bassanini and Dosi 2001, Schienstock 2004). It will be argued that those regions that have taken advantage of the emerging new techno-organisational paradigm have been able to catch up with the leading regions and to forge ahead. Tampere Region will be presented as a region, which by transforming itself from a resource-based into a knowledge-based economy has established itself as a new growth pool. The paper will demonstrate that universities played and still play an important role in this transformation process. It will also be argued that successful regions can no longer be seen as “spaces of places” characterised by institutional density; instead they must be conceptualised as “spaces of flows”, knowledge flows in particular (Castells 2000).

## Path dependency and path creation as theoretical concepts

### The path dependency perspective

The competitiveness of regional economies has often been explained by referring to the concept of path dependency. The concept assumes that economies, be they national or regional, which have developed within a long-term techno-organisational trajectory have been able to create competitive advantages. The strength of the path dependency concept lies in that it does not separate technological and/or organisational innovation from past developments, but assumes some kind of continuity in the process of techno-organisational change. Innovation lines up with earlier changes, which means that it has historical antecedents of novelty (David 1985: 332). Earlier technological advantages, as Foray argues, have laid the foundation for current economic success and succeeding rounds of progress (1997: 65).

In other words, knowledge generation produces "positive externalities"; the more a specific kind of knowledge has been produced and is embodied in new product and/or processes technologies, the easier it becomes to produce even more related knowledge, a phenomenon characterised as the "increasing returns logic" (Arthur 1996). There is, however, empirical evidence that institutional differences across countries play a crucial role in shaping and channelling technological change (Lundvall 1992, Nelson 1993). This is reflected in the differentiation between a technological paradigm and various national pathways or trajectories of development (Dosi et al. 1988). National trajectories increase differentiation and diversification as offshoots from the main development path (OECD 1992).

Path dependency, however, always carries the risk of turning into a 'lock-in' (Grabher 1993, Johnson 1992, Schienstock 1997). And old technology as well as a traditional organisational model can lock the economy of a territory into an inferior option of development and may in the long run result in a loss of competitiveness and in retarding economic growth. Economic actors may have developed a degree of commitment to the

setting up of learning mechanisms with the aim of exploiting particular technological and organisational opportunities. Sticking to those learning mechanisms may allow adaptive but not innovative learning. This means that they are not capable to develop a new growth path based on a newly emerging knowledge paradigm.

**The path creation perspective**

Under the conditions of a shift in the technological and organisational paradigm one can no longer talk about a channelled change, as the institutional setting as well as the dominant culture, in which the traditional techno-organisational trajectory is embedded, become themselves increasingly fragile. The unfolding of a new technological paradigm within specific national or regional trajectories can only take place, as Perez argues (1983), together with not only fundamental organisational, but also institutional and cultural changes. It is likely that the social and institutional framework hospitable to one set of technologies will not be suitable for a radically new technology. Whereas incremental innovations can be easily accommodated in the old institutional and cultural frame, this may not be the case with fundamental techno-organisational changes which by definition involve an element of creative destruction. The negative socio-economic consequences of technological and/or organizational lock-in suggest giving more attention to the problem of unlocking and path creation (Garud and Karnoe 2000).

The emergence of a new techno-organisational development path cannot be explained by referring to single factors. One can identify at least five factors that are decisive in this respect: a window of new technological and/or organisational opportunities, a market able to absorb fundamentally new products, economic pressures to adapt to the new paradigm, change events that trigger and support the transformation process as well as courses of action that steer techno-organisational development into a new direction.

Concerning the technological aspect, the emergence of the digital paradigm in the IC technology represents a fundamental change that opens up new opportunities even for newcomers, as the knowledge accumulated in resource-based industries as well as in the

electro-mechanic paradigm is of little use. And concerning the organisational aspect, the new network model focusing on knowledge flows, represents a new logic of organising businesses more effectively, while knowledge accumulated in the Fordist paradigm becomes outdated. Combined the new technological and organisational paradigm can become the basis of a new national or regional trajectory incorporating a production logic that is much more effective than the old Fordist control paradigm.

The development of a new knowledge-based growth path depends not only on the emergence of a new paradigm, but also on the existence of new markets that can absorb new products. Companies will hardly take advantage of a new paradigm fundamentally transforming their product mix and production processes without envisaging new market opportunities. In this respect regional agglomeration economies have an advantage, because radical, transformative innovation processes which lack standardised criteria for sorting out the best trajectory depend on subjective elements in the user/producer relationships, such as mutual trust. Dynamic collective learning processes based on trust reduce the degree of uncertainty of firms by tacitly and explicitly organising the functional and informational interdependency of local actors.

Companies will not automatically make use of the window of new techno-organisational opportunities even if they can envisage new local markets as technological development and organisational change is associated with high uncertainty and generally entails nothing more than a promise. Particularly leadership in the old techno-organisational paradigm may become a serious obstacle to the swift diffusion of the new one due to a structural, political and cognitive lock-in (Dosi, Pavitt and Soete 1990). Regions that have fallen behind, on the other hand, may take up the new opportunities more eagerly to catch up with the old leaders. Globalisation can be seen as the most important factor that pressures companies and territories to adapt to the new paradigm, even those that hesitate to do so because of their earlier successes in the old paradigm. Globalisation establishes innovation as a new competition factor; as radical, growth enhancing innovations become increasingly difficult to make in the established techno-organisational paradigm, companies as well as regional economies will have no choice but to turn to the new

paradigm and create a new techno-organisational trajectory. The later they do so, the higher the costs of the adaptation, because the needed transformation will become increasingly destructive.

But even strong economic pressures may not trigger transformation processes as long as they are not perceived by the key economic actors as damaging. Often cognitive blockades that hinder companies or other economic actors to adapt to the new paradigm can only be overcome when major change events occurs. A serious economic crisis can be seen as a major change event that is most likely to trigger the changeover to a new techno-organisational paradigm. In an economic crisis it is in general more risky to stay put than to move, even if it is in the wrong direction (Sabel 1995).

To explain the development of a new national or regional techno-organisational trajectory, we cannot only refer to objective factors such as new opportunities, economic pressures, or change events. Instead, we have to emphasise the importance of the human will (Bassanini and Dosi 2000). The path creation perspective, rather than treating economic actors as passive observers within a stream of events, sees them as knowledgeable agents with a capacity to reflect and act in ways other than those prescribed by the existing social rules and taken-for granted technological artefacts.[1] Path creation is seen as a process of mindful deviation by people who have an understanding of the opportunities the new paradigm offers.

Therefore the transformation process to a great extent depends on the engagement of certain people being particularly good at imaginative creation and exploration as well as exploitation. Social pioneers, including creative scientists and politicians prepared to initiate and conduct anticipatory institutional change as well as entrepreneurs eager to take advantage of the new techno-organisational and market opportunities, have a crucial role to play in the path creation process. But it is also important to re-establish a good match between the new techno-organisational paradigm and the institutions that facilitate

[1] It can be argued, however, that the path dependency perspective also treats economic actors as reflective agents, for the reproduction of the existing path must be understood as an active process.

and also regulate its full deployment throughout the economy by unleashing a multitude of social and institutional innovations (Teubal 1998). As long as the underlying problems of the old institutional framework are not recognised and admitted by a great number of economic actors, the mismatch between the new techno-organisational paradigm and the stagnant institutional and cultural framework will continue to grow (Perez 1997).

The changeover from one techno-organisational development path to a new one cannot be understood as a sudden break; instead, it takes place in a longer period of time. On the one hand, based on the emerging new techno-organisational paradigm, a national trajectory may develop more or less unrecognised, as long as the traditional trajectory is not seriously challenged. On the other hand, the long-term dominating industrial sector or cluster will continue to further develop its techno-organisational structures and practices, but will probably integrate more and more elements of the emerging new trajectory. We can therefore expect that the full "homing" of the whole economy in the new trajectory will take some time.

**The role of universities in the transformation process**

There are good reasons for giving universities and research institutes a decisive role in fundamental, path creating transformation processes. They can no longer be seen as part of the institutional setting channelling techno-organisational development but they have to be conceived as a key actor being actively involved in the development of a new regional trajectory. Universities take on increased importance by contributing significantly to knowledge production, knowledge dissemination and even knowledge use to some extent. By getting involved in the new techno-organisational paradigm, universities can produce the knowledge needed in a region for a successful transformation. And as considerable producers of human skills, universities can also contribute to the production of workers educated in the new knowledge paradigm.

But universities and other education and research institutions can also take up a number of additional roles, including that of an anchor, the dynamo and the magnet

(Kolehmainen, Kautonen and Koski 2003). As an anchor these institutions can tie up companies by creating versatile and intensive collaboration relationships with them. The institutions fulfil the generator role, if their activities generate new business by commercialising the results of basic and applied research (spin-off companies and joint ventures). Pioneering educational activities can also stimulate entrepreneurial activities. The magnet role of an educational or research institute is associated which the capability to attract external (foreign) investments into the region because of specialised research and educational activities.

But universities can also play an important part in helping regions to become a significant node in global knowledge production and knowledge use networks. By producing specialised knowledge in the new techno-organisational paradigm, which is scarce and therefore valuable for other regional economies, universities can support their local business partners in establishing co-operation with other actors in global knowledge networks. Furthermore universities as part of a global innovation network can help regions to benefit from the transfer of external knowledge. All in all universities can involve their home regions in the process of global knowledge creation and use in the new techno-organisational paradigm, which can create significant competitive advantages. On the other hand, close co-operation with local business can steer the knowledge creation process in universities and other research institutes to those scientific areas that are likely to generate economically useful knowledge. And universities closely linked to local business become more attractive for international partners as co-operation with these universities not only promises access to new knowledge but indeed access to the whole regional economy.

Of course, universities that are able to take up an important role in fundamental transformation processes have to undertake significant restructuring processes themselves. First, science has to become more integrated with its economic and social context, meaning that universities in addition to their basic research have to get more intensively involved in problem-oriented and applied research. Second, universities have to change from disciplinary-based knowledge production to collaboration over

disciplinary boundaries. Third, as knowledge creation and knowledge utilisation become closely linked, universities can no longer stick to the traditional knowledge transfer model that assumes a one-directional flow of knowledge from universities to industry. Instead universities have to engage in co-production of knowledge with firms in innovation networks.

In such innovation networks traditional boundaries among university research, governmental research institutes and industrial research and development may lose their earlier significance: constant reconfiguration of heterogeneous networks replaces strong institutional affiliations and transforms the whole basis of knowledge production. Knowledge is increasingly produced in the context of application and researchers become more like entrepreneurial actors in business networks. Companies, on the other hand, also rearrange the way in which they co-operate with universities. Instead of “ordering” specific knowledge from universities, they increasingly engage in collective knowledge creation processes.

## The emerging knowledge-based economy in the Tampere Region

### Uneven regional development in Finland

In the last 15 years, the Finnish economy has experienced dramatic changes. As a small Nordic country, Finland has managed to develop into one of the leading knowledge economies despite having started from a backward position: the country did not develop into an industrialised economy until after the beginning of the 1960s. And at the beginning of the 1990s, it was hit by the deepest economic crisis an industrialised country has encountered ever after the Second World War. Yet this event may have kept Finland from going through a long-term economic downturn, as immediate and radical measures had to be taken to overcome the disastrous consequences of the crisis. The recession of the early 1990s can be seen as a key change event that forced Finland into a fundamental structural renewal process based on an endogenous knowledge base (Schienstock 2004). Finland made use of the newly emerging techno-organisational paradigm by specialising in telecommunication and developing in what has been called a network economy (Castells 2000). Of course, the fact that Finland as a small open economy is particularly exposed to global economic pressures has contributed to the fundamental transformation process. Finland represents one of the few cases in which a country was able not only to catch up with the leading knowledge-based economies but even to bypass them and achieve a top position.

At the same time, however, uneven regional development accelerated in Finland. Growth and employment accumulated during the 1990s within a few big city-regions with universities and large R&D facilities, while other regions, particularly in Northern and Eastern Finland more or less stagnated. Tampere Region is one of the few growth pools in Finland, managing to transform itself from the country's industrial heartland dominated by smoke-stake industries into a very competitive knowledge-based economy. Tampere Region with its two universities represents a core part of the Finnish knowledge-based economy, but it is actually aiming at developing into a node in global knowledge-producing and knowledge-using networks.

**The changing industrial structure**

Tampere Region (population 430,000) is Finland's second largest regional centre after the Greater Helsinki Area. The region has been known as the industrial heartland of the country, dominated by smoke-stake industries. However, in the 1980s and 1990s, the region underwent a difficult but ultimately successful transformation process from an old manufacturing region to a high-technology cluster. Of the traditional industries, the machine-building industry managed to retain its strong position in the region's economy despite the recession in the early 1990s. The industry succeeded in developing new technology, which contributed significantly to the global competitiveness of the Finnish forest cluster. Paper production and processing is still very strong in Tampere Region. But companies in this industry have further developed into knowledge-based organizations, because they have specialized in products of higher value added. There are a number of relatively large firms manufacturing paper products in the region including units owned by UPM-Kymmene and M-REAL.

There are a total of some 400 companies engaged in mechanical engineering and automation in the region, with an employment of nearly 20,000 people and a combined turnover in excess of EUR 1.7 billion. A dozen companies operating in the Tampere Region are global market leaders in narrow business segments of high quality products. The rubber, chemical and plastics industries are also quite significant branches in Tampere Region, but this is largely on account of one single operator, Nokian Tyres.

Textile, clothing and footwear industries, which used to be the heart of the local industrial structure, did not renew in similar fashion; they have declined quite dramatically over the past two decades. With a focus on mass production, they were not able to compete with luxury goods producer from Western countries, while at the same time they were driven out of their traditional markets by countries with lower production costs, which succeeded better in international competition.

While concerning employment, the pulp and paper industry and mechanical engineering have been fairly stable in recent years; major growth has come from the ICT sector. In less than five years, the ICT sector more than doubled in size. In 1996, there were a total of 170 ICT firms operating in the sector, employing 5,200 people, with a total turnover of EUR 770 million. By 2000, the turnover had doubled, totalling EUR 1.5 billion. Employment increased from 3,000 in 1994 to 6,800 in 1997, a growth of 125 per cent (Tampere Centre of Expertise 1998). By 2000, the ICT sector in Tampere employed approximately 10,000 people. If the media and new media sub-sector and the related service and commerce sub-sector are included, the ICT cluster employs about 15,000 people (Statistics Finland 2000). Nokia with its various business units has accounted for over half of all the growth in the ICT sector. But in the late 1990s, nearly one hundred new business ventures were also established. The trend of rapid growth slowed down at the turn of the millennium because of the end of the ICT boom.

The ICT sector in Tampere Region is characterized by a very diverse and versatile structure ranging from electronics and telecommunications production and R&D (Nokia) to telecommunications operation and services (Sonera, Soon Communications), to software and information system design and production (Fujitsu Invia, Tietoenator and SecGo), and further to the Internet and other new media content production (TV2, Alma Media). But there is a trend towards converging into a digital media cluster. The most important employer in the ICT sector, the Nokia Group, employed approximately 3,600 white-collar workers in its R&D-related functions in 2001.

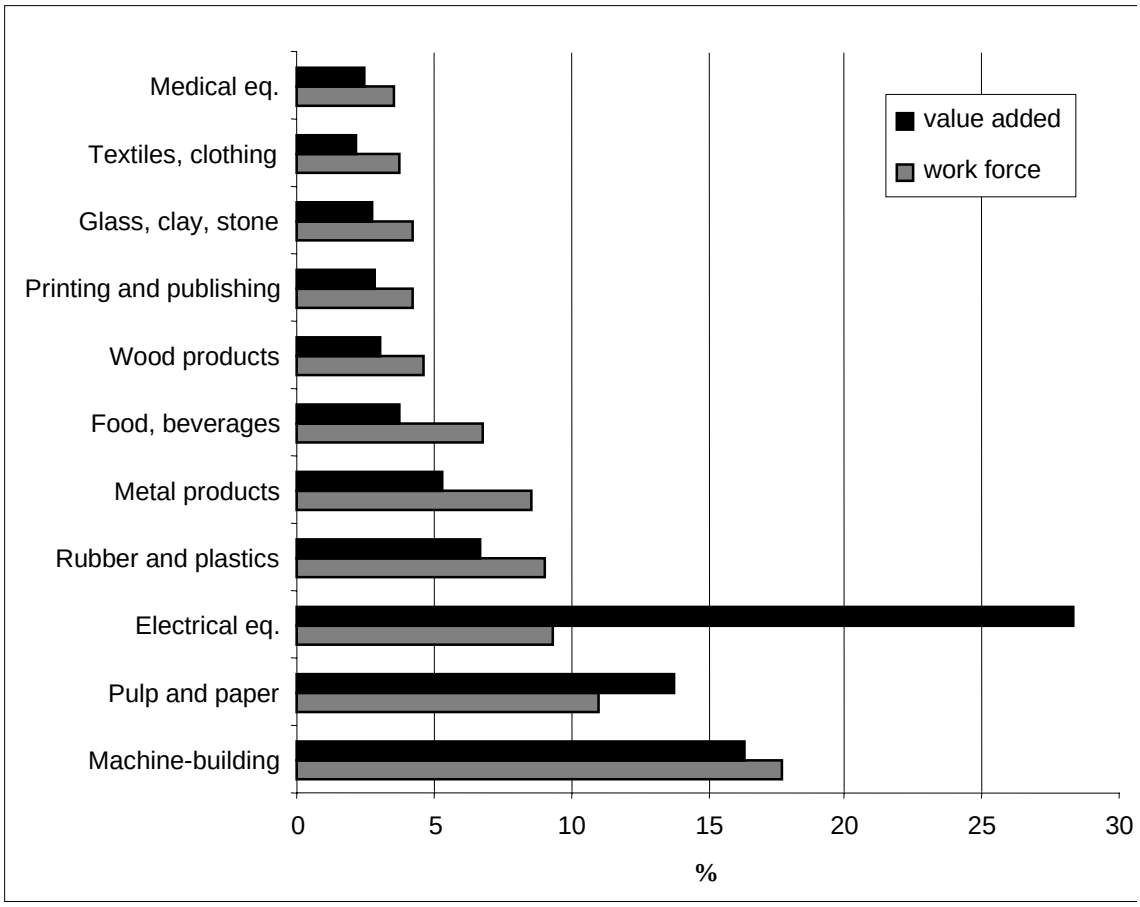


**Figure 1: Industrial production in various sectors in Tampere Region in 2000, %**
(Source: Statistics Finland 2002)

Figure 1 gives an overview of the share of the various industrial sectors in Tampere Region concerning value added and the workforce. The most important industrial agglomerations in Tampere Region are the ICT sector, the pulp and paper industry and mechanical engineering, which altogether account for nearly 60 per cent of the total value of industrial production.

## The role of universities in regional policy

In the beginning of the 1960s the industrial development in Tampere Region reached its peak and the relative proportion of industrial jobs soon began to decline. It became clear that employment in the dominant industries in the region would continue to shrink. Therefore policy makers started to look for new opportunities to compensate the expected

job losses in the traditional industries. To develop an endogenous knowledge base by establishing new educational and research institutes was seen as the best strategy to boost economic development. Getting a university in Tampere became the strategic aim of highest priority. By offering high education for young people policy makers hoped to prevent a brain drain and at the same time to develop the knowledge base, which could attract national and international firms.

Together with the foundation of the Technical University of Tampere more emphasis was given to the research function of universities. The idea of having a technical university in Tampere was influenced by the technopolis model (Gibson and Shiles 2000), which is very much based on a science push perspective. As creators of new scientific knowledge universities can play a critical role in "seeding" a new technopolis (Druilhe and Garnsey 2000). The knowledge is then commercialised by entrepreneurs who spin out of the knowledge creating institution. Geographical proximity supporting networking among important actors facilitates the spin out and commercialisation process.

In the 1980s the science policy approach was replaced by a technology policy approach both on the national as well as on the regional level. The focus shifted from the creation of a knowledge base to the development of strong industrial clusters. There was wide agreement in Finland as well as in the Tampere Region that the ICT cluster offered the best possibilities of renewing the industrial base. The cluster model, as Porter (1990) argues, aims at fostering dynamic co-operation and competition among synergic firms and within values-chains, which will lead to the development of competitive advantages. Scientific knowledge and universities and other institutions that create knowledge are seen as critical resources for innovation activities on the firm level.

Finland was the first country to apply "systems of innovation" as a basic concept to guide national policy already in the beginning of the 1990s. Policy makers in the Tampere Region later on applied the concept of "regional innovation systems". The concept points to the need of systemic transformation implying that all factors, influencing innovation processes, have to be adapted to the new growth path. The system of innovation concept

sees learning as the most important aspect of economic development, which is predominantly an interactive process. Most of the research programmes influenced by the system of innovation concept, which were launched on the national as well as on the regional level, therefore focused on the creation of innovation networks. Universities and other research and training institutions were seen as core actors in the process of transforming the Tampere Region into a knowledge-based network economy. The concept of industrial milieu also influenced the thinking of policy makers in the Tampere region. The "feeling like home" of both people and companies was considered as essential. Consequently policy makers have put particular emphasis on a number of environmental factors that could attract knowledge workers and knowledge-based firms such as a good education system, a developed infrastructure and the conservation of the natural environment. The strengthening of the image of Tampere supported the improvement of the appeal of the city, which in turn attracted new experts and students to the universities but also new companies to broaden and improve the industrial base.

After the mid-1990s, innovation policy in the Tampere Region became increasingly influenced by Castells' (2000) concept of regions as spaces of flows, knowledge flows in particular. This can be illustrated by comparing various strategy papers. In the programme of 1987, Tampere is seen as a "provincial centre" and a location of national sub-activities. In 1998, to develop the city into an exemplary "European city of life long learning", was stated as new strategic aim. And in 1999 an even more ambitious goal was set, namely to develop Tampere into a "world-class" operator with regard to information society and into one of the nodes of the global network society (Kostiainen 1999).

**The regional knowledge base**

Tampere Region has a strong, indigenous science and technology base, which matches the needs of industry due to a long tradition of university-industry co-operation and areas of high-level research conducted in the local universities. The quality of the two universities, Tampere University of Technology and the University of Tampere, was and still is a key resource for the economic restructuring. Both universities have put strong

emphasis on information technology, linking up with industrial firms to advance research and develop in cutting-edge communication technologies and their application. But also the engineering industry could benefit a great deal from the possibilities that the University of Technology offered in their development work. Without new knowledge and technologies developed in this university, the metal and machine-building industries would not have been able to maintain their strong position in global innovation competition (Kostiainen and Soutarauta 2002).

Both universities in Tampere Region are rather new establishments. The University of Tampere (UTA) is the result of a transfer in 1960 of the private School of Social Science based in Helsinki, which in 1974 became a state university. Even more important than the establishment of the UTA was the foundation of a technical university in the region. In 1965, Tampere University of Technology (TUT) was established as a branch of the Helsinki University of Technology and, in 1972, it became an independent state university. In addition to teaching and research, the new university emphasized close co-operation with industry right from the beginning. Even in the mid-1970 when the Ministry of Education strictly limited universities' research services for business, TUT continued to co-operate intensively with industry which led to the characterization of TUT as a "university of industry". The university has approximately 12,000 students and about 1,800 people work at TUT.

ICT-related education and research is a stronghold for TUT. Already in the 1980s, computer science became a major subject in TUT. Particularly in the mid-1990s, the number of degrees completed at the Department of Information Technology increased significantly. A major part of the ICT-related research work in TUT is carried out in the Digital Media Institute. Already in the mid-1980s, the two universities in Tampere started to co-operate in the field of information technology. TUT, UTA, the City of Tampere and the business interests founded a Research Institute of Information Technology, later named Digital Media Institute, which concentrated particularly on digital image processing, artificial intelligence, automation technology and micro-processors (Seppälä 1998). This institute employs about 400 people, mainly researchers. It is almost totally

dependent on external public and private money. The institute has become an important partner to companies and it has developed into a core actor in the regional ICT cluster. The high quality of the research conducted in the institute was acknowledged by the Academy of Finland by selecting it to become a Centre of Excellence in its fields. More recently co-operation between the two universities has extended to other fields including science, technology and innovation research. An inter-university research institute in this area was founded (TaSTI), which got major grants from the Ministry of Education for the first development phase. Besides the Digital Media Institute, the Optoelectronic Research Centre has become one of TUT's core of activities in the field of digital media. This sector also has a great deal of commercial potential. The institute aims to promote collaboration with companies and university spin-offs. It is also very internationally oriented having research partners, both companies and university units worldwide.

The high quality of research in TUT is indicated by the fact that, in addition to the Centre of Excellence in digital signal processing, the university got two other centres in the fields of bio-materials and hydraulics and automation for the period 2000–2005. In all these fields of research, TUT has a longstanding tradition of co-operation with the industry in the region. University-industry co-operation has been partly achieved through high labour mobility. Furthermore, students have written their master's theses in co-operation with firms, and university staff has provided training courses for firms. University initiatives, such as part-time professorships for experts from industry, also indicate close university-industry co-operation in the region. About 60 per cent of the university's funding consists of external funding, including financial support from the local industry. And 45 per cent of all students are studying in the faculties of information technology and electrical engineering; both very closely related to the ICT sector. The appointment of a professor of electronics in TUT, being specialized in the field of digital signal processing, as research and development manager of the Nokia Mobile Phones, also indicates the close relationship between TUT and the industry in Tampere Region.

In the 1990s, also the University of Tampere (UTA) raised its regional profile. The university with its 12,500 first-degree students and about 2000 post-graduate students had

traditionally been oriented towards humanities and towards educating a workforce for the public sector, whereas university-industry co-operation had developed only in the medical faculty. In the 1990s, computer science and information sciences, as well as hypermedia, developed into a stronghold of UTA and became an important fields of co-operation with industry. This was one of the reasons for establishing a new Faculty of Information Science at the university in 2001. The human-computer interaction is a very important research area in the department where also themes like information retrieval, seeking and management are researched. The Hypermedia Laboratory is an important unit within the Faculty of Information Science, which has grown very fast and currently employs about 50 experts. The main research themes of the laboratory are related to adaptive systems and content, experience design, knowledge-creating systems and learning. Digital games and gaming is a rising field of research and teaching within the laboratory.

The second stronghold of ICT and media-related activities at UTA is communication theory and mass media. While these areas have always been a strong area of teaching and research, in recent years they have gained particular attraction, as the issue of new media have aroused great interest. The newly formed Information Society Institute has become a new unit at UTA aiming at promoting research on the information society. In this institute, social scientists are expected to explore social trends, needs and behaviour to ensure a citizen-driven, consumer-driven and social uses-driven expansion of information technologies (Castells and Himanen 2001).

The strength of the ICT industry in the Tampere Region is also demonstrated by the fact that the Tampere University of Technology (TUT) and the University of Tampere together grant more than 200 Master's degrees annually in the fields of electronics, information and communication technologies and new media. The two universities in Tampere also played a crucial role in the emerging ICT sector, as researchers established some of the first companies in the field.

Besides its strong ICT sector, Tampere Region was always looking for new growth areas. And again universities played an important role in the development of a new knowledge-based industrial structure in the region. The co-operation between the Faculty of Medicine and the Tampere University Hospital was seen as a solid basis to develop "health care technology" into a new field of strength in the Tampere Region, which resulted in the establishment of the technology centre Finn-Medi. Health care technology got additional support, when it was chosen to be one field of the Tampere Region Centre of Expertise Programme. It is likely that in future the two knowledge bases are moving closer to one another.

The two universities form the core of Tampere Region's knowledge base, but there are also other knowledge-creating and distributing institutions in the region. VTT, Finland's main research centre of technology, is well represented in Tampere Region with its about 250 employees. VTT specializes in applied research, concentrating on improving product and process technologies. Most of its research projects are commissioned by private companies or state-owned institutes, Tekes in particular, but the VTT institutes are also engaged in self-initiated research projects. Of VTT's nine research areas in Finland, five are present in Tampere*:* mechanical automation, construction, plastic and fiber technology, security technology and metallurgy, and information technology. Its strengths overlap to a great extent with those of TUT: automation technology, as well as information and telecommunication technologies.

There are numerous educational and training institutions in Tampere Region, including two recently established polytechnics: Pirkanmaa Polytechnic, concentrating on social and health care sector education; and Tampere Polytechnic, concentrating on fields such as business administration, engineering, and information technology. There are also quite a few vocational training institutions in Tampere Region. This institutional knowledge base represents an excellent source for local companies, as intensive co-operation between knowledge-creating institutions and industry indicates.

Summing up, we can mention the following fields as research and teaching strongholds of various institutions of Tampere's digital media agglomeration.

**Table 1. The key research and education institutions of the digital media agglomeration in Tampere and their major competence fields**

| Organization | Examples of competence fields |
|---|---|
| **Tampere University of Technology**<br>basic research<br>education<br>commercial services | digital and computer systems<br>electronics<br>software systems<br>optoelectronics<br>signal processing<br>communication engineering<br>virtual reality<br>research on e-business |
| **University of Tampere**<br>basic and applied research<br>education<br>commercial services | computer science (human-computer interaction)<br>information studies<br>hypermedia<br>journalism and mass communication<br>research on information society and e-business |
| **Tampere Polytechnic**<br>education<br>development projects<br>commercial services | data processing (e.g. hypermedia and software business)<br>computer and software technology<br>communication (e.g. interaction media) |
| **VTT Technical Research Centre of Finland (units located in Tampere)**<br>basic and applied research<br>commercial services | human interaction technologies and human centred design<br>wireless solutions<br>integrated systems<br>wellness applications |

Figure 2 shows the extent to which companies in the region engage in close co-operation with key knowledge producers. Altogether, approximately 80 per cent of the manufacturing and knowledge-intensive business service companies that employ ten or more people have at least some co-operation with these organizations.

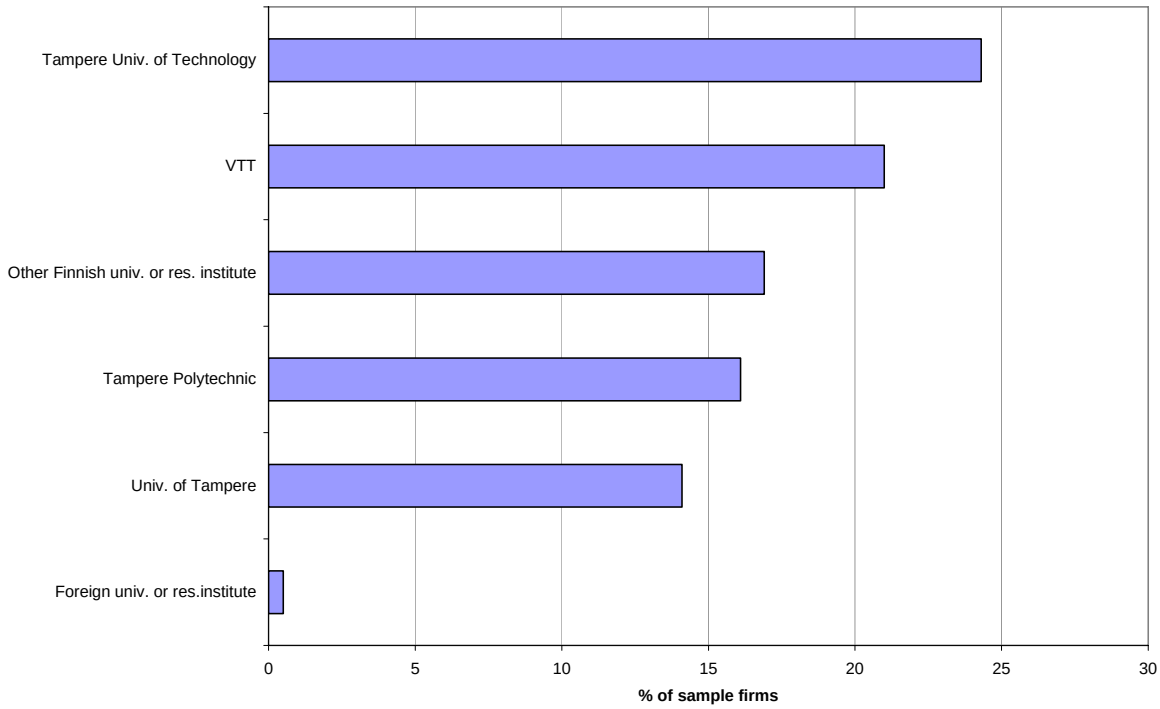


**Figure 2: Share of companies having frequent (Likert-5, values 4-5) co-operation with some selected universities or research institutes (N=195)**
(Source: Kautonen et al. 2002)

Nokia, the Finnish telecommunications giant, forms an important part of the private sector's knowledge base in Tampere Region, because one of its largest research centres is located there. Nokia became increasingly interested in Tampere Region when it took over the software producer Softplan, an off-spring of UTA. The takeover had a remarkable impact on the development of Tampere-based information technology, as some of the workers acquired influential positions in Nokia, while others transferred their knowledge to other companies in the region. Tampere Region has significantly benefited from Nokia's strategy to systemically improve its innovation capabilities in Finland by continuously increasing its R&D budget.

In 1988, Nokia started the Nokia Cellular Systems in Tampere, which develops mobile phone systems. The high expertise of TUT in electronics and information technology very much influenced Nokia's decision to settle in Tampere Region. Particularly towards the end of the 1990s, Nokia's activities in Tampere Region expanded continuously in its

two business groups, Nokia Mobile Phones and Nokia Networks. Products developed in Tampere, mostly in close co-operation with TUT and VTT, include the Cellular Data Card and Nokia Communicator as well as NMS/2000 of net management.

Taking into account the strong knowledge-base it does not come as a surprise that the growth of R&D investments in Tampere Region has been remarkable: the real annual change in 1995–1999 was as high as 25 per cent compared to the national level of 14 per cent. In 1995, R&D expenditures in Tampere Region only accounted for about 10 per cent of Finland's entire R&D expenditures. Nowadays expenditures in R&D in the region, which have been growing particularly in the business sector, represent a share of about 14 per cent of national spending (Statistics Finland 2001). Finland's R&D expenditures with a share of 3.5 per cent of GDP have already reached the Barcelona criteria.

Thanks to its two large universities, VTT's research facilities and some R&D-intensive companies, Tampere Region benefited greatly from the R&D programmes of the National Technology Agency Tekes, the research programmes of the Academy of Finland and the Framework Programmes of the EU. In 1999, Tekes financed company R&D in Tampere Region totalling EUR 22 million (9% of the national total) and in the same year its support for R&D in universities and public research institutes totalled EUR 67 million (15% of the national total). While Helsinki Region with its share of 45 per cent strongly dominates national R&D expenditures, per capita R&D expenditures in Tampere Region are higher than in Helsinki Region. Concerning the regional proportion of R&D personnel of the workforce, Tampere Region also has a strong position. While on average 3.1 per cent of the workforce in Finland is engaged in R&D-related jobs, Tampere Region has been able to raise this share to 4.6 per cent (Statistics Finland 2002). In this respect, it is the most dynamic region in Finland. Contrary to other regions, Tampere Region continuously increased employment in R&D in both the public and the private sector.

Patent applications represent an important indicator when measuring the outcome of R&D inputs. Helsinki Region has been the strongest region with 34 per cent of all Finnish applications, whereas Tampere Region holds second place with its 17 per cent share of the national total in 2001 (Statistics Finland 2002). It is also important to notice that the share of Tampere Region is higher in patent applications than its share in R&D expenditures (14%) and R&D personnel (13%). According to Statistics Finland (2001), the largest patent classes in the region are electrical engineering (32.4%), processes and transport (18.8%), and physics (15.7%). The fairly even distribution of patenting activities among the various sectors reflects the widely diffused science and technology base of the region.

**Creating strong ties between the knowledge base and industry**

Of course, it is not enough to have a strong knowledge base in producing growth and employment; as important is the linkage between the knowledge creating institutions and industry. Finland is well-known for its successful policy of developing regional clusters built around technology centres and science parks. Tampere Region has been very active in establishing institutions that support networking between various economic actors. In all these activities, the two universities played a significant role. At the beginning of the 1990s, Hermia Science Park was established in Tampere Region in the immediate proximity of TUT. With a focus on IT and automation technology, Hermia gradually expended and, in 2001, there were 145 companies with the staff of nearly 3,000 employees working in its premises of 100,000 square meters.

Later on, Finn-Medi Science Park was established and the latest high-technology agglomeration has developed in the centre of the City of Tampere, where the large, old industrial estates have been turned into a complex of software and new media companies. This sector is co-ordinated by Media Tampere Ltd – a company that is mostly owned by private companies like Nokia and Fujitsu Invia. This commitment reflects the fact that these companies aim at using the city as their testing arena for new products and

applications and as a seedbed for new business ventures, especially in the field of mobile and Internet technologies (Kautonen et al. 2002).

The launching of the National Centre of Expertise Programme in 1994 as part of the programme-based regional development strategy of the national government had an important impact on the further development of the knowledge-based economy in the Tampere Region. The aim of the Centre of Expertise Programme is to enhance the regional knowledge base and to construct clusters of internationally high-level expertise. This should be achieved by supporting joint projects of firms, universities, research institutes, technology centres, and public administration in selected industries (Valtonen 1999). Instead of supporting weak industrial sectors, the Centre of Expertise Programme focuses on regional strongholds and on enhancing and further developing them. The programme was seen as important measure to support regional specialization through the development of strong regional clusters and was prolonged by the responsible ministries.

Tampere Region also prepared a proposal for the first application round and achieved its goal of being nominated as Centre of Expertise in mechanical engineering technology, automation and information technology and health care technology. The choice combined the traditional stronghold in mechanical engineering technology with new developments in information technology caused by the rapid growth of Nokia. The leading expertise of Tampere Region's ICT sector lies in such areas as data communications, wireless networks, telecommunications networks, workstation software, team software, databases, mechatronics**,** process automation, sound, image and video processing, production control and logistics systems. And as far as health care and health informatics technology are concerned, there was a great faith in the future potential of this field.

In the proposal for the new Centre of Expertise Programme in 1998 the region focused on the already existing fields, information technology, engineering and health care technology but added communications and knowledge-intensive business services as new fields. Communication was selected because of the growing importance of the new media industry. The new media industries' specific strengths lie in digitizing and mobile

communications, digital content and distribution services, new media industries and the social impact of new communications technology. Particular attention is given to new media content production and services. The field is also strongly anchored in UTA, as research and teaching in the field of journalism and mass communication has been conducted in the university for many years.

Knowledge-intensive business services were chosen because a study conducted in TUT demonstrated the huge growth potential of the sector (Kautonen et al. 1998). The proposal for knowledge-intensive business services did not get the approval of the selecting committee but the local policy makers decided to further develop the area through the means of local funding without national backing. The sub-programme is seen as important not only because of the rapid growth of employment taking place in this field, but also because it has a significant impact on the innovation activities of other industrial sectors, as KIBS companies play an important role as creators, carriers and disseminators of new knowledge (Miles et al. 1995). A new company, Professia Ltd, was established to co-ordinate the programme in this field.

While one may doubt whether the financial support granted by the Centre of Expertise Programme is of significance in regard to regional economies, the indirect influence of the programme is quite significant. A major consequence of the programme is that it forces regions to choose particular industrial sectors seen as strategic for their future development (Kostiainen and Soutarauta 2002). At the same time, the programme signals some kind of commitment of local policy makers to further support the development of competencies in the selected industries. The development projects co-ordinated by the programme aim to cover all the technological, market and social factors that are relevant to business success. Moreover, the programme functions as a catalyst for promoting new developments and bringing different actors together. It also acts as a mediator between national-level financiers, on the one hand, and service-suppliers and local firms on the other. In addition to development projects carried out with firms and networks of service organizations, the programme also intends to identify gaps and weak linkages in the regional system of innovation and to propose possible solutions.

Figure 3 shows that the Tampere Centres of Expertise Programme has been very successful. All industrial sectors belonging to the regional Centres of Expertise Programme have expanded quite significantly. The ICT sector and the knowledge-intensive business services sector have been growing the most rapidly. In the ICT and KIBS sectors, the total turnover of companies more than doubled between 1995 and 2000. However, in 2001, the growth came to a halt due to the international stagnation of the global ICT boom. It remains to be seen whether the third generation of mobile telephony will create a new growth wave. In the mechanical engineering and automation sector, modes of production evidently became more knowledge-intensive: This is indicated by an increase in R&D spending and the substantial growth of productivity in the latter part of the 1990s. It can also be seen in the technological level of the companies and their products (Kautonen et al. 2002: 157).

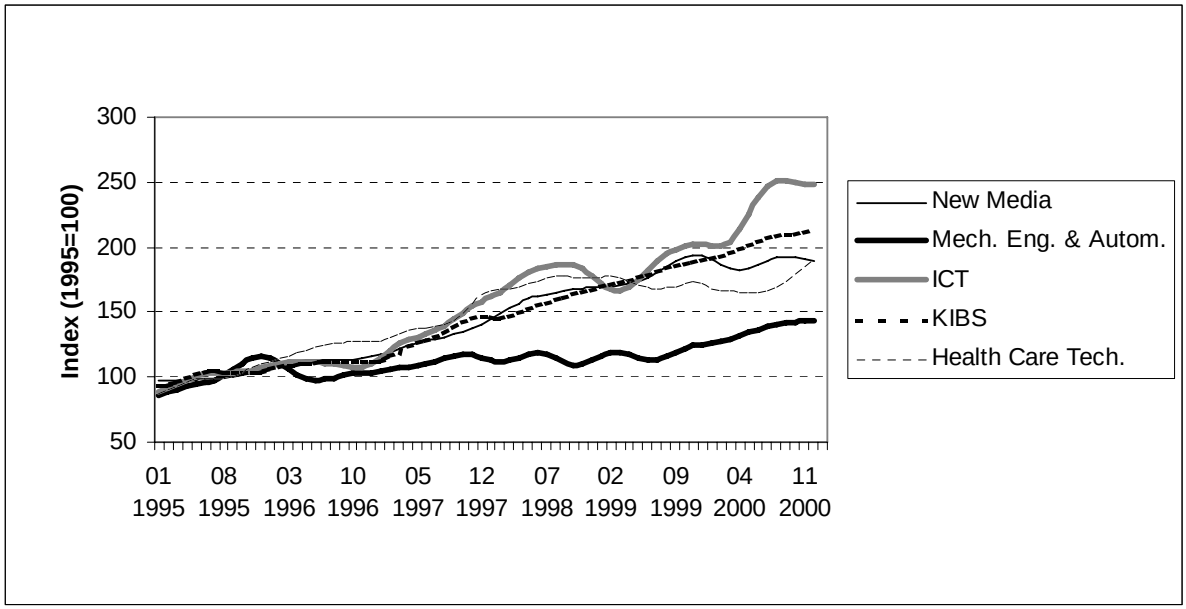


**Figure 3: Development of total turnover in industries belonging to the Tampere Region Centre of Expertise Programme, 1995–2000, index**

(Source: Statistics Finland, Tampere Cityweb Statistics 2002)

To bring the region a step further towards reaching its ambitious goal of becoming a node in global knowledge networks a new, broad development programme named e-Tampere was initiated. The object was to develop Tampere Region into the world's leading researcher, developer and applicator of the information society. In addition to the City of Tampere, the two universities, VTT and companies of the region were involved in the implementation of the programme. Within it, new virtual units have been set up, including the eBusiness Research Centre connecting TUT and UTA, the Information Society Research Institute at UTA and the ReLab of VTT. Because of the large budget of EUR 130 million for five years, the programme was considered to be very ambitious. But also because it consists of a great number of sub-programs covering a wide range of activities from basic and applied research to business incubation and further to the development of information society citizenship, the programme can be seen as a major challenge for all actors involved. The programme covering technological, market and social aspects is seen as unique not only in Finland, but also in Europe (Castells & Himanen 2001). As part of the eTampere Programme, a sub-program referred to as eAccelerator was launched. It is based on the concept of a virtual, highly efficient business incubator oriented towards new technology-based companies. Its rather ambitious goal was to guide 20–25 companies into international growth trajectories.

Although a systematic evaluation of the programme is still missing, it is clear that the project did not achieve its main goals. This is partly because its goals were too ambitious to be reached in a period of five years. In addition, because of its complexity, the project became very difficult to manage. And, most important, the project started when the E-boom came to an end. The deteriorating economic situation in the ICT sector put paid to the optimistic expectations that triggered the eTampere programme. Insiders mention some aspects that might make the programme appear in a more favourable light: the regional identity was strengthened, communication and co-operation between representatives of different enterprises, academic institutions and regional authorities increased and the regards of the Tampere Region within the Nokia Corporation has grown (Ainamo forthcoming). Whether these indirect achievements will result in direct improvements in the long run remains to be seen. Nevertheless, we can argue that due to

the various initiatives the Tampere Region has developed a regional innovation system, characterized by a strong knowledge base, a thick institutional support structure, intensive networking between the main economic actors and openness to global knowledge flows.

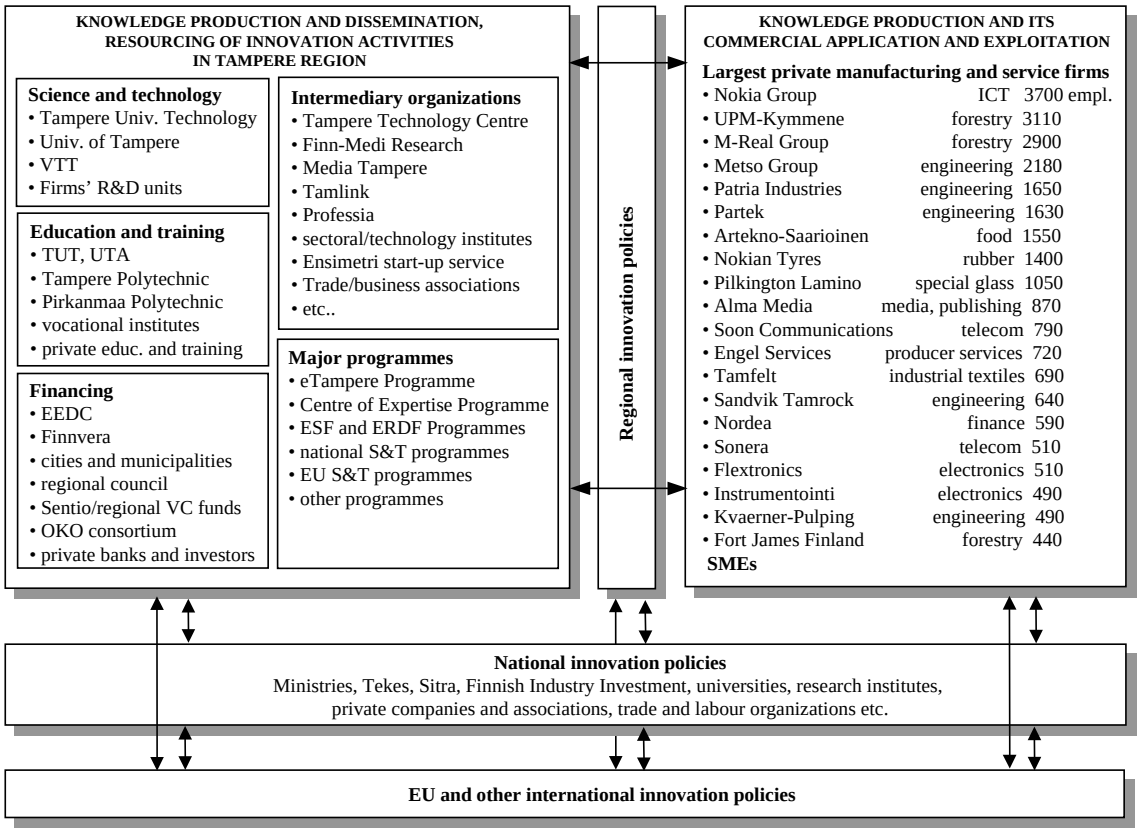


**Figure 4: The regional innovation system in Tampere Region**

(Source: Kautonen et al. 2002, p. 159)

## University industry relations from the firm perspective[2]

Finland has recently been characterized as a network economy (Castells and Himanen 2000). Besides restructuring internally to enable organizational learning, companies in Tampere Region are increasingly influenced by the network logic of organizing business. Co-operation not only among firms, but also between firms and (technical) universities have risen significantly in the last 15 years. There are of course differences between firms in their co-operation activities with universities. Not surprisingly, mainly high or medium high-tech firms (IT) and knowledge-intensive business services that have regular in-house R&D activities represent the type of firms that are co-operating with universities. It seems that the existence of in-house R&D has a greater impact on industry-university co-operation than the technical level of the company. Furthermore, the greater the numbers of research personnel and the higher the research investments, the more likely there will also be co-operation with universities.

**Table 3: Firms' co-operation with universities according to regularity of in-house R&D and technological level (%)**

| R&D performed in plant | | High or medium high-tech | Medium low or low-tech | KIBS | Total |
|---|---|---|---|---|---|
| Regularly | No co-operation | 29 | 35 | 17 | 25 |
| | Co-operation | 71 | 65 | 83 | 75 |
| Occasionally | No co-operation | 54 | 68 | 50 | 59 |
| | Co-operation | 46 | 32 | 50 | 41 |
| No R&D | No co-operation | 63 | 78 | 76 | 74 |
| | Co-operation | 37 | 22 | 24 | 26 |

[2] The analysis is based on a survey that was conducted within the project "Universities as key actor in regional innovation systems" (led by Gerd Schienstock) in 1999. The questionnaire was send out to 1,480 companies in Tampere, Turku and Oulu Regions (About 40% of the completed questionnaires came from companies in Tampere Region). The return rate was about 25 per cent. Most of the firms surveyed were employing between 50 and 200 persons. Altogether 64 per cent of the respondent represented industrial enterprises and 36 per cent knowledge-intensive business services. The data, although not fully representative for the industry in Tampere Region, provide some insight into industry-university collaboration from the firm perspective. Results of this survey were first published in Nieminen and Kaukonen (2001).

There are several answers to the question why R&D intensity has an impact on university-industry co-operation. First, the capacity to absorb external knowledge very much depends on companies' own research and development capacity. Second, companies engaged in R&D activities may depend on complementary external knowledge to produce new innovations. It is interesting that companies with high export shares co-operate more often with universities than companies that primarily produce for the regional or national market. This might indicate that globally oriented companies are more pressured by innovation competition than locally oriented companies.

Naturally universities are not the only source to acquire knowledge, most firms utilize many sources of knowledge and know how in their environment. Universities are actually belonging to the group of less important partners in innovation networks. Customers, equipment suppliers and subcontractors are mentioned as most important co-operation partners in innovation processes, while only a minority of firms (23%) sees co-operation with technical universities as important for their innovation activities. On the basis of our research results, we can distinguish between three types of companies. Companies belonging to the first group hardly innovate at all; these firms are most likely small low-tech firms with no in-house R&D and practically no co-operation with universities. Companies focusing on incremental innovations hardly need support from universities, they relay on customers, subcontractors and supplier firms as source of new knowledge. In the case of more complex and radical innovations, companies become involved in more heterogeneous innovation networks including universities as relevant co-operation partner. The third group of firms, however, consists of high-tech firms and KIBS.

**Table 4: The most important partners in companies' innovation-related co-operation (%)**

| | No significance | Of little significance | Fairly or very significant |
|---|---|---|---|
| Customer firms | 3 | 14 | 83 |
| Equipment suppliers | 10 | 37 | 54 |
| Subcontractors | 15 | 36 | 49 |
| Public financing and consulting | 31 | 26 | 42 |
| Rivals | 24 | 45 | 31 |
| Research institutes | 34 | 34 | 31 |
| Private consultants | 34 | 38 | 28 |
| Technical universities | 41 | 36 | 23 |
| Other education institutions | 35 | 44 | 21 |
| Universities | 49 | 39 | 12 |
| Industrial associations | 61 | 31 | 8 |
| Technology centres | 67 | 27 | 6 |
| Business schools | 66 | 31 | 3 |

Companies that co-operate with universities turn to local universities in the first place. Almost 80 per cent of all companies that had experienced university co-operation had one or more partners from a local university, whereas under half of the co-operating firms had partners from other Finnish universities and only about 1 per cent of co-operating firms had partners from foreign universities. We can assume that the knowledge produced in universities fits very well into the knowledge base of the more innovative firms. However, proximity is not the most important reason for the establishment of university-industry co-operation. Although two out of three companies having contact with universities mention proximity as an important factor to engage in innovation co-operation; companies in general see the applicability of the universities' services, universities' active search for business partners, a high standard of university research and earlier experience of co-operation with universities as more important factors that influence the choice of the university with which they prefer to co-operate.

Although to jointly create new knowledge with universities or to transfer new knowledge from universities is an important motive for companies to co-operate, it is not the only reason for them to develop contacts with universities. Monitoring technological development, training the workforce, acquiring new personnel or developing new organization forms, for example, can also be seen as important motives to co-operate with universities.

Our research suggests that more than 50 per cent of all companies see commercialization of new knowledge, acquisition of new scientific knowledge, monitoring technological development, acquisition of new knowledge through students' theses, technology transfer, and training of personnel as fairly or very significant goals, when they start co-operating with universities. Table 5 indicates that companies pursue a number of different goals when getting into contact with universities. We have identified five major goals, including a number of sub-factors, which motivate companies to co-operate with universities.

**Table 5: Companies' goals concerning university co-operation (%)**[3]

| | No significance | Of little significance | Fairly or very significant |
|---|---|---|---|
| **Acquisition of knowledge** | | | |
| acquiring new scientific knowledge | 11 | 23 | 66 |
| new or substantially improved research methods and equipment | 17 | 36 | 47 |
| transfer of technology | 13 | 31 | 56 |
| monitoring technological development in the field | 9 | 29 | 62 |
| (joint use of equipment) | 33 | 37 | 30 |
| (testing and measuring results | 25 | 26 | 49 |
| **External links** | | | |
| international contacts | 34 | 32 | 34 |
| monitoring competitors | 37 | 42 | 21 |
| co-operation with clients and subcontractors | 34 | 34 | 33 |
| (fulfilling the requirements of standards) | 49 | 49 | 24 |
| (sharing risks and costs) | 40 | 37 | 23 |
| **Development and commercialization** | | | |
| testing and making prototypes | 44 | 28 | 28 |
| acquiring patents and licenses | 72 | 20 | 8 |
| commercial exploitation of new knowledge | 7 | 24 | 70 |
| **Training** | | | |
| training of personnel | 22 | 27 | 51 |
| (development of software) | 44 | 30 | 26 |
| **Acquiring knowledge through students' theses** | 23 | 17 | 59 |

Naturally co-operation does not always results in the achievement of the intended advantage. The impact of co-operation may differ from the initial goal. Table 7 shows what companies see as the main outcome of their co-operation with universities. The most important advantage of the co-operation for companies seems to be the increase of the knowledge basis. Co-operation also seems to lead to improved quality of products and services. It is interesting that companies often mention added prestige as an important outcome of their co-operation with universities. On the other hand, co-operation with universities has a minor impact on the commercial utilization of new knowledge than was

[3] The identification of the five main goals is based on a factor analysis. The sub-factors in ( ) do not fit very well with the overall goal.

the initial goal of companies. This may reflect the fact that Finns in general think of innovation more in technical than in market terms.[4]

**Table 6: The impact of university co-operation (%)**

| | No impact | Little impact | Fair or big impact |
|---|---|---|---|
| Increased know-how | 3 | 15 | 82 |
| Improved quality of products/services | 16 | 30 | 54 |
| Added prestige | 24 | 30 | 46 |
| Employment of new personnel | 36 | 21 | 42 |
| Improved working methods and process | 28 | 33 | 39 |
| Increased ease in commercialization of products/services | 25 | 41 | 34 |
| Added productivity | 38 | 33 | 29 |
| Increased co-operation with other firms | 42 | 31 | 27 |
| Increased internationalization | 41 | 34 | 25 |
| Added sales or increased market share | 32 | 46 | 22 |

It seems that industry-university co-operation is proceeding very smoothly in Finland and in Tampere Region. Companies hardly mention any bottlenecks in their co-operation with universities. If problems occur, they are mainly related to communication, the inactivity of some partners, the non-complementarity of knowledge, too ambitious goals or the lack of funding. The question remains why some companies choose not to co-operate with universities. As can be seen in Table 7, the lack of time, ignorance of co-operation opportunities and limited resources are the main reasons which hinder companies from engaging in co-operation with universities. Although co-operation between universities and industry has increased in recent years, still about 70 per cent of all companies assume that co-operating with universities is of no or little significance to them. Of course, small producers of highly standardized parts seldom need to acquire new knowledge from

[4] The fact that companies hardly co-operate with business schools seems to indicate a technology-oriented perspective of innovation.

universities. But according to our findings, also more than 60 per cent of all medium and high-tech firms and KIBS do not recognize co-operation with universities being of high priority and particular relevance for their business. One can assume that a significant number of companies are not aware of possible advantages resulting from the co-operation with universities.

**Table 7: Impediments to university-industry co-operation (%)**

| | **No significance** | **Little significance** | **Fairly or very significant** |
|---|---|---|---|
| Lack of time | 25 | 26 | 50 |
| Not aware of co-operation possibilities | 25 | 31 | 45 |
| No resources to pay for services | 30 | 35 | 36 |
| Different time scope of operation | 40 | 25 | 35 |
| Difficulties to get in contact with universities | 37 | 34 | 30 |
| Co-operation not important | 30 | 41 | 29 |
| Bureaucracy | 46 | 33 | 21 |
| No autonomy to start co-operation | 72 | 14 | 14 |
| Have tried but it has not started | 85 | 10 | 5 |

## What can we learn from the case of Tampere Region?

The case of the Tampere Region demonstrates that old industrialized regions which have fallen behind in global competition do not have to stay backward in the long run. Even regions strongly anchored in the industrial paradigm can achieve a fundamental structural change in a relatively short period of time and can catch up with the leading regions in the emerging knowledge-based economy. But preparedness to think in categories of transformation is an important precondition for such an achievement. Structural conservatism, on the other hand, implies the danger of a long-term lock-in, which can result in falling behind even further.

However, foundations for such a fundamental structural change from a resource-based to a knowledge-based economy must be laid rather early. An anticipatory institutional change, particularly in the education and science system, can create the preconditions for

engaging in industrial change if a new knowledge paradigm becomes economically relevant. This means that regions have to prepare themselves for a fundamental economic change by establishing an institutional setting including universities and other research institutes to create a new knowledge base.

The creation of a new knowledge base through anticipatory institutional change in the research and education system has to focus on specialized areas of knowledge. It is only possible to achieve a leading position in the new knowledge paradigm, if the relevant institutions specialize in particular areas in which they can sustain a leading position. If local universities or research institutes are able to forge ahead in the knowledge production in particular specialized areas, regions may become an attractive place even for large companies to invest. This means that regions have to react to companies' strategy to search for the most suitable environment by specializing in particular knowledge areas.

Regions need to maintain the dynamic of economic transformation by applying a systemic perspective taking into account the whole economy and all relevant support institutions. In the beginning of a transformation process, the change dynamics may come from some knowledge islands, but if in the long run they are not connected with the whole economy, there is a danger of growing intra-regional inequality. A long-term success of an economic transformation process requires therefore increasing networking among the key economic actors. Universities as knowledge creators and knowledge disseminators can become key actors in such holistic transformation processes, particularly if they become partners in regional innovation networks.

A successful transformation depends on the attempt of economic actors to synchronize their operations. Consequently universities and industries have to co-ordinate and mutually adjust their long-term strategies. If such an adjustment does not take place, there is the danger that the new knowledge base and the industrial base of a region increasingly fall apart with negative consequences for both. An agreement on joint procedures and long-term goals among the key economic actors is decisive for the success of a

transformation process. Regional policy makers can support the development of a common knowledge base from which to proceed by establishing mechanisms for discursive co-ordination and they can steer the development process by creating a vision for future development.

As knowledge creation becomes increasingly complex and dynamic, regions can no longer focus on endogenous knowledge creation only. Depending only on internally produced knowledge will no longer guarantee the competitiveness of regional economies. Instead, to stay ahead in the emerging new knowledge paradigm, regions have to become integrated into global knowledge flows, because it becomes increasingly impossible to produce all the needed knowledge internally. Of course, the production of knowledge valuable for others is important, as this is a precondition for becoming an accepted partner in global knowledge networks. The quality of the local universities and research may well decide about whether regions can establish themselves as a growth node in global knowledge networks.

Finally, it has to be taken into account that fundamental transformation processes do not only produce winners, but also losers. The support of existing economic strongholds and promising new economic developments at the expense of economically weak and internationally not competitive industries is likely to produce serious social problems. A fundamental transformation process has to take place in a socially integrative way to avoid a societal segmentation, which may even put the success of the whole renewal process into question.

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