MASSACHUSETTS INSTITUTE OF TECHNOLOGY
INDUSTRIAL PERFORMANCE CENTER
SPECIAL WORKING PAPER SERIES ON LOCAL INNOVATION SYSTEMS

TERRITORIAL AGGLOMERATION AS A LOCAL INNOVATION ENVIRONMENT

THE CASE OF A DIGITAL MEDIA AGGLOMERATION IN TAMPERE, FINLAND

JARI KOLEHMAINEN

MIT-IPC-LIS-03-002

The views expressed herein are the author's responsibility and do not necessarily reflect those of the MIT Industrial Performance Center or the Massachusetts Institute of Technology.

Territorial Agglomeration as a Local Innovation Environment

The Case of a Digital Media Agglomeration in Tampere, Finland

Jari Kolehmainen

University of Tampere
Research Unit for Urban and Regional Development Studies (Sente)
FIN-33014 University of Tampere
Finland
jari.kolehmainen@uta.fi

MIT IPC-LIS Working Paper 03-002

Abstract

In this article the concept of territorial agglomeration is discussed and reflected from the point of view of innovation activities. From this same angle, some suggestions are also made as to how to bring some clarity to the complex issue of the relationship between companies and their local operational environment. One of the conclusions is that a territorial agglomeration can be a basis for stimulating the local innovation environment, although the agglomeration does not necessarily contribute directly to the innovation activities of companies belonging to it. It is argued that a local innovation environment consists of many interrelated elements ranging from the institutional setting to the behaviour of individuals. Also, a preliminary way to approach this complex issue is suggested. It is argued that a local innovation environment can be divided into three levels: *1. the structural and institutional level, 2. the level of organisational relationships,* and *3. the level of individuals.* The case of a digital media agglomeration in Tampere is used as an empirical illustration for the structural and institutional elements of a local innovation environment.

The digital media agglomeration in Tampere has its roots quite far back in history, but it grew very rapidly and reached its current form in the 1990s. It is dominated by the business units of large international digital media companies, which is partly linked to its weak entrepreneurial atmosphere. Its major strengths, however, are its educational institutions and science and technology base. Additionally, several local collective actions have been taken by both private and public actors, often together, towards facilitating and strengthening the agglomeration's institutional setting and knowledge base. Still, it should be emphasised that structures and the institutional setting alone cannot guarantee the innovation performance of a territorial agglomeration or a region.

Introduction

Today companies' success is increasingly defined by innovation and learning. Very broadly speaking, focusing on these matters is the only way for companies to succeed or even survive in the globalising economy. Schienstock and Hämäläinen (2001) conclude that innovation is a recursive process which concerns all activities from the search for a solution to technical or other problems to a situation in which a new product or production process has been launched on the market (see also e.g. Schienstock & Kuusi 1999). They also emphasise that the concept of innovation should not be restricted only to technical innovations (e.g. new products and technical enhancements of production processes), because social innovations – including organisational, procedural and institutional innovations – are of great importance.

Companies are not alone in this, because regions and nations are also under the same pressure. In the global network economy, regions compete with each other, and according to a modern scientific view, regions are trying to catch their share of global capital, investments, inhabitants, etc. Kostiainen (1999, 20) defines the competitiveness of an urban region as its ability to "*attract flows of information, technology, capital, culture, people and organisations that are important to the region, and with this the ability to maintain and develop the quality of life and standards of living of local residents, as well as an ability to create an innovative environment, in which companies can develop their competitiveness*." (cf. e.g. Sotarauta & Linnamaa 1997, Cooke & Schienstock 2000) As can be noted, the importance of innovations arises in the regional context as well.

Therefore the improving of competitiveness and creation of innovations are common challenges to companies and regions alike, even though the ways in which they manifest themselves in practice are different. In fact, this common challenge culminates in companies' local operational environment. It has been suggested in many studies that an appropriate local operational environment – a local

innovation environment – can have a positive effect on companies' possibilities to innovate. Often the starting point in this kind of analysis is an industrial agglomeration.

The relationship between companies and their local operational environment – especially from the point of view of innovation activities – is an interesting research theme, which has also remarkable societal relevance. Consequently many alternative and slightly different theoretical approaches and concepts have been developed, including (regional) clusters (e.g. Porter 1990; 1998), new industrial districts (e.g. Harrison 1992; Cossentino et al. 1996) innovative milieus (e.g. Camagni 1991; 1995) and (regional) systems of innovation (e.g. Braczyk et al. 1998; Howells 1999). All of these concepts are based in one way or another on the idea that certain kinds of activities have clustered spatially in certain territories. This notion brings us to the concept of (territorial) industrial agglomeration (Marshall 1890/1920). It is basically a very old concept, but – as I argue – it is still very useful when studying the relationship between companies and their local operational environment or the development of a certain regional or local economy as a whole.

Furthermore it can be argued to some extent that all of the above-mentioned theoretical concepts concentrate on identifying the macro-level factors that promote regional innovation; however, the micro-level operations should be understood better (cf. Männistö 2002). In any case, the ways in which the local operational environment can promote innovation are very intricate and the role of the local innovation environment should not be exaggerated. There are many high-technology or other knowledge-intensive companies that are very loosely or not at all connected to their local environment, which makes the bold generalisations related to the role of regions debatable (cf. Miettinen et al. 1999; Miettinen 2002)

The aim of this paper is to discuss the concept of territorial (industrial) agglomeration and to reflect on it from the point of view of innovation activities. The paper is partly based on the research project "Networks, Innovation Milieus and Regions", which was conducted in Work Research Centre, University of Tampere, and funded by the National Technology Agency (Tekes) (see the final report by Kautonen et al. 2002). The project was a part of the Technology Study Programme of Tekes and the Finnish Ministry of Trade and Industry and its research tasks were to investigate both regional milieus as companies' innovation environments, companies' regional ties from the perspective of their innovation activities and, as a third closely related theme, regional innovation policies and strategies. The research project consisted of several studies which shared a common general framework, namely the concept of regional innovation system. This approach was augmented by several theoretical concepts from various disciplines, the theory of geographical agglomeration and the innovative milieu, for example. The case study of a digital media agglomeration in Tampere represented here was conducted especially in relation to these concepts. The main data of this case study consisted of 29 interviews of experts working in digital media related companies (11) and other organisations (18) alike. Interviews were conducted in years 2000 and 2001. In addition to interview data, a considerable amount of other written and electronic materials (e.g. statistics, bulletins, articles, websites) have been used.

The paper is organised as follows. First some general theoretical perspectives on the relationship between innovation and region are introduced; the concept of geographical agglomeration functions as

a starting point. From this innovation-emphasising angle, some suggestions are made about how to bring some clarity to the complex issue of the relationship between companies and their local operational environment. In this connection the concept of local innovation environment is introduced. After the theoretical discussion, the case of digital media agglomeration in Tampere is introduced to provide an empirical illustration of some of the theoretical issues. In the end some concluding remarks are presented.

Theoretical perspectives on the relationship between region and innovation

Basic features of the concept of territorial agglomeration

The concept of agglomeration is closely linked to the traditional industrial location theory, which is largely based on a quite straightforward view of the activities of (productive) companies. In his classic work, Alfred Weber (1909/1929[1]) recognised three general location forces: *1. transport cost differentials, 2. labour cost differentials* and *3. agglomeration (deglomeration) economies and diseconomies*. Furthermore the agglomeration economies have traditionally been divided into three categories or factors as follows (cf. e.g. Weber 1909/1929; Ohlin 1933; Isard 1956):

- *Large-scale internal economies* that exist within a company and are based on the scale economies of production at one geographical point.
- *Localisation economies* result from the scale of a particular industry and they benefit all companies in a particular industry at a single location. Scale economies in intermediate inputs, labour-market pooling and knowledge spillovers are typical examples of positive localisation economies.
- *Urbanisation economies* result from the scale of an entire urban economy and they are available for all companies in all industries at a single location. Developed labour market and basic facilities (e.g. transportation, welfare and educational services), supply of private services (e.g. recreation) and considerable local market potentiality are typical examples of positive urbanisation economies.

Usually the first factor is not considered to belong to the agglomeration economies, because it is internal to a single company. In other words, other companies are not able to benefit from it. Territorial agglomerations exist at least partly because of these agglomeration economies, but we have to remember that companies and people do not always act rationally and maximise their profits or other benefits. Consequently there are plenty of reasons for the emergence and existence of certain agglomerations, historical reasons (cumulative development or "economic inertia"), coincidences and natural geography (cf. Krugman 1999), for instance.

In this paper, agglomeration refers to the spatial accumulation of economic activities of the same kind, more specifically the accumulation of companies belonging to the same branch or industry and immediate branches or industries. The concept of agglomeration does not necessarily refer to a territorial agglomeration, although external economies exist among companies located in a certain geographic locality or region. In this respect, the concept of territorial agglomeration should be used to

[1] Friedrich's (1929) translation of Weber's (1909) book *"Über den Standort der Industrien"* , titled *"Alfred Weber's Theory of Location of Industries"*.

emphasise the geographical nature of agglomeration economies. However, in the sense of geographical scales, it is used very flexibly, which could also be a problem from the point of view of empirical research. In the Finnish context it is relevant to focus on city-region-wide territorial agglomerations, which consist of a significant number of companies belonging to the same branch or immediate branches and which are of great importance from the point of view of the regional economy. Accordingly the concept of territorial agglomeration in this paper refers to relatively local economic activities.

Within big conurbations or city regions it is typical that the economic structure of the region is based on several territorial agglomerations, or key clusters, which can differ from each other drastically. Some territorial agglomerations may have sprung up because of a good supply of raw materials or energy (pulp and paper or sawmill industry), whereas some new knowledge-intensive agglomerations (e.g. digital media) may have sprung up because of accumulated knowledge and expertise (educational and research activities). Thus the agglomerations can be at different stages of development, which sets great challenges for regional or local economic development and innovation policy.

Three basic types of territorial agglomerations

As mentioned earlier, there are different types of agglomerations, differing from each other by the ways in which they have structurally been built or constituted. Gordon and McCann (2000) introduce a typology that recognises three types of agglomerations, which also include different types of externalities and require different types of policy measures and interventions (for another typology, see Markusen 1996). The basic types according to Gordon and McCann (2000) are the following (see also Kautonen et al. 2002): *1. The Model of Pure Agglomeration, 2. The Industrial-complex Model*, and *3. The Social-network Model.*

The Model of Pure Agglomeration is based on those agglomeration economies – external to all companies – which exist because of geographic proximity even in a competitive environment. These classical and most obvious reasons can be summarised as follows (cf. Krugman 1991, Gordon & McCann 2000, Arrow 1962, Porter 1990):

- *decreasing transaction costs* (e.g. transportation and communication costs)
- *specialised local labour force* (e.g. decreasing search costs and accumulation of human capital)
- *branch-specific resources and infrastructure* (e.g. specialised services and presence of demanding local customers)
- *maximal flow of information and ideas* (e.g. mobility of labour, knowledge spillovers, informal contacts between companies)

The pure, 'classical', agglomerations are 'atomistic' in nature and they are characterised by 'open membership'; investments in relationships are not needed. This means that this kind of agglomeration can emerge without requiring any conscious effort. The features of a pure agglomeration can be recognised in new branches, metropolitan areas and other cities producing high-order services (Gordon & McCann 2000). This model is very flexible but, at the same time, *fragmentation* is its problem from the point of view of innovation policy (Kautonen & Kolehmainen 2001). Fragmentation refers to a situation in which companies belonging to the same agglomeration would be able to gain synergy

benefits if they could recognise these benefits by having even some kind of mutual relationship, or if the strategies of the companies allowed the collaboration.

The Industrial-complex Model is based on the identifiable and stable relations among companies which are at least partly manifested in their spatial behaviour. The relations between companies are conceived primarily in terms of trading links. Thus the patterns of sales and purchases are crucial for the locational behaviour of the companies. The industrial complex is basically more stable than a pure agglomeration, because the relationships between companies require investments, which in turn are based on careful consideration and decision-making. In other words, spatial clustering takes place in this model because companies aim to minimise their observable spatial transaction costs (e.g. transportation and telecommunication costs) and have, implicitly or explicitly, determined that this is best achieved by locating close to other companies of the same refining chain or value chain. The industrial clusters are in many cases led by an engine company which exports the final products to international markets. The industrial complexes are typical in mature branches.

From the point of view of innovation policy, a *lock-in* is a potential problem in an industrial complex (Kautonen & Kolehmainen 2001). There are many definitions of *lock-ins,* but basically it refers to a situation in which the flexibility, the freedom of choice and the development opportunities of the whole complex or a separate company belonging it to have decreased (cf. Grabher 1993). The industrial complex is hierarchical in nature and it is typically based on asymmetric dependency relationships. These features can inhibit the diffusion of innovations and discourage companies locating low in hierarchy to make investments in R&D and marketing. Also the dominance of big engine companies can affect negatively the entrepreneurial atmosphere and opportunities of the whole agglomeration.

The Social-network Model emphasises the social embeddedness of economic activities and the role of institutions and networks. This model is based on the idea that trust-based and even informal interpersonal relationships are a powerful 'tool' in the economic respect. Interpersonal networks can replace pure market contracts or hierarchically organised relationships in the agglomeration's internal processes (see e.g. Harrison 1992). A local agglomeration is a natural context for the emergence of these kinds of relationships and social capital, because they are created and maintained through common social history and ongoing collective actions and 'joint ventures'. Still, it should be remembered that the social networks of companies are not necessarily formed at the regional or local level, although geographic and cultural proximity can facilitate the formation process.

Agglomerations and the concept of innovative milieu

The above-mentioned agglomeration typology is created mainly on the basis of the business structure and the nature of relationships between companies. In the Social-network Model the issue of individuals' mutual relationships and social networks are also highlighted. Still, the level of knowledge-intensiveness, the technological level or companies' innovation activities are not discussed very widely in this typology, although the knowledge spillovers are an important source of agglomeration economies in addition to labour market pooling and input sharing, for example (see Rosenthal & Strange 2001).

As was mentioned earlier, innovation is today seen as a 'circular' or 'recursive' process. Consequently versatile feedback mechanisms and interactive relationships involving producers (companies), product users, scientific and technical research, development activities and supporting infrastructure are of great importance (see e.g. Edquist 1996, Hämäläinen & Schienstock 2001). In this innovation model, different actors learn from each other in interactive innovation processes, in different kinds of arenas. Therefore both strong, explicit and inter-organisational innovation networks and weaker social linkages have become crucially important in research as well. From the point of view of knowledge typologies, the recursive innovation model emphasises tacit knowledge in addition to explicit knowledge (cf. Nonaka & Takeuchi 1995).

There has been some research into the geographic clustering of especially knowledge-intensive or high-technology activities, particularly the cases of Silicon Valley and Route 128 are very well-known internationally (see e.g. Saxenian 1994, Kenney 2000 and Lee et al. 2000). Recently this research theme has aroused increasing interest in Finland as well (see e.g. Schienstock et al. 1999, O'Gorman & Kautonen 2001, Autere 2000, Autio 2000, Linnamaa 2001, Männistö 2002 and Pelkonen 2002). Although many kinds of theoretical approaches are applied in the above-mentioned studies, they share at least one feature: innovations are seen to play a central role in the economic development of a city or a region.

An agglomeration is not necessarily an innovative environment for the companies within it. Certain structural features of an agglomeration and companies' collaborative or competitive relationships do not guarantee that the companies would search, adopt, mediate and create innovations effectively. In fact, territorial inter-organisational relationships of a certain kind, institutional setting and culture also inhibit the birth of innovations, or at least complicate the innovation activities and processes of the companies. Furthermore the positive synergy between different actors in an agglomeration can also be related to basic production or service activities, in which case the synergy is static. Therefore the innovation performance of an agglomeration can be low or moderate, even though the agglomeration consists of multiple actors and of very dense networks between them.

Consequently the agglomeration boosts its innovation activities only when the relationships among and between companies (collaborative and competitive) and between companies and other organisations are characterised by intensive innovation or mutual learning orientation. In that case, we can use the concept of innovative environment or milieu, which can simply be defined as an existing set of companies, institutions and social networks which creates a potential base for the emergence of localised innovation networks (cf. Cooke 1998, 2002; Camagni 1991). In other words, an innovative environment consists of weak, implicit ties among people, groups and organisations, which can be changed into strong, explicit innovation networks, when needed.

The innovative milieu is basically an economic concept, but it also emphasises the role of social relationships, trust and culture in innovation activities and economic growth in addition to the pure agglomeration economies. In the economic sense, the innovative milieu yields the following advantages to the companies (Camagni 1995, 319):

- *district economies* that promote a kind of 'industrial atmosphere' capable not only of reducing the cost disadvantage of small local firms in respect to large firms, but especially of helping them in their innovation process (*dynamic efficiency elements*).
- *proximity economies* that reduce 'transaction costs' and the 'use cost of the market' in general through easier information circulation, face-to-face contacts, and lower information gathering costs within the local economy information (*information elements*).
- *synergy elements* that enhance local innovation capability through imitation processes, interaction between local agents, private-public partnerships for infrastructure and service projects, interaction between the research centres and potential adopters of inventions and customer-supplier co-operation.

These economic advantages of innovative environments have two positive basic effects: 1. *reduction of the uncertainty elements in innovation processes* and *2. promotion of local or regional collective learning processes*. The uncertainty in innovation processes is reduced, for example, by collecting, screening and transcoding information efficiently and by controlling the competitors' moves. In large companies these tasks are usually performed by the R&D or strategic planning departments, but in the innovative milieu they are taken care of in a collective and socialised way, through fast local information circulation, imitation and co-operation processes. On the other hand, collective learning processes take place in innovative milieus because of the efficient transfer of tacit knowledge and know-how and immaterial assets among companies. The local labour market and the inter-personal networks are typical modes of the transfer of tacit knowledge and immaterial assets. (Camagni 1995, 319–320)

In addition to the intra-regional networks and dynamics, the role of linkages external to the region should be emphasised. Versatile linkages to different kinds of companies and other organisations funnel usually highly useful technological or other knowledge and know-how to the region or agglomeration. In the innovative milieu, external knowledge and know-how can be distributed effectively.

The concept of innovative milieu or environment is obviously very complex and multifaceted. Its versatile aspects are described in Kostiainen's (2002, 44) definition (see also Kostiainen 2000). He defines the innovative milieu as…

> *"... a whole of relations appearing in a certain geographical area with a high level of quality of life which has also networked beyond the area itself and which increases the unity of production systems, economic actors and industrial culture creating local collective learning and acting as a mechanism alleviating insecurity within the innovation process".* (cf. Camagni 1995, 320)

Kostiainen (2002) suggests that high-level quality of life is an important part of the innovative milieu, because innovative companies are dependent on skilful workers and experts who place a high premium on localities with high-level quality of life (cf. Raunio 2001). Consequently the 'clustering' of highly skilled labour assists the further development of innovativeness of these kinds of localities. The definition by Kostiainen (ibid.) is very comprehensive and it seems to be precise as well. However, his definition embodies many other concepts and it gives many 'tasks' or requirements to the innovative milieus (e.g. high-level quality of life, networking beyond the area itself, increasing the unity of production systems, economic actors and industrial culture, creating local collective learning and acting

as a mechanism alleviating insecurity within the innovation process). On the one hand, this complexity of the definition makes the empirical operationalisation of the concept very difficult; on the other hand, it describes very well the complexity of the "real world", where the ways in which a local operational environment can promote innovation are very intricate.

All companies are not alike

It should also be taken into account that not all companies have the same kind of relationship with the local operational environment, because each company follows its own strategy in this respect as well. Yet some general behaviour patterns can be found. For example, on the basis of their empirical study, Kautonen et al. (2002) argue that the firms referred to as KIBS firms and traditional, supplier-dominated manufacturers are tightly integrated into their regional environment by having locally or regionally located partners in their innovation networks[2]. These partners are usually either key customers, suppliers, partner companies or other organisations such as public business service providers. These types of companies are usually also the smallest ones. Scale-intensive and science-based firms and specialised suppliers are considerably less integrated to their regional operational or innovation environment, although they very often seem to have close co-operation with research laboratories or universities of their own region. Furthermore Kautonen et al. argue that KIBS firms have an important role in regional innovation environment, because they mostly have very close network-type relationships with their innovation partners and these are often located in the same region (cf. e.g. Muller & Zenker 2001). This notion makes the knowledge-intensive agglomerations even more interesting as reseach subjects.

McCann et al. (2002) discuss the location behaviour of multi-national enterprises (MNEs). One of their main conclusions is that the institutional logic of the cluster and the nature of the transactions which take place between companies within the cluster should be given careful consideration. For example, the local informal information and knowledge spillovers among individuals and companies may not be available or attainable for MNEs. Consequently the MNEs do not benefit from, or contribute to, this kind of spatial externalities. The reason is that MNEs' centralised organizational logic and behaviour hinder these kinds of information and knowledge transactions which are usually internalised and formalised. Consequently it might be sensible to give more autonomy to the local business units to make them able to engage more efficiently in informal local knowledge processes as well. Naturally MNEs are in most cases able to benefit from other agglomeration economies, such as the quality and availability of local labour and the low transaction costs involved in the acquiring and transmission of market and input supply information.

To sum up this discussion of companies' versatile relationships with the regional or local operational environment with respect to innovation activities, a good insight by Sternberg and Arndt (2001) should be introduced. They (ibid., 379) crystallise the relationship between companies' innovation performance and their regional environment as follows:

[2] Kautonen et al (2002) have divided firms into six categories: supplier-dominated firms, scale-intensive firms, specialised suppliers, science-based firms, technology-based knowledge-intensive services (KIBS) and other KIBS ("management KIBS"). This typology is based partly on Pavitt's classic taxonomy of innovating firms (see. e.g. Pavitt 1984; 1990 and Tidd et al. 1997).

"Of course, a firm without considerable innovation potential cannot generate notable innovations, even if the innovation conditions in the region where it is located are very favorable (...) However, the regional environment can help firms to realize their existing, but sometimes unexploited, innovation potential."

This formulation does not exaggerate the role of the local or regional operational environment, as some theoretical concepts might do. The concept of innovation potential can be accompanied by the concept of innovation capability. Companies have to have certain capabilities to be able to benefit from the resources offered by the local innovation environment (e.g. information, knowledge, technology and competences of other companies, universities and research institutes; R&D and other finance, new trends in demand). It can be claimed that some agglomeration economies are available for all companies, but the full utilisation of the benefits, especially innovation-related benefits, of territorial agglomeration – the local innovation environment – requires capabilities and active measures also from companies.

Three levels of the local innovation environment

When analysing a certain region, locality or territorial agglomeration, it might be useful to prefer the concept of innovation environment to the concept of innovative milieu, because the former does not have the same normative flavour as the latter. Namely, the local innovation environment can be either good or bad or it may make no difference at all. In any case, the concept of innovative milieu points out many relevant factors and elements of a local operational environment or an agglomeration which contributes positively to companies' innovation activities and processes, if they are able to take advantage of those local features. I preliminarily argue that these factors and elements should be analysed at three different levels: *1. the structural and institutional level, 2. the level of organisational relationships* and *3. the level of individuals.* Each level has certain characteristics and dynamics that are necessary to make a local innovation environment (e.g. an industrial agglomeration) innovative. I discuss all three levels only briefly, with emphasis on the structural and institutional level.

The structural and institutional level. As the typology of industrial agglomerations shows, the basic business and institutional structure of the agglomeration has a significant influence on the dynamics of an agglomeration. This holds true also from the point of view of innovation activities. Therefore, when analysing a local innovation environment, attention should be drawn at least to the following factors and elements: the number and nature of companies and business units, educational institutions, science and technology base (e.g. universities, research institutes and private R&D units), specialised private, semi-public and public business services (e.g. financing, consultancy, technology transfer and incubation services) and interest groups (e.g. trade and entrepreneurial associations, chambers of commerce), local authorities. When considering the institutional setting, the concepts of local *institutional density* and *institutional thickness* become very interesting. These concepts refer to the local presence of numerous different institutions collaborating synergetically to attain a somewhat common goal, guided by partly shared norms, values and understanding (cf. Amin & Thrift 1996).

For example, Kolehmainen et al. (2003) argue that the educational and research institutions can have a very crucial role in the creation and further development of a good local innovation environment,

especially in knowledge-intensive "technopoleis" (cf. Gibson & Stiles 2000). Kosonen (2002) makes the same notion when discussing the concepts of innovation and institutional capacity in the context of less favoured regions. The importance of educational and research institutions, especially universities, has increased because of many different reasons. For example, there is a development trend which erodes the traditional institutional boundaries between the industry, government and (higher) education and research institutions. In the research and development activities, multifaceted inter-organisational networks and hybrid organisations involving researchers and experts from science, governmental and business sectors come to the core. In this respect, the notions of "Triple-Helixes" (see Etzkowitz & Leydesdorff 1997) and a "new mode of knowledge production" (see Gibbons et al. 1994) have become very popular.

Despite their growing economic significance, the educational and research institutions' direct contribution to the companies' innovation activities should not be exaggerated (see e.g. Revilla Diez 2000). Consequently Kolehmainen et al. (2003) deal with the role of educational and research institutions in their location regions from a broader standpoint. They suggest that these institutions can have at least three different roles: *1. the anchor, 2. the dynamo,* and *3. the magnet.* An educational or research institution has the *anchor role* if it is able to tie up the (key) companies in the region by creating versatile and intensive collaboration relationships (e.g. joined research projects, educational planning) with them. Respectively the institution has the *generator role* if its activities generate new businesses by commercialising the results of basic or applied research (e.g. spin-off companies and joint ventures). Pioneering educational activities can also significantly stimulate the entrepreneurial activities. To fully utilise the generating potentiality of educational or research institutions, the entrepreneurship-supporting services and mechanisms (e.g. incubation services, finance, consultancy in intellectual property rights) should be available and of high quality. The *magnet role* of an educational or research institution refers to situations in which the institution is able to attract external (foreign) investments into the region because it has unique or otherwise special research and educational activities. The magnet role can be supported regionally by taking care of the issues considered in the typical investment decision-making processes (e.g. supply of business services and suitable premises, subsidies). (Kolehmainen et al. 2003).

The level of organisational relationships. A city or an agglomeration does not innovate by itself, but it can support the innovation activities of organisations. The structural and institutional setting of a local innovation environment forms one possible basis for these activities which are increasingly inter-organisational and network-based in nature. The innovation networks of companies or their innovation-related collaboration are not necessarily (and should not be) localised, because companies seek, or at least should seek, the most suitable partners in co-operation. However, it can be argued that geographical and cultural proximity may facilitate the interaction in these networks and relationships. Consequently, when analysing the local innovation environment from the point of view of companies, attention should be drawn to the presence of demanding customers, advanced suppliers and subcontractors, technology and other partner companies and universities and research institutions, for example. Naturally the local presence of these kinds of organisations is not enough, because their nature (e.g. the level of know-how, ability to co-operate and resources) determines whether or not there are possibilities for mutually synergetic co-operation. In addition to the co-operative local inter-

organisational relationships, the local competition between different organisations, mainly between companies, can stimulate the innovation activities.

The level of individuals. Inter-organisational relationships can to some extent be reduced to relationships among individuals working in organisations. This notion sets up the argument that the role of individual people is very remarkable in local innovation environments. The social nature of inter-organisational relationships is only one dimension of the role of individuals, because skilled workers and experts usually have extensive, work-related personal networks which facilitate the seeking of rare, reliable, or in other ways valuable information and knowledge, for example. Naturally the economic importance of intra-organisational and inter-organisational social relationships and networks has been noted a long time ago and various concepts are applied in those analyses. For example, the notions of "weak and strong ties" (see Granovetter 1973), "(social) embeddedness", (see Granovetter 1985, Oinas 1998),"social capital" (see Putnam 1993, Nahapiet & Ghoshal 1998) and "communities of practice" (see Wenger 1998; 2000) have become very popular. These concepts are very interesting, but they require further elaboration, especially from the regional and local perspective.

It can be argued that these inter-personal networks and relationships – from the point of view of innovation activities, 'information and knowledge channels' - enhance not only individual, but also organisational learning and innovation. Therefore it is important also to understand the linkages between individual and collective or organisational learning and knowledge creation processes. From the spatial point of view, it can be argued that proximity does matter in the formation and utilisation of these individual contacts despite the advanced information, communication and transportation facilities. However, from the point of view of individuals, the local innovation environment cannot be reduced to only a 'platform' for localised social networks and relationships. There are also other dimensions. For example, for the individuals, the local innovation environment should also be 'a creative problem-solving environment', which is a concept that refers to the presence of diverse and high-quality career and further education opportunities (cf. Raunio 2001), for example.

In the next chapter the case of a digital media agglomeration in Tampere[3] is used as an empirical illustration for the structural and institutional elements of a local innovation environment. The other levels of the local innovation environment are not discussed empirically in this article.

Case: A Digital Media Agglomeration in Tampere

Basic description of the agglomeration

Founded in 1779, Tampere is Finland's third largest city with its approximately 200,000 inhabitants. The population within the Central Tampere Region totals approximately 300,000. Tampere has a long industrial history, and it can even be claimed that the industrialization of Finland got under way in Tampere. The main industrial forces of Tampere were the cotton mills and paper factories. Later on

[3] The digital media agglomeration in Tampere includes those actors that *1) produce digital or digitality-related products and services; 2) produce products and services whose production process is based on digital technology; 3) produce and disseminate digitality-based technology, knowledge and competencies (e.g..educational and research institutes);* and/or *4) in some other way promote digitality-related business, entrepreneurship, research, educational or civic activities.*

this industrial base expanded to include the textile industry, mechanical engineering, food-processing and chemical industries. The smoke-stack industries formed the basis of the economic development until the 1990s, when Finland was hit by a very deep recession. This recession was a turning point in the development of the industrial structure. The strategy of Tampere has been to modernise traditional industries and to develop new high-tech industries. Today, the city promotes a diverse and controlled cluster-based specialisation, especially in the fields of ICT, health and biotechnology, mechanical engineering and automation, media and communication, and expertise-intensive business services. Companies belonging to these clusters are supported by universities, research institutes, technology centres, and other public and semi-public support organisations. (Schienstock et al., forthcoming; see also Kostiainen & Sotarauta 2002).

The roots of the digital media agglomeration in Tampere go far back in history. In the early 1990s there was only a clutch of separate companies in various branches that were loosely related to each other. After that the agglomeration grew very rapidly and reached its current form in the late 1990s. Also, many new business activities and companies emerged. For example, the "Internet revolution" in the mid-1990s generated the new media business which has thereafter transformed drastically. It has even been claimed that there is no longer such a thing as new media. However, different digital-media-related branches have been growing rapidly and they have gradually come closer to each other – converged – forming an agglomeration, which is still quite loose and multifaceted.

In the year 1996 the agglomeration consisted of approximately 170 companies and business units with a total of 5,200 employees, with a total turnover of about 770 million euro. In the year 2000 the total turnover had doubled, amounting to 1.5 billion euro. The number of employees in private companies has also increased rapidly. For example, it grew from 3,000 to 6,800 between 1994 and 1997, which means that the growth rate was approximately 125 percent (*Tampereen osaamiskeskusohjelma 1999-2006* 1998). By the year 2000, the digital media agglomeration employed 10,000 people. (O'Gorman & Kautonen 2001). If the agglomeration is defined in broader terms (including, e.g., all mass media and ICT wholesale and retail), the number of employees amounts to about 15,500. The rapid development of the agglomeration results partly from the natural, rapid development of the digital media sector. On the other hand, digital media has been one of the most important focus areas of local (business) development and innovation policy in Tampere Region. Therefore several visionary and resolute local collective actions have been taken by both private and public actors – often together – towards facilitating and strengthening the agglomeration and especially its institutional setting and knowledge base. Figure 1 describes the basic institutional and structural setting of the digital media agglomeration in Tampere.

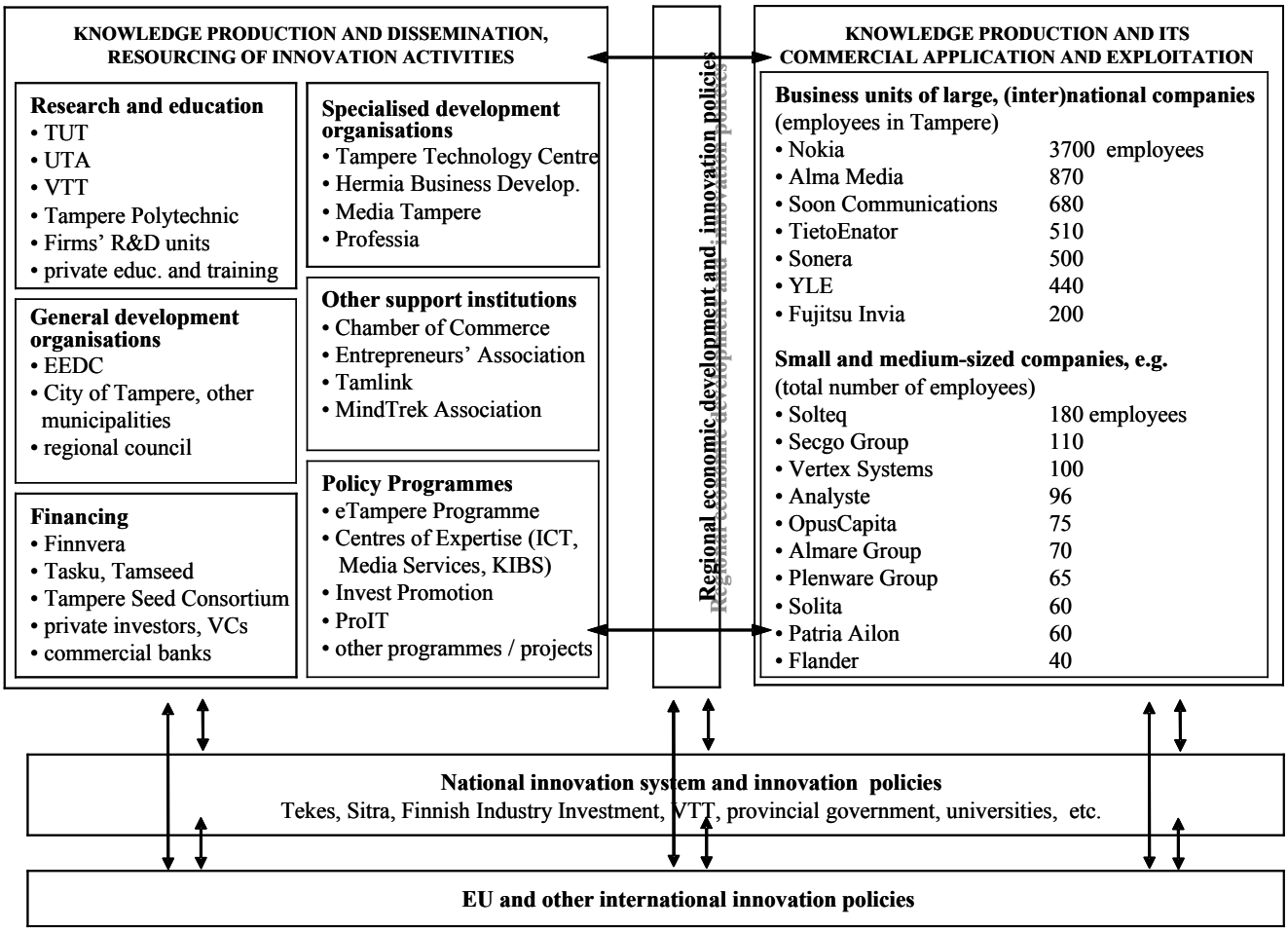

Figure 1. The basic institutional and structural setting of the digital media agglomeration in Tampere. Source: adapted and augmented from Kautonen et al. (2002, 159)

In the following chapters some structural and institutional features of the agglomeration and policy activities related to it are considered in greater detail. Attention is drawn especially to the science and technology base and to the role of local specialised development organisations.

Business structure and its nature

The business structure of the agglomeration is very diverse and dominated by the business units of large, international ICT companies, such as Nokia, Elisa Communications, TietoEnator, Sonera, and Fujitsu Invia. For example, Nokia Corporation has located business units of all its main divisions (Nokia Networks, Nokia Mobile Phones and Nokia Research Center) in Tampere. These units employ approximately 3,700 people. The agglomeration is oriented towards research and development, which concerns also the above-mentioned business units of large companies. On the one hand, this orientation is favourable, because R&D is a more stable business function than sales, marketing and production, for example. On the other hand, it would be beneficial to the development of the agglomeration if Tampere also had more "headquarters functions" with close connections to international markets, investors, etc.

It can be claimed that the remarkable role of large companies in the agglomeration has negative side effects as well. The agglomeration has one major weakness, namely a debilitated entrepreneurial atmosphere, which is in turn linked to the paucity of (new) companies aiming at fast growth and internationalisation (cf. Autere 2000). Naturally, there are many small companies competing among themselves and also some advanced growth companies, but they are few in number, especially regarding the strong science and technology base of the agglomeration. This feature was striking especially at the end of the 1990s, when the ultimate 'IT hype' occurred in Finland and many new companies with reckless objectives were founded. On the other hand, Tampere has survived quite well in the 'IT recession' of the beginning of the twenty-first century: large-scale bankruptcies, lay-offs or denouncements have not been seen, although there have been some rearrangements and only a few growth companies have faced serious problems. It can be argued that the companies' cautious strategies are one reason for this fairly good success in a very difficult demand situation.

Science and technology base and the educational institutions[4]

The strong science and technology base and the educational institutions are among the major strengths of the digital media agglomeration in Tampere. The most important institutions in this respect are the Tampere University of Technology, the University of Tampere, Tampere Polytechnic, and VTT Technical Research Centre of Finland.

Tampere University of Technology (TUT) has a central role in the digital media agglomeration. It has traditionally had very close relationships with local commercial and especially industrial activities, as well as with other institutions financing technological research. It is therefore natural that almost half of TUT's budget consists of external finance (in 2001, 45.3%). TUT and local companies collaborate in educational and research activities alike. Additionally, new forms of collaboration have been developed: part-time professorships for experts and managers working in companies are examples of these.

When considering TUT's collaboration with companies, the role of Nokia Corporation cannot be ignored. Many departments and institutes of Tampere University of Technology have close linkages with diverse of units of Nokia. Typical forms of collaboration have been commissioning and joint research projects, providing positions for trainees as well as for undergraduates writing their theses, collaboration in the planning of basic, post-graduate and supplementary education, consultancy, inter-organisational job rotation, joint seminars, etc. These forms of collaboration are not recently developed; they have existed for several years (see e.g. Haavisto 1996). The collaboration between Nokia and educational and research institutions, especially TUT, is of great importance in relation to the development of the whole agglomeration: this good state of collaboration is one reason for Nokia's strategy to locate a considerable number of its R&D activities in Tampere.

ICT-related education and research began to strengthen in the 1980s when computer science became a major subject in TUT. Since then, the scale of information, communication and electro-technical

[4]Updated details have been checked on the websites of organisations in question. The list of the relevant websites can be found below the bibliography.

education and research have grown very rapidly. For example, the number of degrees completed at the Department of Information Technology per year has roughly been decupled since the year 1990. Especially in the mid-1990s there was a dramatic increase. In addition to diverse basic-degree and post-graduate education, TUT also offers in-service training and supplementary education. The Centre for Continuing Education (Edutech) is in this sense a central organisation, although institutes also arrange these courses by themselves. For example, the "project manager course" has been arranged by the Institute of Software Systems for ten years now and approximately 400 experts from companies and other organisations have attended it. Thus it has been an interesting forum for local networking in addition to its educational substance.

A major part of digital-media-related research work in TUT is done in the Digital Media Institute (DMI). Another very important unit in this respect is the Optoelectronics Research Centre (ORC). DMI is a matrix organization consisting of the institutes of TUT. Thus the research of certain institutes is done under DMI, but teaching is conducted traditionally. This kind of organisational solution brings together research and education, on the one hand, and critical mass and better public visibility and accessibility of research on the other. DMI employs more than 400 researchers and research assistants. It co-ordinates Technology Engine Programmes, which constitute a subprogramme of the eTampere Programme[5]. The aim of these programmes is to strengthen the ICT-related research in Tampere and to produce new, commercialiseable knowledge in various projects. DMI operates almost totally on external public and private funding and about one third of its budget comes directly from private companies.

The Optoelectronics Research Centre illustrates interestingly the roles that the university institute can have in an agglomeration. Optoelectronics is an upward scientific sector, which also has a lot of commercial potential. About 75 percent of ORC's finance comes from external sources. For instance, the City of Tampere finances ORC directly and the financial instruments of the EU are also used (ERDF, Objective 2). These investments in optoelectronics research are very well justifiable from the point of view of the local economic development policy: ORC and its precursors have generated a couple of succeeding spin-offs and attracted foreign investments in Tampere (e.g. Memscap S.A.).

The University of Tampere (UTA) has its roots in social sciences, but today it is a diversified university with approximately 11,900 first-degree students and 1,600 post-graduate students. Despite its emphasis on social sciences, UTA has long traditions in computer science and other digital-media-related fields of education and research as well. UTA started teaching activities in computer science in 1965, first ever in Nordic countries. Earlier the ICT and digital-media-related activities (e.g. computer science, information science, hypermedia) were dispersed in several faculties, but these were brought together under a new faculty, the Faculty of Information Sciences. The reshaping of the faculty structure

[5] eTampere Programme is a five-year development project with a total budget of 130 million euro and it aims to provide an extensive and possibly the first local application for the EU-based eEurope Programme. The general objective of eTampere is to make Tampere a global leader in the research, development and application of issues related to the information society. To achieve this very bold goal, the programme focuses on three themes: 1) public online services will be developed and made available to all residents, 2) the knowledge base of research and training will be strengthened and 3) new business related to the information society will be generated. There are seven subprogrammes in this programme (co-ordinator / background organisation in parenthesis): *1. Information Society Institute (UTA), 2. eBusiness Research Center (TUT & UTA), 3. Research and Evaluation Laboratory RELab (VTT), 4. the eAccelerator (Hermia Business Development Ltd.), 5. Technology Engine Programmes (TUT / DMI), 6. Infocity (City of Tampere),* and *7. eTampere Office (Media Tampere Ltd.)*

increases natural possibilities for synergetic action between different disciplines and makes them more 'visible' from the point of view of business life.

The Faculty of Information Sciences is an important unit in the agglomeration in terms of education and research. For example, there are nearly 90 employees in the Department of Computer and Information Sciences. The human-computer interaction is a very important area of research and there is even a separate Tampere Unit for Computer-Human Interaction (TAUCHI) and Usability Laboratory in the department for this purpose. The Usability Laboratory offers usability testing and evaluation services and training and consultancy related to usability matters. At the Department of Information Studies, for example, themes like information retrieval, seeking and management are researched. In addition to basic research activities, the department also offers research services in its main fields of competence. The Hypermedia Laboratory also belongs to the Faculty of Information Sciences and it has grown significantly in the past few years, employing currently over 50 experts. The Hypermedia Laboratory realises its research and development projects mainly in close collaboration with companies and other institutions. The main research themes of the laboratory are related to adaptive systems and contents, experience design, knowledge-creating systems (e.g. knowledge management tools) and learning (e.g. mobile learning and edutainment).

The second corner stone of digital-media-related activities in UTA is the communication(s) theory and mass media. It has always been a very strong area in teaching and research within the university and in the past few years, the issues of new media (e.g. audiovisual media culture and education) have aroused great interest. Many researchers within social sciences and humanities have also become interested in issues related to digital media. From this perspective, the Information Society Institute (ISI) is a central organisation. ISI is a subprogramme of the eTampere Programme and its main task is to promote research on the information society in UTA and TUT. ISI has been founded by UTA and TUT together, even though UTA bears the operational responsibility. Like ISI, eBusiness Research Center (eBRC) is a subprogramme of the eTampere Programme and a joint venture of UTA and TUT. The aim of eBRC is to study different kinds of phenomena related to the electronic business activities in co-operation with the businesses themselves.

Tampere Polytechnic completes the operations of the two universities in Tampere. Tampere Polytechnic has a total of 17 training programmes in the fields of engineering and transportation, business, culture and natural resources (forestry). Its diversified teaching activities support in many ways the development of a digital media agglomeration, although it is smaller than the two universities. Tampere Polytechnic has about 4,000 students and 250 teachers as well as three independent schools: the Business School, the School of Technology and Forestry, and the School of Art and Media. All of these schools carry out activities that are somehow connected to digital media. The School of Technology and Forestry also produces engineers in the field of ICT and the Business School bachelors of business administration majoring in data processing (e.g. hypermedia and software business). Tampere Polytechnic also has a Teacher Education Center. The School of Art and Media was established in 1991; in 1996 it was affiliated to Tampere Polytechnic. The School of Art and Media has a very unique profile which combines art and communications, as well as the use of 'old' and 'new' technologies. It has also strong collaboration relationships to the (local) media businesses: working life contacts are a crucial part of its education.

From the viewpoint of research, the units of *VTT Technical Research Centre of Finland* located in Tampere are important institutions in the digital media agglomeration. VTT provides technology and applied research services for private companies and other organisations. VTT Information Technology has recently made an effort to develop local collaboration, and a large number of its projects are conducted with local or regional partners. Its main customers are mobile phone manufacturers, teleoperators and small software companies. VTT Industrial Systems also has ICT-related activities in Tampere. For example, wireless data transmission technologies (e.g. WLAN), location technologies are researched. This unit is also responsible for the Research & Evaluation Laboratory (RELab), which is one of the subprogrammes of the eTampere Programme.

The key research and educational institutions of the digital media agglomeration in Tampere and their major competence fields are summarised in Table 1.

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

Organisation	Examples of competence fields
Tampere University of Technology • basic and applied research • education • commercial services	• Digital and computer systems • Electronics • Software systems • Optoelectronics • Signal processing • Communications Engineering • Virtual reality
University of Tampere • basic and applied research • education • commercial services	• Computer science (e.g.human-computer interaction) • Information studies (e.g. information retrieval and management) • Hypermedia • Journalism and mass communication • Research on information society
Tampere Polytechnic • education • development projects • commercial services	• Data-processing (e.g. hypermedia and software business) • Computer and software technology • Communications (e.g. interacting media)
VTT Technical Research Centre of Finland (units located in Tampere) • basic and applied research • commercial services	• Human interaction technologies and human-centred design • Wireless solutions • Integrated systems • Wellness Applications

Specialised development organisations and economic development policy[6]

As mentioned earlier, digital media has been one of the key areas of local business development and innovation policy in Tampere. One of the main aims of policy actions has been to build a specialised business and innovation support organisation infrastructure. In this chapter, the key organisations in this respect are introduced. Although the basic technological knowledge and other competences of the

[6] Updated details have been checked on the websites of organisations in question. The list of the relevant websites can be found below the bibliography.

agglomeration lie in companies, universities, research institutes and educational institutions, competent business support, development and intermediation organisations can harness these competences to better use and even participate in the process of creating new regional competences. When considering a certain agglomeration, the role of a specialised development organisation is emphasised, although a general development organisation (e.g. Employment and Economic Development Centres, the Business Development Centre of a city) can play an important role as an incidental opinion leader, financier, or strategist[7]. However, this part covers only the most important specialised development organisations of the digital media agglomeration in Tampere: Tampere Technology Centre Ltd, Hermia Business Development Ltd, Media Tampere Ltd, and Professia Ltd.

Tampere Technology Centre Ltd was established in 1990. In the beginning its main aim was to develop the Technology Centre Hermia, which had been founded four years earlier. Later on, the tasks of promoting the development of high-tech companies and implementing the Regional Centre of Expertise Programme[8] also became significant. The first of the above-mentioned tasks includes producing, commercialising and developing services (e.g. licensing and business plan evaluation) for existing high-tech companies and beginning companies alike. This very task is carried out by Hermia Business Development Ltd, which is now, after recent ownership arrangements, a privately-publicly owned business development company. This kind of private-public partnership is a relatively new phenomenon in regional development policy. Hermia Business Development Ltd is also responsible for the operations of eAccelerator, which is a subprogramme of the eTampere Programme. The aim of the eAccelerator concept is to launch 20 companies onto a very rapid growth track by coaching the chosen companies, matching them with suitable partners (financiers, customers etc.) and offering pre-seed finance.

The second task, namely the implementation of the Regional Centre of Expertise Programme, is carried out by the Technology and Expertise Unit of Tampere Technology Centre Ltd. There are four official Centres of Expertise in Tampere, and Tampere Technology Centre is responsible for two of them (mechanical engineering and automation and information and communication technology). In practice this responsibility includes building co-operation networks and co-ordinating different kinds of education, research and technology initiatives, projects and programmes which are generated on the basis of companies' needs. The Tampere Region Centre of Expertise Programme does not have a very large financial base, but it is still an important forum for local collaboration. It also enhances and builds up the image of the region's expertise and competences.

[7] Sotarauta (2000, 131) divides development organisations into general development organisations and specialised development organisations. General development organisations are responsible for the development of a whole region, whereas the task of specialised development organisations is to develope a certain branch or certain function of regional development.

[8] The Tampere Region Centre of Expertise Programme is a part of the national Centre of Expertise Programme co-ordinated by the Ministy of the Interior. The basic idea of this programme is to enhance the collaboration among companies and between companies and research and educational institutions in order to stimulate and develop high-profile business activities. Tampere has four officially and nationally recognized Centres of Expertise: Mechanical Engineering and Automation, Information and Communication Technology, Health Care Technology and Media Services. Besides the seed finance by the ministry, the programme is financed by National Technology Agency TEKES, the Council of Tampere Region, the City of Tampere and nine of its neighbouring municipalities.

Tampere Technology Centre Ltd and Hermia Business Development Ltd attend to the development of high-tech companies, including ICT companies (e.g. software companies and component manufacturers). The other major part of the digital media branch consists of companies whose competences are related to digital contents and communication (e.g. computer games, web services and web-based marketing). Media Tampere Ltd is specialised in developing digital media companies of this kind in Tampere[9]. Media Tampere Ltd is owned by Alma Media, Fujitsu Invia, Nokia, the City of Tampere, Soon Communications and the University of Tampere. In practice, the development of digital media locally means establishing different kinds of development projects and facilitating co-operation between companies, educational and research institutions, financiers and other relevant organisations. These general networking and developing tasks are very much manifested in the implementation of the Centre of Expertise for Media Services, for which Media Tampere Ltd is responsible. Media Tampere Ltd also has its own R&D projects which are linked mainly to (public) web and mobile services. In addition to these activities, Media Tampere Ltd. also offers business incubation services for new companies and people aiming at establishing new businesses. These services are located in Media Club Incubator, which is financed by Tampere Polytechnic, the City of Tampere and the Employment and Economic Development Centre of Tampere Region (EEDC).

Professia Ltd is a 'newcomer' in the support organisation infrastructure in Tampere. It was founded in 2000 and its focus lies on developing knowledge-intensive business service (KIBS) companies. Professia is owned equally by the City of Tampere, Tampere University Foundation, Finnvera plc. and Tampere Region Growth Foundation. Professia Ltd provides various kinds of consultancy services to beginning and already established KIBS companies, on the one hand, and to researchers and other personnel in universities and other institutions of higher education in Tampere on the other. This second task aims at advancing knowledge transfer from universities to companies and other organizations and the commercialisation of knowledge and expertise produced in research activities. Professia also offers typical incubation services for new companies within its thematic focus. In addition to these more specific services, Professia Ltd carries responsibility for the co-ordination of the Centre of Expertise for Knowledge-Intensive Business Services, which does not have the national status of the Centre of Excellence or status-related finance from the Ministry of the Interior. Still, this centre is financed locally, because the development of the KIBS branch has been considered to be important. The key specialised development organisations of the digital media agglomeration in Tampere and their major functions and services are summarised in Table 2.

Table 2.The key specialised development organisations and some examples of their functions and services

Organisation	Examples of functions and services
Tampere Technology Centre Ltd	• Provision of premises • Co-ordination of Centre of Expertise (Information and Communication Technology
Hermia Business Development Ltd	• Commercialisation of product and business ideas • Development of technology-based firms • Incubator

[9] The Ministry of Education has contracted out an interesting mapping on the current situation of content production and Tampere was dealt with very visibly and positively in this report (see Pennanen 2002).

	• eAccelerator (a part of the eTampere Programme)
Media Tampere Ltd	• Product development (web services) • Consultancy and project management • Development of media and new media firms • Incubator (Media Club) • Co-ordination of Centre of Expertise (Media Services)
Professia Ltd	• Development of KIBS firms • Incubator • Co-ordination of Centre of Expertise (Expert Services)

Concluding remarks

Economic activities seem to have a tendency to cluster in certain regions or localities because of different kinds of agglomeration economies. Consequently the territorial (industrial) agglomerations and their (internal) dynamics have aroused interest among researchers for a long time. It should first be noted that there are many kinds of agglomerations. For example, they differ from each in the ways in which they have structurally been built or constituted. Some agglomerations are atomistic or competitive in nature, whereas some are based on more stable, local sales and purchase relations or social networks. It follows then that the basic structure of an agglomeration has a great influence on its internal dynamics.

On the other hand, the great economic importance of innovations and learning has been recognised widely. Companies are naturally in primary roles in innovation processes that are very often recursive and interactive in nature, which accentuates the role of companies' customers, suppliers, subcontractors, partner companies, financiers, research institutes, semi-public and public development organisations, etc. Therefore both explicit, inter-organisational innovation networks and weaker innovation-related social linkages have gained more strategic importance. The localisation of these innovation networks and social linkages augment the positive effect of 'pure' agglomeration economies, thus facilitating the flows of knowledge and innovation. However, these notions together invite us to further elaborate the role of territorial agglomerations in boosting the local innovation performance.

It is often claimed axiomatically that agglomerations boost the companies' innovation activities. It would be more accurate to state that a territorial agglomeration can be a basis for the development of a good local innovation environment. Consequently the agglomeration does not automatically and directly enhance the innovation activities of companies within it. The agglomeration may make no difference at all, or it may even inhibit innovation. There are many theoretical concepts that describe companies' local operational environments, even from the point of view of innovation activities. What can be learned from these models is that the ways in which local operational environment can promote innovation are very complex and intricate. To bring some clarity to this issue, the concept of local innovation environment was introduced. It is argued that a local innovation environment consists of many interrelated elements ranging from the institutional setting to the behaviour of individuals. It is also argued that the local innovation environment can be divided into three levels: *1. the structural and institutional level, 2. the level of organisational relationships* and *3. the level of individuals.* There are certain characteristics in each of these levels that are necessary for the local innovation environment to really set the scene for the innovation activities companies.

The case of a digital media agglomeration in Tampere was used as an empirical illustration for especially the structural and institutional elements of a local innovation environment. The roots of the agglomeration go quite far back in history, but it grew very rapidly and reached its current form only in the 1990s. The empirical case underlines the complexity of the 'real world'. It cannot be said that the digital media agglomeration in Tampere is a 'pure', classical agglomeration, an industrial complex, or based only on social networks. The agglomeration/It has certain features of every model: it is dominated by business units of large, externally owned companies. These business units have also

many stable local sales and especially purchasing relationships. For example, many small software companies have one or several of these large companies as their key customers. In many cases, there is a clear asymmetric dependency between large and small companies. Furthermore, among major weaknesses of the agglomeration are the weak entrepreneurial atmosphere and the paucity of (new) companies with high goals. These features of the agglomeration are quite similar to the ideas presented in the industrial-complex model.

On the other hand, there are also features of the model of pure agglomeration. Many small software and new media companies compete with each other in both local and national markets. These companies can still benefit from the territory-specific agglomeration economies, such as the supply of specialised services and a pool of skilled labour force. The versatile set of educational institutions of the agglomeration has guaranteed the availability of skilled applicants for the companies during the stage of rapid growth of the digital media sector as a whole as well. The empirical case also implied that several local collective actions have been taken by both private and public actors, often together, towards facilitating and strengthening the knowledge base and institutional setting, common for a number of companies. These actions indicate that many companies, or at least certain decision makers in those companies, have acknowledged the possibilities to intentionally build their local environment to match their needs for complementary and untraded assets. It should also be noted that the role of the City of Tampere and other public actors has also been crucial in the creation of the institutional setting of the agglomeration. Many of the above-mentioned collective actions have also been facilitated by versatile and close social relationships among the individuals in key positions in the agglomeration. Especially with respect to local business development and innovation policy activities, the role of local social networks is very significant. These notions connect the digital media agglomeration in Tampere also to the social-network model.

The case of digital media agglomeration in Tampere accentuates also the importance of the institutional setting of the agglomeration and public policy measures. These factors augment the role of 'pure' external economies of an agglomeration in the emergence and further development of a stimulative local innovation environment. It can be claimed that universities and other educational institutions have played a very crucial role in the digital media agglomeration. Consequently the versatile set of educational institutions and very strong science and technology base are also among the main strengths of the agglomeration. Also, the innovation support infrastructure, and especially the set of specialised development organisations, seems to be quite extensive and solid.

Generally speaking, the institutional setting of the digital media agglomeration in Tampere is quite strong. From the policy perspective it is therefore natural that the recent public actions aiming to enhance the local innovation environment are based more often on the existing institutional basis; the idea is to make good use of it to gain substantial benefits for the companies, other organisations and the inhabitants of Tampere. The eTampere Programme is a good example of this kind of policy activities. This notion also highlights the theoretical conclusion that certain structures, institutional settings or policy activities alone cannot guarantee the innovativeness and innovation performance of a territorial agglomeration which result from the innovativeness and innovation performance of companies and individuals belonging to the agglomeration. In the future the role of local inter-organisational and inter-

personal social networks and individual people's conditions for work and personal development should therefore be paid great attention when analysing and developing the local innovation environment.

References

AMIN, A. & THRIFT, N. 1996. Living in the Global. In Amin, A. & Thrift, N. (eds) Globalization, Institutions, and Regional Development in Europe. Oxford University Press. New York.

ARROW, K. 1962. The Economic Implications of Learning by Doing. *Review of Economic Studies*, Vol. 29. 153 – 173.

AUTERE, J. 2000. Ohjelmistotuoteyritysten kasvuhakuisuus Helsingin, Oulun ja Tampereen seuduilla. In Kostiainen, J. & Sotarauta, M. (eds). *Kaupungit innovatiivisina toimintaympäristöinä*. Tekniikan akateemisten liitto TEK ry. Helsinki.

AUTIO, E. 2000. Alue, yrittäjyys ja talouskasvu: Vertailu Sophia Antipoliksen ja Espoon Otaniemen välillä. In Kostiainen, J. & Sotarauta, M. (eds). *Kaupungit innovatiivisina toimintaympäristöinä*. Tekniikan akateemisten liitto TEK ry. Helsinki.

BRACZYK, H-J., COOKE, P. & HEIDENREICH, M. (eds). 1998. *Regional Innovation Systems: The Role of Governance in Globalized World*. UCL Press. London.

CAMAGNI, R. 1991. (ed.) *Innovation networks: Spatial perspectives.* Belhaven Press. London – New York.

CAMAGNI, R. 1995. The Concept of Innovative Milieu and its Relevance for Public Policies in European Lagging Regions. *Papers in Regional Science*, The Journal of the RSAI 74, 4. 317–340.

COOKE, P. 1998. Introduction. Origins of the Concept. In Braczyk, H.-J., Cooke, P. & Heidenreich, M. (eds). *Regional Innovation Systems*. UCL Press. London.

COOKE, P. & SCHIENSTOCK, G. 2000. Structural Competitiveness and Learning Regions. *Enterprise and Innovation Management Studies,* Vol. 1, No. 3. 265–280.

COOKE, P. 2002. *Knowledge Economies: Clusters, learning and co-operative advantage*. Routledge. London – New York.

COSSENTINO, F., PYKE, F. & SENGENBERGER, W. (eds). 1996. *Local and regional response to global pressure: The case of Italy and its industrial districts*. International Institute for Labour Studies, Research Series 103. Geneva.

ETZKOWITZ, H & LEYDESDORFF, L. (eds) 1997. *Universities and the Global Knowledge Economy. A Triple-Helix of University-Industry-Government relations.* Pinter. London – Washington.

GIBBONS, M., LIMOGES, C., NOWOTNY, H., SCHWARTZMA, S., SCOTT, P & TROW, M. 1994. *The New Production of Knowledge. The Dynamics of Science and Research in Contemporary Societies.* Sage Publications. London.

GIBSON, D.V. & STILES, C.E. 2000. Technopoleis, Technology Transfer, and Globally Networked Entrepreneurship. In Conceicao, P., Gibson, D., Heitor, M. & Shariq, S. (eds). *Science, Technology, and Innovation Policy. Opportunities and challenges for the knowledge economy*. Quorum Books. London.

GORDON, I. R. & McCANN, P. 2000. Industrial Clusters: Complexes, Agglomeration and/or Social Networks? *Urban Studies*, Vol. 37. 513–532.

GRANOVETTER, M. 1973. The Strength of Weak Ties. *American Journal of Sociology*, 78. 1360–1380.

GRANOVETTER, M. 1985. Economic Action and Social Structures: The Problem of "Embeddedness". *American Journal of Sociology*, Vol. 91, No. 3. 481–510.

GRAPHER, G. 1993. The Weakness of Strong Ties: the Lock-in of Regional Development in the Ruhr area. In Grabher, G. (ed.) *The Embedded Firm: On the Socioeconomics of Industrial Networks*. Routledge. London.

HAAVISTO, P. 1996. Teollisuuden ja korkeakoulujen paikallisesta yhteistyöstä. *Tietojenkäsittelytiede,* No. 7 / Helmikuu 1996. 26–32.

HARRISON, B. 1992. *Industrial Districts: Old Wine in New Bottles?* Regional Studies, Vol. 26. 469–483.

HOWELLS, J. 1999. *Regional systems of innovation?* In Archibugi, D., Howells, J. & Michie, J. (eds). Innovation Policy in a Global Economy. Cambridge University Press. Cambridge.

ISARD, W. 1956. *Location and Space Economy: A General Theory Relating to Industrial Location, Market Areas, Land Use, Trade and Urban Structure*. The Massachusetts Institute of Technology, The MIT Press. Cambridge.

KAUTONEN, M. & KOLEHMAINEN, J. 2001. Näkökulmia oppivan talouden alueelliseen innovaatiopolitiikkaan. In Sotarauta, M. & Mustikkamäki, N. (eds) *Aluekehittämisen kahdeksan elementtiä*. The Association of Finnish Local and Regional Authorities, Acta No. 137. Helsinki.

KAUTONEN, M., KOLEHMAINEN, J. & KOSKI, P. 2002. *Yritysten innovaatioympäristöt: Tutkimus yritysten innovaatiotoiminnasta ja alueellisesta innovaatiopolitiikasta Pirkanmaalla ja Keski-Suomessa*. Tekes, Teknologiakatsauksia 120 / 2002. Helsinki.

KENNEY, M. (ed.) 2000. *Understanding Silicon Valley: The Anatomy of an Entrepreneurial Region*. Stanford University Press. Stanford.

KOLEHMAINEN, J., KAUTONEN, M. & KOSKI, P. 2003. Korkeakoulut ja alueellisen innovaatiopolitiikan visiot. In Aittola, H. (ed.) *€KG? €urooppa, korkeakoulutus, globalisaatio?*. Jyväskylän yliopisto, Koulutuksen tutkimuslaitos. Jyväskylä.

KOSONEN, K.–J. 2002. *Building Innovation Capacity in the Less Favoured Regions: New Technologies and University Networks*. Paper presented at "New Technologies and Regional Development", 5th Conference on Regional Development, 8-9 November 2002, Seinäjoki, Finland.

KOSTIAINEN, J. 1999. Competitiveness and Urban Economic Development Policy in Information Society. In Sotarauta, M. (ed.) Urban Futures: A Loss of Shadows in the Flowing Spaces? Futura, Volume 18, No 3 / 1999. 14–36.

KOSTIAINEN, J. 2000. Helsingin, Oulun ja Tampereen kaupunkiseudut innovatiivisina miljöinä. In Kostiainen, J. & Sotarauta, M. (eds) Kaupungit innovatiivisina toimintaympäristöinä. Tekniikan akateemisten liitto TEK ry. Helsinki.

KOSTIAINEN, J. 2002. *Urban Economic Development Policy in the Network Society*. Tekniikan Akateemisten Liitto TEK Ry. Helsinki.

KOSTIAINEN, J. & SOTARAUTA, M. 2002. *Finnish City Reinvented: Tampere's Path from Industrial to Knowledge Economy*. MIT/IPC Working Paper 02-007. Cambridge: USA.

KRUGMAN, P. 1991. *Geography and Trade*. MIT Press. Cambridge.

KRUGMAN, P. 1999. The Role of Geography in Development. *International Regional Science Review*, Volume 22, No. 2 (August 1999). 142–161.

LEE, C.–M., MILLER W. F., CONG HANCOCK, M. & ROWEN, H. S. (eds) 2000. *The Silicon Valley Edge: A Habitat for Innovation and Entrepreneurship*. Stanford University Press. Stanford.

LINNAMAA, R. 2001. *Development Process of the ICT Cluster in the Jyväskylä Urban Region*. University of Tampere. Research Unit for Urban and Regional Development Studies. Sente Working Papers 2/2001.

MARKUSEN, A. 1996. Sticky Places in Slippery Space: A Typology of Industrial Districts. *Economic Geography*, Vol. 72, No. 2: 294–314.

MARSHALL, A. 1890/1920. *Principles of Economics*. Eight Edition. Macmillan and Co. London – New York.

McCANN, P., ARITA, T. & GORDON, I. R. 2002. Industrial clusters, transactions costs and the institutional determinants of MNE location behaviour. *International Business Review*, Vol. 11. 647–663.

MIETTINEN, R., LEHENKARI, J., HASU, M. & HYVÖNEN, J. 1999. *Osaaminen ja uuden luominen innovaatioverkoissa.* Sitra 226, Taloustieto Oy. Helsinki

MIETTINEN, R. 2002. *National Innovation System: Scientific Concept or Political Rhetoric*. Edita. Helsinki.

MULLER, E. & ZENKER, A. 2001. Business services as actors of knowledge transformation: the role of KIBS in regional and national innovation systems. *Research Policy*, Vol. 30. 1501–1516.

MÄNNISTÖ, J. 2002. *Voluntaristinen alueellinen innovaatiojärjestelmä: Tapaustutkimus Oulun alueen ict-klusterista*. Lapin yliopisto, Acta Universitas Lapponiensis 46. Rovaniemi.

NAHAPIET, J. & GHOSHAL, S. 1998. Social Capital, Intellectual Capital and the Organizational Advantage. *Academy of Management Review*, Vol. 23(2). 242–266.

NONAKA, I. & TAKEUCHI, H. 1995. *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press. New York - Oxford.

O'GORMAN, C. & KAUTONEN, M. 2001. Policies for New Prosperity. Promoting Agglomerations of Knowledge-Intensive Industries. *Conference Proceedings of Technological Entrepreneurship in Emerging Regions*, National University of Singapore, Singapore, 28–30 June 2001.

OHLIN, B. 1933. Interregional and International Trade. Harvard University Press. Cambridge.

OINAS, P. 1998. *The Embedded Firm? Prelude for a Revived Geography of Enterprise*. Helsinki School of Economics and Business Administration. Acta Universitas Oeconomicae Helsingiensis, A-143. Helsinki.

PAVITT, K. 1984. Sectoral patterns of technical change: Towards a taxonomy and a theory. *Research Policy* 13. 343–373.

PAVITT, K. 1990. What We Know about the Strategic Management of Technology. *California Management Review*, Vol 32. No. 3 Spring 1990. 17–26.

PELKONEN, A. 2002. *ICT Restructuring the Capital Region: Revising the New Economy Thesis and Growth Pole Policies?* Paper prepared for the Nordic Sociological Conference in Reykjavik, Iceland, 15–17 August 2002. Session 9. Information and Communication Technology.

PENNANEN, T. 2002. *Sisältötuotantoalan alueellinen kartoitus 2002*. Opetusministeriö, Sisältötuotanto-työryhmän väliraportti 8, 40: 2002. Helsinki.

PORTER, M. 1990. *The Competitive Advantage of Nations*. Macmillan. London.

PORTER, M. 1998. Clusters and the New Economics of Competition. *Harvard Business Review*, November-December 1998, 77–90.

PUTNAM, R. 1993. *Making Democracy Work: Civic Traditions in Modern Italy.* Princeton University Press. Princeton.

RAUNIO, M. 2001. *Osaajat valintojen kentällä. Helsingin Tampereen, Turun, Jyväskylän, Porin ja Seinäjoen seutujen vetovoimaisuus virtaavassa maailmassa*. Tampereen yliopisto, Alueellisen kehittämisen tutkimusyksikkö. Sente-julkaisuja 11/2001. Tampere.

REVILLA DIEZ, J. 2000. The Importance of Public Research Institutes in Innovative Networks: Empirical Results from the Metropolitan Innovation Systems Barcelona, Stockholm and Vienna. *European Planning Studies*, Vol. 8, No. 4. 451–463.

ROSENTHAL, S. S. & STRANGE, W. C. 2001. The Determinants of Agglomeration. *Journal of Urban Economics*, Vol 50. 191–229.

SAXENIAN, A. 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128.* Harvard University Press. Cambridge.

SCHIENSTOCK, G. & KUUSI, O. (eds) 1999. *Transformation Towards a Learning Economy: The Challenge for the Finnish Innovation System*. Sitra, Sitra 213. Helsinki.

SCHIENSTOCK, G., RÄSÄNEN, H. & KAUTONEN, M. 1999. From Smoke-stack Industries to Information Society: Multimedia industry in the Tampere Region. In Braczyk, H. – J., Fuchs, G. & Wolf, H. – G. (eds) *Multimedia and Regional Economic Restructuring*. Routledge. London – New York.

SCHIENSTOCK, G. & HÄMÄLÄINEN, T. 2001. *Transformation of the Finnish innovation system: A network approach*. Sitra, Sitra Report series 7. Helsinki.

SCHIENSTOCK, G., KAUTONEN, M. & KOSKI, P. (forthcoming). Escaping Path Dependency: The Case of Tampere Region, Finland. In Cooke, P. & Heidenreich, M. (eds) Regional Innovation Systems. Second Edition. UCL Press. London.

SOTARAUTA, M. & LINNAMAA, R. 1997. *Kaupunkiseudun elinkeinopolitiikka ja prosessien laatu: Tampere, Turku, Oulu, Seinäjoki, Vammala ja Parkano benchmarking-vertailussa*. Tampereen yliopisto, Aluetieteen ja ympäristöpolitiikan laitos, Sarja A, 19. Tampere.

SOTARAUTA, M. 2000. Kaupunkiseudun ydinkompetenssien kehittäminen. In Kostiainen, J. & Sotarauta, M. (eds) *Kaupungit innovatiivisina toimintaympäristöinä*. Tekniikan akateemisten liitto TEK ry. Helsinki.

STERNBERG, R. & ARNDT, O. 2001. The Firm or the Region: What Determines the Innovation Behavior of European Fims? *Economic Geography*. Vol 77, No. 4. 364–382.

Tampereen seudun osaamiskeskusohjelma 1999-2006. 1998. Pirkanmaan liitto ja Tampereen teknologiakeskus Oy. Tampere.

TIDD, J., BESSANT, J. & PAVITT, K. 1997. *Managing Innovation: Integrating Technological, Market and Organizational Change*. John Wiley & Sons. Chichester.

WEBER, A. 1909/1929. *Über den Standort der Industrien*. Translated into English by Friedrich, C. J. 1929. *Alfred Weber's Theory of Location of Industries*. University of Chicago Press. Chicago.

WENGER, E. 1998. *Communities of Practice: Learning, Meaning, and Identity*. Cambridge University Press. New York.

WENGER, E. 2000. Communities of Practice and Social Learning Systems. *Organization*, Volume 7(2). 225–246.

The Local Innovation Systems Project

The Local Innovation Systems Project, an international research partnership based at the Industrial Performance Center (IPC) at MIT, is addressing a central issue now confronting industrial practitioners and economic policymakers throughout the world: How can local economic communities survive and prosper in the rapidly changing global economy?

Our particular focus is on the role of innovation – in products, services, and processes – in promoting productivity growth and competitive advantage at the local and regional levels. National and local governments around the world, as well as other institutions with an interest in economic development, are greatly interested in creating and sustaining local environments that are attractive for innovation. Firms, too, recognize that their innovation performance is affected by their location.

The policy debate has been dominated by a few outstandingly successful centers of technological entrepreneurship, notably including Silicon Valley and the Boston area in the United States, and the Cambridge region in the U.K. But most locales do not have clusters of high-technology ventures of such scale, nor are they home to research and educational institutions with world-class strengths across a broad range of disciplines. Many, on the other hand, do have distinctive industrial capabilities and vibrant higher educational institutions, and some of these locales have been quite successful in harnessing new technology to revitalize their economies or even to reinvent themselves as centers of innovation and competitive advantage.

The Local Innovation Systems Project is investigating cases of actual and attempted industrial transformation in more than 20 locales in the United States, Europe, and Asia. Our research is aimed at developing new insights into how regional capabilities can spur innovation and economic growth. We seek ultimately to develop new models of innovation-led industrial development.

We are currently completing the initial year of a projected multi-year study. In the first phase of research, we are investigating the roles of universities and other public research institutions as creators, receptors, and interpreters of innovation and ideas; as sources of human capital; and as key components of social infrastructure and social capital. Later phases of our research will explore the process of enterprise growth and the ability of different locations to attract and retain innovating firms. We are also investigating different approaches to individual and institutional leadership in locally-based systems of innovation.

The founding research partners of the Local Innovation Systems Project consist of an interdisciplinary team of faculty, graduate students and research staff at the MIT Industrial Performance Center, together with their counterparts at the University of Tampere and the Helsinki University of Technology in Finland, the University of Cambridge in England, and the University of Tokyo, Japan.

Current research sites include several locations in the United States (Boston, MA; Rochester, NY; Akron, OH; Allentown, PA; Youngstown, OH; Newhaven, CT; Charlotte, NC; and the Greenville-Spartanburg area of SC), Finland (Helsinki, Turku, Oulu, Tampere, Seinajöki, Pori), Japan (Hamamatsu, Kyoto), and the United Kingdom. Additional research

is being carried out in Ireland, India, Taiwan and Israel.

At each location, teams of researchers from the partner institutions are studying innovation trajectories and developing comparative case studies of growth and transformation in several industries, mature as well as new, including polymers, ceramics, optoelectronics, industrial machinery and automation, auto/motorsports, medical equipment, biotechnology, and wireless communications.

The outreach activities of the Local Innovation Systems Project will include the preparation of discussion papers and books, executive briefings and informal workshops, international conferences, and executive education and training programs for policymakers, research managers, and industry executives.

Current sponsors of the Local Innovation Systems Project include, in the United States, the Alfred P. Sloan Foundation and the National Science Foundation, Tekes (the National Technology Agency of Finland), the Cambridge-MIT Institute, and the University of Tokyo.

For further information, please contact the Project Director, Professor Richard Lester (617-253-7522, rklester@mit.edu).

List of sources on the Internet

eTampere Programme
www.etampere.fi

Media Club
www.mediaclubi.com

Media Tampere Ltd
www.mediatampere.fi

Hermia Business Development Ltd
www.yrke.hermia.fi

Professia Ltd
www.professia.fi

Tampere Polytechnic
www.tpu.fi

Tampere Technology Centre Ltd
www.hermia.fi

Tampere University of Technology
www.tut.fi

University of Tampere
www.uta.fi

VTT Technical Research Centre of Finland
www.vtt.fi

The Local Innovation Systems Project

The Local Innovation Systems Project, an international research partnership based at the Industrial Performance Center (IPC) at MIT, is addressing a central issue now confronting industrial practitioners and economic policymakers throughout the world: How can local economic communities survive and prosper in the rapidly changing global economy?

Our particular focus is on the role of innovation – in products, services, and processes – in promoting productivity growth and competitive advantage at the local and regional levels. National and local governments around the world, as well as other institutions with an interest in economic development, are greatly interested in creating and sustaining local environments that are attractive for innovation. Firms, too, recognize that their innovation performance is affected by their location.

The policy debate has been dominated by a few outstandingly successful centers of technological entrepreneurship, notably including Silicon Valley and the Boston area in the United States, and the Cambridge region in the U.K. But most locales do not have clusters of high-technology ventures of such scale, nor are they home to research and educational institutions with world-class strengths across a broad range of disciplines. Many, on the other hand, do have distinctive industrial capabilities and vibrant higher educational institutions, and some of these locales have been quite successful in harnessing new technology to revitalize their economies or even to reinvent themselves as centers of innovation and competitive advantage.

The Local Innovation Systems Project is investigating cases of actual and attempted industrial transformation in more than 20 locales in the United States, Europe, and Asia. Our research is aimed at developing new insights into how regional capabilities can spur innovation and economic growth. We seek ultimately to develop new models of innovation-led industrial development.

We are currently completing the initial year of a projected multi-year study. In the first phase of research, we are investigating the roles of universities and other public research institutions as creators, receptors, and interpreters of innovation and ideas; as sources of human capital; and as key components of social infrastructure and social capital. Later phases of our research will explore the process of enterprise growth and the ability of different locations to attract and retain innovating firms. We are also investigating different approaches to individual and institutional leadership in locally-based systems of innovation.

The founding research partners of the Local Innovation Systems Project consist of an interdisciplinary team of faculty, graduate students and research staff at the MIT Industrial Performance Center, together with their counterparts at the University of Tampere and the Helsinki University of Technology in Finland, the University of Cambridge in England, and the University of Tokyo, Japan.

Current research sites include several locations in the United States (Boston, MA; Rochester, NY; Akron, OH; Allentown, PA; Youngstown, OH; New Haven, CT; Charlotte, NC; and the Greenville-Spartanburg area of SC), Finland (Helsinki, Turku, Oulu, Tampere, Seinajöki, Pori), Japan (Hamamatsu, Kyoto), and the United Kingdom. Additional research

is being carried out in Ireland, India, Taiwan and Israel.

At each location, teams of researchers from the partner institutions are studying innovation trajectories and developing comparative case studies of growth and transformation in several industries, mature as well as new, including polymers, ceramics, optoelectronics, industrial machinery and automation, auto/motorsports, medical equipment, biotechnology, and wireless communications.

The outreach activities of the Local Innovation Systems Project will include the preparation of discussion papers and books, executive briefings and informal workshops, international conferences, and executive education and training programs for policymakers, research managers, and industry executives.

Current sponsors of the Local Innovation Systems Project include, in the United States, the Alfred P. Sloan Foundation and the National Science Foundation, Tekes (the National Technology Agency of Finland), the Cambridge-MIT Institute, and the University of Tokyo.

For further information, please contact the Project Director, Professor Richard Lester (617-253-7522, rklester@mit.edu).