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**Co-evolution of the Finnish National and Local Innovation and Science Arenas: Towards a Dynamic Understanding of Multi-Level Governance**

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Markku Sotarauta & Mika Kautonen

Co-evolution of the Finnish National and Local Innovation and Science Arenas: Towards a Dynamic Understanding of Multi-Level Governance

Abstract

In Finland, science policy is in the hands of central government and regions/localities do not directly have any say in the formulation of science policies. However, Finnish city-regions have influenced national science policies indirectly and the interaction of national and local policies has unfolded in time in innovation and science arenas. This paper aims to provide answers to the following questions: a) how has the institutional basis for science and innovation evolved in Finland, over the past 50 years, especially in three Finnish case city-regions b) who have been the main actors in the evolution of institutional capacity and what have their main strategies been, c) how have national and local policies and developments co-evolved over time? The article focuses particularly on how different policies, local and national, have co-evolved in the context of multi-level governance.

1 Introduction

During the last 50 years Finland first transformed from an agricultural into an industrial economy and then quite rapidly into one of the foremost countries of the knowledge economy. At every level the public sector, often in co-operation with research and educational institutes and firms, has aimed to strengthen the innovation capacity of both regions and firms through science, innovation and/or technology policies. We scrutinize here how national and local efforts have co-evolved in time and how they have influenced each other and the development of innovation capacity both nationally and in various parts of the country. The novelty of this paper relates to the focus on the interplay between national and local efforts and policies to strengthen innovation capacity. In Finland, science policy is in the hands of central government, and regions/localities do not directly have any say in the formulation of science policies. However, we aim to show how regions, and especially city-regions, have influenced science policies indirectly, and the ways in which the interaction of national and local has unfolded over time in innovation and science arenas.

When discussing local developments we focus on three different Finnish city-regions. Tampere and Jyväskylä are traditional industrial cities that have been able to recreate themselves and rise to a key position amongst the group of cities which are utilizing the possibilities of new technologies and science-based trajectories. Seinäjoki, on the other hand, is a small centre of a traditional agricultural region and, due to historical reasons, its institutional base supporting innovation is thin. Nevertheless, Seinäjoki has created solutions to strengthen its institutions and to link to major knowledge and innovation networks in Finland and beyond. We decided to focus on these three cases for two main reasons. First, the choice of city-regions has been determined by extensive case-study work carried out in these localities. Second, Tampere and Jyväskylä are known to be proactive in

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their local development efforts and are therefore representative of the co-evolution of local and national points of view. During the last ten years, Seinäjoki has also actively promoted economic development and been able to adapt to the changing external environment.

Of course, other Finnish cases could have been selected. Oulu is a fairly well known and celebrated case through which many interesting observations about the co-evolution of national and local developments could have been raised (for more about Oulu, see Tervo 2002; Männistö 2002). Relating to the field of biotechnology, Turku could also have been among the cases discussed here (see Höyssä 2004 et al.; Bruun 2002; Srinivas & Viljamaa 2003). Helsinki, of course, dominates the Finnish scene in science, innovation and technology development. However, being the only city-region in Finland that might be labelled metropolitan, it is quite a different case. It represents a complex and versatile metropolitan region, where truly proactive and collective local development efforts have only started to emerge slowly in the early 2000s, but where the institutional basis for innovation and corporate and research activities are very strong due to its capital status (for more about Helsinki, see e.g. Pelkonen 2005; Boucher et al. 2001).

In the Tampere case, we draw on several earlier studies on innovation activities and economic development that have been carried out by ourselves or by other members of our two research groups (see Kautonen et al. 2002; Kostianen & Sotarauta 2003; Kautonen et al. 2004; Schienstock et al. 1998; Schienstock et al. 2004; Martinez-Vela & Viljamaa 2004; Kautonen 2006). In these studies over 100 interviews have been carried out and archival data was extensively used. The Jyväskylä case is based on a study focusing on the emergence of the information and communication technology cluster (see Linnamaa 2002). In this study 25 interviews were done and various written documents, such as strategic plans, memoranda, evaluations and overviews, were analysed (see Linnamaa 2002). In the Seinäjoki case, we draw on studies carried out by Sotarauta and Kosonen (Sotarauta & Kosonen 2004; Kosonen 2005) through which 55 interviews were carried out and archival data analysed. In each case, the key actors in respective development processes – representatives from firms, local, regional and national development agencies, local government, research and educational institutes and science parks - were interviewed.

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FIGURE 1. The location of the cases in Finland

Global and national developments and policies are intertwined and they have clearly influenced local developments. However, we also demonstrate how local developments and policies have fed into larger developmental patterns, making it possible to talk about the ‘co-evolution’ of national and local developments, rather than simply about top-down or bottom-up policies, or multi-level governance. Our aim is not, however, to replace the concept of multi-level governance with co-evolution but to complement it, by showing that the relationship between various levels is not a static but a dynamic one. At the same time, if we want to better understand the role that various actors at various levels play in economic development, we need to be more sensitive to temporal issues.

This paper aims to answer the following questions: a) how has the institutional basis for science and innovation evolved in Finland over the past 50 years, especially in three Finnish city-regions, and what have the main science, technology and innovation policies been; b) who have been the main actors in the evolution of institutional capacity and what have their main strategies been; and c) how have national and local policies and developments co-evolved over time, in terms of the extent to which the roles and policies of different administrative levels have influenced each other? We are especially interested in how different policies, local and national, have co-evolved in the context of multi-level governance.

2 Co-evolution instead of top-down or bottom-up

Since the 1970s the interrelationship between global and local forces has aroused great interest among regional scientists. In the 1970s, according to Machimura (1998), local development was largely seen as the result of global forces (multinational corporations, international capital, international division of labour, etc.). In the 1980s, a new “bottom-up-oriented development view” started to gain ground to counterbalance, or to challenge, the

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earlier development paradigm. The new emphasis on regional and local levels became apparent, for instance, in the fact that development was increasingly seen to emerge from the bottom-up (e.g. Stöhr 1981 and 1988), as well as in the many models of local development in the 1990s and 2000s which stressed the significance of locality in economic development. Some commentators have even claimed that regions have replaced the nation-state as the centrepiece of economic activity. (Ohmae 1995.)

In the mid-2000s, it has become clear that the voices that earlier prophesied the role of the state to fade away have been proven wrong, or at least have hugely exaggerated the situation. For example, the State of Finland still plays a crucial role in the various policy fields, but it is also obvious that the role of regions, or rather sub-regions (and especially city-regions), has grown during the last 10–15 years. The role of the region in knowledge accumulation is relative (Amin and Tomaney 1995), and those commentators who only stress regional innovation systems, networks and/or learning regions, do not adequately take the role of national policies and decisions into consideration, or rather the co-evolution of various policies at various levels. These observations are especially valid from the viewpoint of small countries like Finland. As Kautonen and Schienstock (1998) and Kautonen (2006) have observed, the Finnish innovation system is national-local in character. Basically the Finnish system has a strong central government and local government, and what could be labelled as regional government is, in practice, state agencies at regional level and inter-municipal co-operation for organizing certain services and functions beyond municipal borders.

In regional development studies, there has been a tendency to see regional and local agents acting within an overall framework of national – and later also trans-national – institutions and policies. At least implicitly, this kind of view indicates that local and regional agents adapt and design their own strategies within that framework. The brief discussion above suggests that another view on “top-down” vs. “bottom-up” discussion may be adopted. As Halkier and Sagan (2005, 2) argue, the twin pitfall of “celebratory bottom-up worship”, on the one hand, and globalist or state-centric writing on sub-national phenomena, on the other hand, should be avoided and new approaches to study the richness of actual developments ought to be found.

## 2.1 Framing the concept of multi-level governance

“Governance” is concerned with co-operation transcending various borders, takes many goals into consideration and consists of constantly evolving combinations of teams according to different situations. Governance also recognizes and acknowledges that many activities have shifted from formal organizing to more informal networking, and therefore network negotiation and co-ordination can be confounded by the political context in which they are embedded. Governance can thus be defined as self-organizing, inter-organizational networks that are characterized by interdependence between organizations. Interactions in these networks are game-like, rooted in trust and regulated by the rules of the game negotiated and agreed by network participants (Rhodes 2000, 61). As Hirst has pointed out, complexity and interdependence embedded in modern governance raises two crucial questions: first, “how to create an at least minimally effective division of labour in

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governance, one that will link together a complex of very different bodies that, even in combination, cannot be considered to be a ‘political community’”, and second, “how to ensure at the different levels within this division of labour an effective presence of democratic voice – so that the actions of a body at one level do not systematically negate decisions at another.” (Hirst 2000, 25)

In terms of governance issues in innovation systems, previous research has identified different types of regional innovation policy ranging from decentralized bottom-up modes of action to centralized top-down modes of co-ordination (Howells 2005). Especially in the comparative analyses of regional innovation systems and policies, the concept of multi-level governance has gained ground (Cooke et al., 2000; Cooke et al. 2004), shifting attention towards the interrelationships between administrative levels in a multi-layered context. This need has arisen due to the nation-state falling under pressures ‘from above’ as well as ‘from below’ (Bullman 1997). Decentralization and regionalization have been strategic responses from nation-states to these pressures. The need to shift attention is also raised by Hill and Fujita (2003) by showing how cities are embedded in multilevel spatial and institutional configurations.

In spite of the growing interest in multi-level governances, the literature on regional innovation systems has a ‘national-bias’ (Iammarino 2005). Iammarino argues that this bias has strongly affected the identification of actors, relationships and attributes operating at the sub-national scale. Iammarino further argues that the historical evolution of the regional dimension has rarely been considered and that the complexity, heterogeneity and path dependency of multi-level governance in current innovation systems are often neglected. We fully endorse these views and furthermore support the need to also better understand the evolution of relationships within multi-level governance contexts. Nested cities

As a concept, multi-level governance is still in a state of becoming. A volume of essays dedicated to multi-level governance suggests that the concept is useful in organizing descriptions of interdependent relations between different levels of government, rather than an analytical concept guiding research (Bache & Flinders 2004). In many cases, it simply refers to different administrative levels and structures (local, regional, national and transnational) of policies that are emerging (see e.g. Kitagawa 2005). However, there seems to be a clear need to analyse more deeply the roles that different levels of administration play in innovation arenas, their interrelationships and vertical co-ordination issues (see e.g. Kaiser & Prange 2004; Kitagawa 2004). There is also a need for greater sensitivity to the temporal dimension of the multi-level governance of science and innovation. In these respects, the concept of co-evolution may prove useful in the future efforts of regional development scholars to get a better grasp on the reciprocal and two-way nature of multi-level governance over time.

## 2.2 Framing the concept of co-evolution

Drawing on complex evolving systems and emergence (Mittleton-Kelly 2003; Johnson 2002), global and national structures can be seen as actually produced by, on the one hand, local interaction and by global-national-local/regional interaction on the other hand.

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Hence multiple agents create their environment and adapt to it at the same time. The influence of individual agents is, of course, minor, but if we aim to understand how policy and actual economic development influence each other, we need to study developments as two-way dynamic processes.

Conceptually, co-evolution takes place if two or more agents and/or their environments influence each other's selection and/or retention processes and if a series of variations takes place in them. If an agent merely responds to another agent's presence or activities by adaptation, that is not seen as co-evolution, because co-evolution consists of a series of responses and can therefore be seen as a reciprocally induced evolutionary change between two or more agents and their environment over time (Murmam 2003; Lewin & Volberda 1999; Sotarauta & Srinivas 2006). Evolutionary theory reasons that the emergence of new basic varieties of policy is quite hard to predict. Policy makers have often witnessed how new development paths cannot be planned and foreseen, but what they have also seen is how new developments emerge quite spontaneously and unexpectedly in space (Boschma & Lambooy, 1999; see also Boschma 2004). More often than not, policy makers are therefore adapters rather than optimizers, pursuing a policy of trial-and-error (Metcalfe 1994.) For these reasons, evolutionary approaches stress adaptation to changing selection environments, but do not deny the role of human purpose and strategic action as forces directing the evolution of organizations, regions and nations. The relationship between strategic intention and adaptation is one of the key issues in the co-evolutionary approach, and thus it may add new insights into our understanding of path dependency as well.

Especially important for regional development is the co-evolutionary notion that micro-agent change leads to macro system evolution, i.e. before change at a macro level becomes visible, it has taken place at many micro levels simultaneously (McKelvey 1999). This is usually the case in regional development; prior to any sign of changes at the regional level, many of the individuals and individual organizations may have gone through major changes that in time also lead to changes at the regional level (Sotarauta & Srinivas 2006).

We do not intend to discuss the evolutionary approach and the concept of co-evolution in depth here, but it is important to note that the co-evolutionary view suggests that both the environment and agency are important in the course of evolution. When regional development issues are approached from a (co)evolutionary point of view, fresh insights are gained into questions such as how policy co-evolves, as a two-way process, with spontaneous economic development and how various agents and their policies co-evolve with each other and their environment.

### 3 Evolving times, evolving policies in Finland

As Lemola (2002) states, there is always an interaction between industrial, economic and social structure and public policy orientation that influences the structure of innovation systems and policies. Also theory and policy learning influence each other forming a co-evolving and interactive process (Mytelka & Smith 2002). Although there has been a certain built-in inertia in Finnish policy institutions, they have also adapted to changes in their policy environment by deliberate learning and especially reacted to the experiences of other countries, reinterpreting foreign models and initiatives for Finnish needs. Until the 1990s

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both the acquisition of foreign machinery and equipment by industry and the implementation of absorbing policies and models created elsewhere played key roles in the process of technological catch-up (Georghiou et al. 2003). As Georghiou et al. further state, in addition to learning from abroad, Finnish policy-making has also reacted to changes in industrial structures both nationally and internationally.

The basic pillars of technology and science policies were partly built in the 1960s, but mostly in the 1970s and 1980s. In the early days of policy formulation, the goal was to raise the technological level of Finnish industries and to reduce dependence on raw material-driven production and exports. The one-sided structure of exports was regarded as a problem. Not being among the richest countries in the world at that time, actual changes in policies occurred step by step and even if there were some visible changes in policy thinking, Finland's research and development (R&D) expenditure relative to gross domestic product (GDP) was still one of the lowest in the industrialized countries at the end of the 1970s (Hermans et al. 2005, 136). The evolution of Finnish science, innovation and technology policies can be divided into three major phases:

- The era of building the basic structures and institutions (from WWII to the 1970s)
- The era of technology orientation (1980s)
- The era of building the knowledge-based society and the national innovation system (1990s) (slightly modified from Lemola 2002 and Georghiou et al. 2003).

These three phases will next be analysed from national and local points of view in order to demonstrate the co-evolution of policy in this domain.

#### 4 The era of building the basic structures and institutions, post WWII – 1970s

##### 4.1 National developments

In the 1950s and 1960s, Finnish science and technology policies were still in their early stages of development. Kivinen et al. (1993) have labelled this period of Finnish higher education as reflecting an 'academic-traditionalist' doctrine. University autonomy, elitist education and freedom of research and teaching were emphasized, and no expectations towards the economic utility of university education or research were expressed (Nieminen 2005, 45).

In the early 1960s, science and technology policies were institutionalized, the aim being to improve the conditions for industrial research and development. According to Georghiou et al. (2003), the most important changes over the 1960s and 1970s were: 1) policy doctrines were created (the conceptual fundamentals of science and technology policy); 2) the establishment of a ministerial committee on science in 1963, the Science Policy Council (from 1987 the Science and Technology Policy Council), for the formulation and co-ordination of science and technology policy guidelines; 3) the creation of new mechanisms for the planning, co-ordination and financing of university research (including the Academy of Finland and new universities); and 4) the development of higher education in general playing a more significant role than previously (Georghiou et al. 2003, 58).

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In the 1970s, Finland started to move from resource-driven to a more technology-driven industrial growth. At the same time, public R&D inputs were increased to enhance the integration of science, technology and industry, and, finally, to strengthen technology policy organizations. All in all, Finland followed the spirit of the time and, more pragmatically, it followed the general OECD instructions to make science serve societal development (Nieminen 2005, 48-49). The emphasis was placed on targeted research, applications and the democratic steering of the entire system. In addition, a key aim was to strengthen the role of central government in relation to scientific questions. A need to use scarce resources as rationally as possible was one of the background triggers for change (Nieminen 2005, 48-49). For the universities, this indicated the end of the old doctrine at the turn of the 1960s and 1970s, and the beginning of the "development doctrine" (Kivinen et al. 1993). Consequently the system began to expand quickly and social relevance was emphasized (Nieminen 2005, 44).

During this period, Finland moved towards a top-down policy regime with a strong national emphasis. This led to the systematic planning of research in selected areas and the channelling of funding to specific projects was seen as relevant. Yet there were several reasons why these attempts failed from a centralized science policy point of view. Targeted research did not fit in with the traditions of academic research; timetables were unrealistic and there was not enough interaction between planners in the central administration and the academic community. For its part, the politicized atmosphere of the country at that time further inhibited interaction from emerging (Immonen 1995; quoted in Nieminen 2004, 49).

During this period the university system was expanded by the state to cover new regions outside the Helsinki and Turku regions. The first two new universities, the University of Oulu and the College of Education in Jyväskylä (later the University of Jyväskylä) had already been established at the end of the 1950's (Kivinen et al. 1993). In the 1960s higher education policy and regional policy continued to intertwine, and four new universities were established in different parts of the country (the Universities of Kuopio and Joensuu, and the Universities of Technology of Lappeenranta and Tampere). At the turn of the 1970s and 1980s two more universities were established in Vaasa and Rovaniemi (the University of Lapland) (Nieminen 2005, 47). It is clear therefore that by the end of the 1970s local economic development policies and national regional policy had already begun to intertwine in many ways with national science and higher education policies.

#### 4.2 Three cases of local developments in the era of building the basic structures and institutions

In addition to the well-known "Oulu phenomenon" (see Männistö 2002; Tervo 2002), Jyväskylä and especially Tampere also became well-known cases in Finland in the 1990s when the activities related to information and communication technology (ICT), both business and academic, grew rapidly in these cities. Outside the Helsinki metropolitan region, these cities were able to seize the opportunities provided by the era. Yet even though major growth occurred in the 1990s, the origins of this development can be traced

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back to post-WWII developments. In particular, the founding and expansion of universities strengthened the institutional basis for economic development at the time and also for later initiatives. The institutions that had been established in the 1960s and 1970s turned out to be among the key elements in later economic transformations (see Linnamaa 2002; Kostiainen & Sotarauta 2003; Männistö 2002; Tervo 2002).

We use Tampere as an example of how such structures were strengthened. After World War II Tampere was an old industrial centre, where there were no higher education institutions (Rasila 1992; Seppälä 1998). The local champions of economic development desperately wanted to have higher education institutions in their town. The decisions concerning new universities were largely based on national deliberations, aided naturally by local lobbyism, but Tampere was a different case in the sense that it was local activity that was crucial in getting two universities transferred from Helsinki to Tampere (Kostiainen & Sotarauta 2003).

A local development coalition's plan was to get a small private university, called the School of Social Sciences, to move from Helsinki to Tampere. This aim was influenced both by push forces in Helsinki and pull factors in Tampere. The transfer was realized in 1960, especially as a result of the active efforts of the Tampere city government. Particularly in the beginning, the city government also provided the university with strong financial aid. In 1966, the name of the institute was changed into the University of Tampere (UTA) (Kaaminen 2000, 13–40). Next, the plan was to firstly induce the Helsinki University of Technology (HUT) to open a branch unit in Tampere and later to make it an independent university. After various adventurous developments, a Tampere branch of HUT was indeed opened in 1965 and in 1972 the independent Tampere University of Technology began its activities (Seppälä 1998, 143–145, see also Rasila 1992, 461–464). In addition to the universities, the foundations for the knowledge economy were strengthened when the state founded the Technical Research Centre of Finland (VTI) in Tampere (Ahonen 1993, 387). By the mid-1970s, a basic structure of solid and versatile academic teaching and research had been created in Tampere from scratch.

One of the critical incidents that later proved to be significant was the creation of a professorship in computer sciences in 1965 in the University of Tampere, the first in the Nordic countries. At the same time, in Jyväskylä, at the end of the 1960s, the Jyväskylä Commercial Association endowed the University of Jyväskylä with a professorial post in computer science (Linnamaa 2002). In the course of time many important activities gathered around these professors and also spread into other organizations. The basis for the ICT knowledge base of Jyväskylä was further strengthened by the devolution of several ADP-related state units at the turn of the 1980s including the State Computing Centre and the Computer Centre of the Social Insurance Institution of Finland (Ojala 1997, 110). The relocation of these high-technology units by the state served to increase the number of actors involved in ICT, thereby laying a foundation for subsequent development.

During this period, Seinäjoki appeared almost as a total outsider in science and technology policy arenas. It did not have any research- or higher-education-oriented institutions, nor were they founded during this period. However, the core policy makers of South Ostrobothnia had also read the signs of the time and aimed to strengthen the

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institutional basis of the town. For that purpose, the municipalities of South Ostrobothnia founded a University Association of South Ostrobothnia for improving the conditions for higher education (see Aaltonen 2000; Kosonen 2005). The Association also created some ploys to get a university in Seinäjoki. These failed, perhaps because Seinäjoki was a small centre of an agricultural region, lacking political weight, and also because coherent arguments of the relative merits of the town, in competition with larger cities, were not adequately propounded.

In Finland until the 1970s, the emphasis was on catching up with more advanced countries, not only in technology and industry, but also in science and technology policies. The emphasis was, as we might say today drawing on Amin and Thrift (1995), on increasing the institutional thickness both at national and local levels. The era was dominated by a top-down view and could not be characterized as national-local co-evolution in its real meaning. Local economic development efforts aimed at integrating themselves into national developments and at influencing national deliberations. Yet behind the expansion of the university system to new regions, explicit aims to balance Finnish regional development could already be seen. National science and research arenas began to reach for regions and localities, and regions and localities began to reach for national institutions. The institutional seeds for future developments were sown in many localities.

## 5 The era of technology orientation, 1980s

### 5.1 National developments

In the early 1970s, enthusiasm in science and technology policy began to wither away in more or less all OECD countries. In Finland, government support for R&D was also constrained by budget cuts, and many of the efforts to plan and re-direct research activities towards the solution of economic and social problems were ended (Lemola 2002, 1484). However, already in the late 1970s, new science and technology priorities had begun to surface. There was a shift from institution building towards technology policy. In addition, special attention was now given to basic natural science, on the one hand, and to new strategic technological fields on the other. The country began to shift from a narrowly conceived science policy towards broader science, technology and innovation policies (Nieminen & Kaukonen 2001, 31).

At that time, many countries were inspired by Japanese industrial and technology policies. Japan seemed to be able to identify growth sectors, pick winners and provide ample resources to promising new technology areas. Drawing on Japanese economic and technological success, Finland also aimed to stimulate industrial innovation. Finnish policy makers began to learn from Japanese organizations and institutions in integrating science, technology and industry (Lemola 2002, 1484). Active exploitation of the opportunities opened up by new technologies for the benefit of economic growth and employment became the new core of Finnish science and technology policy.

A key aspect at the beginning of the 1980s was to make technology policy increasingly target-orientated and systematic. To strengthen institutional capacity in fulfilling these

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tasks, the National Technology Agency (Tekes) was established, designed after the Swedish Board for Technical Development. In line with the operations of Japan and Sweden, national technology programmes were developed to serve as a new instrument by which Tekes could control R&D activities. The programmes turned out to be an effective instrument to intensify co-operation between universities, research institutes and firms. (Georghiou et al 2003; Lemola 2002, 1484). Basic research and universities were already considered important, but in the 1980s, policies explicitly emphasized the utilization of research and new technologies. It was seen as especially important that research should serve societal policy in general but also several key technologies. In addition, technology transfer and commercialization of research became important issues (Nieminen 2005, 50). However, the clear integration of science and technology policy had not yet emerged.

### 5.2 Three examples of local developments in the era of technology orientation

Following the strengthening of institutions for research and development, the first technology centre in the Nordic Countries was founded in Oulu in 1982. It was a joint project between the City of Oulu, the University of Oulu and local business. Tampere also followed the same course of action, and both a local technology transfer company and a technology centre were established in the immediate proximity of Tampere University of Technology in 1986. Nokia established its research laboratory in the technology centre (Hermia) the next year (for more, see Lehtimäki 2005).

In Jyväskylä, a technology centre was founded in 1987, later its name was changed into Jyväskylä Science Park Ltd. (Ojala 1997, 112-113). In the mid-1980s, there were very few subjects offered at the University of Jyväskylä to support technological development or enterprises in the field. In 1989, this problem was addressed by launching new programmes in applied computer science, in applied physics and in applied chemistry. Moreover, the programme entailed the beginning of co-operation with Helsinki University of Technology in educating Masters of Science in paper manufacturing technology and environmental and energy technology (Linnamaa 2002).

While the larger towns such as Tampere, Oulu and Jyväskylä concentrated on establishing technology centres and technology transfer institutions in line with the national spirit of the time, Seinäjoki continued its efforts to link itself to the Finnish university system with some degree of success. In 1981, the University of Tampere opened the Institute for Extension Studies in Seinäjoki, and later, in 1988, the University of Helsinki established the Institute for Rural Research and Training there. Hence, in the 1980s, due to the active role played by local government, Seinäjoki was able to get a small share of university education. However, the institutes founded were small and, in addition, they focused mainly on further education and development projects. The basis for knowledge-based economy still proved to be thin in the 1990s (for more, see Kosonen 2005).

The direction of the most important policies were still largely top-down, but it is worth noting that there were many quite purely local initiatives undertaken to strengthen the basis for technology transfer and university-industry interaction. In practice, development measures were more or less isolated, lacking co-ordination. Initiatives and decisions were based on the strong will, vision and pioneering spirit of key individuals (Linnamaa 2002,

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Tervo 2002, Männistö 2002; Kostiainen & Sotarauta 2003). In comparison to other regional development efforts, innovation and technology still played a somewhat marginal role.

Yet although not that effective in the beginning, local initiatives served as platforms to study and learn innovation-oriented activities and new models of regional development and to mould the ground for the rapid developments of the 1990s. In this period many capabilities, operational models and interaction patterns were learned that enabled localities to seize future opportunities. In many city-regions, development agencies were learning new skills, although not always knowing what for and how. In practice, those first persons working in technology centres, industry liaison offices and public technology transfer companies formed a small, yet national, community of people who became known to each other, to key persons in Tekes and in other central government offices. A relatively small but active national innovation and technology community with fairly strong local connections was born. Among other things, this community played an “evangelist’s” role in propagation of the importance of technology and innovation for economic growth and local development in general, contributing also to the spread of new ideas and models. The key-people also learnt to know each other fairly well and affected each other’s thinking that was a good point of departure for future collaboration, i.e. deeper co-evolution between national and local.

6 The era of building the knowledge-based society and national innovation system, 1990s

6.1 National developments

In the early 1990s, the Finnish economy took a plunge, indeed, the 1990s saw quite different developments than those expected in the 1980s. Industrial production shrank by over 10 per cent and real GDP dropped by over 10 per cent in just three years. Unemployment rose to nearly 20 per cent by 1994, having been below 4 per cent only a few years earlier (Honkapohja & Koskela 1999). In Finland, the depression of the early 1990s has often been referred to as a watershed between the investment/resource and innovation-driven phases of national development. The Finnish economy was increasingly exposed to foreign competition and it was considered obvious that without strong national buffers, competitive advantage had to be based on world-class innovation, efficiency and value-adding capacity. Having a strong engineering orientation, the Finnish value-adding strategy was quite naturally oriented towards technological innovation (Schienstock & Hämäläinen 2001).

By the beginning of the 1990s, Finland had developed a fairly strong public infrastructure consisting of universities and government research institutes. A new ideology initiated by the Science and Technology Council began to emerge at the turn of the 1990s, embracing the “national innovation system” and “knowledge and know-how” as central elements. Cluster-based industrial policies also fit well into this line of policy thinking. All this emphasized four viewpoints: 1) the creation and utilization of knowledge and know-how, 2) the R&D system at the core with education having an important role, 3) the

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influence of the general atmosphere and environment on the development and take-up of new technologies, and 4) the ability to co-operate both nationally and internationally, (Georghiou et al. 2003).

The concrete target in the 1990s was to increase R&D expenditures. Policies based on indirect measures to influence firm behaviour, avoid direct interventions in product markets, concentrate on rectifying failures in factor markets and promote competition suited the economic environment of the 1990s and 2000s better than policies pursued in the 1980s. The conditions-providing or -enabling policies of this type were adopted as major guidelines for Finnish industrial policy-making in the early 1990s (Georghiou et al. 2003).

The new strategy for science and technology consisted of a mixture of state, market and academic regulation. The consequences of the new trajectory and the economic depression were seen, among other things, in the changing patterns of university research funding. Public funding was increasingly channelled through competitive funding mechanisms and the criteria for funding from extra-budgetary sources increasingly presupposed co-operation as a condition for funding (between the universities, international co-operation, and university-industry co-operation). Former mechanisms for financing universities and other research activities were reformed on the basis of practical as well as legitimating reasons. The Academy of Finland obtained a more prominent and important role in the S&T system. Its funding grew fairly steadily throughout the 1980s and 1990s, giving it a central position in Finnish science policy. Applied interdisciplinary research programmes also became more important in the funding policy of the Academy (Nieminen & Kaukonen 2001, 32-33).

### 6.2 Three examples of local developments in the era of building the knowledge-based society and the national innovation system

Local economic development efforts followed national and international trends, but at the same time, earlier investments in structures and institutions, and hence also in creating playing grounds for individuals, now began to pay off.

New innovation-oriented thinking behind policies was quickly reflected in Finnish regional policy. There was an anticipated need not only to distribute created wealth to less-favoured regions, as was mainly done in traditional regional policy, but also to foster the development of those regions capable to function as 'growth poles' (although this term was not officially used). Now innovation and technology moved to the core of most development efforts. From this starting point, the national Centre of Expertise Programme was initiated and launched in 1994.

One of the main aims of the Centre of Expertise Programme was to direct local, regional and national resources towards the development of selected internationally competitive areas of expertise. The Centre of Expertise Programme was a natural continuation to many local development efforts already carried out earlier. Without local development efforts in the earlier eras, this kind of national development programme with a strong local emphasis would not have yielded positive results. Local aspects have now become more integrated into national and international aspects, and in the 1990s there were already signs of true co-evolution. This, however, is not well balanced throughout the

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country, because the five leading city-regions have significantly stronger starting points in the co-evolution between national and local, in terms of structural and human capital,

In Tampere, many of the key structures and institutions that had already been built earlier were effectively mobilized during the recession. Locally, the Centre of Expertise Programme served as a guidepost to combine the efforts of industry, S&T institutions and local government. This combination of resources could particularly be seen in sustaining the competitiveness of the traditionally strong mechanical engineering and automation industries by key firms' own enhanced R&D activities, supported by Tampere University of Technology (TUT) and the local branches of the Technical Research Centre of Finland (VTT). Many of these joint activities were initiated by the local Centre of Expertise Programme and co-financed by the National Technology Agency. On the other hand, Tampere managed to open up entirely new pathways, of which the most significant is the emergence of the ICT industries employing some 3,000 in 1994 and about 15,000 at the turn of the millennium (O'Gorman & Kautonen 2004, 468-9; Kautonen et al. 2004). This rapid growth was made possible by the substantial increase in the supply of university graduates from the two local universities, which in turn was made possible partly by the national government's so-called 'future package' that, inter alia, allocated approximately 17 million euros to 22 projects to support Finnish universities in their regional missions (Valtioneuvoston kanslia 2000, 183).

The same national government's support, combined with an effective use of the EU Structural Funds Objective-2, also facilitated the growth of the ICT industries in Jyväskylä, where it was evaluated that about 2,000 jobs in private R&D, software design and related functions were created in 1995-1999 (Linnamaa 2002). Thus, both in Tampere and Jyväskylä, the combination of national and local resources and aligning of strategic programmes with developments in firms led to positive outcomes.

Quite different from the rapidly growing city-regions, Seinäjoki faced the innovation challenge in the 1990s with a fear that the region had been left out from the recent innovation- and technology-oriented development. The general policy discourse often culminated in the lack of a local university (Sotarauta & Kosonen 2004). Seinäjoki launched a campaign to become a service centre of the information society, instead of an agricultural society. Basically the aim was to do what the larger cities had already done earlier: to build infrastructure and strengthen institutions. This included developing Seinäjoki Polytechnic, establishing the Seinäjoki Innovation and Technology Village and inducing Tampere University of Technology to found the Digital Medical Laboratory/ Mediwest Health Care Technology Centre (see Kosonen 2005).

Most of the new organizations were small, resource-scarce and most of the innovation-oriented capabilities were still to emerge within an overall embryonic innovation culture. In spite of new developments and significantly changed perceptions among policy makers, most of the firms in the Seinäjoki region did not see the need to integrate themselves with the knowledge economy and its operational models (Kosonen 2005; Sotarauta & Kosonen 2004). Policy makers in co-operation with the business community and local higher education institutes aimed to network the region and especially its centre more closely to the main universities of Finland. The most important realization was that the low quantity

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and quality of research in South Ostrobothnia was not a problem as such, but the real problem lay in the fact that there were not enough competent individuals who could compete for national and international research funding and who were also respected and credible actors in academia. The whole innovation system and the R&D climate were distinctively regional and thus rather introverted in nature, and eventually, an objective to create a multidisciplinary research community of 40–60 researchers formed by more than one university was set. The central idea was to found 12 new research professorships as the core of a new community, with the professors themselves supposed to attract funds for their own research groups (Sotarauta & Kosonen 2004). In the mid-2000s, this plan has been implemented and there are 15 professors and approximately 45 researchers working in Seinäjoki, and most importantly, they are linking a small, emerging research environment to wider innovation networks through their own personal contacts.

During this period co-evolution between national and local became more organized, systematic and visible. All in all, it is worth noting that in the Finnish case the co-evolution between national and local has stretched over longer periods of time. Many developments of the 1990's were partly based on the measures taken during earlier periods. For example, in the 2000's some of the national programmes capitalize on local structures created much earlier.

## 7 Conclusion

Co-evolution provides us with an additional concept to complement the conceptual tool kit traditionally used in regional development studies. It reveals new dimensions in the roles that various actors and forces at national and local levels play in policy arenas over time. In our view, in spite of being a useful concept in analysing multi-layered governance structures multi-level governance does not adequately reveal the complexity of economic development and related policies, nor capture the long unfolding social processes that are in so central a position in regional development. Multi-level governance shifts our attention towards the interrelationships between administrative levels in a multi-layered context, and co-evolution stresses the need to study the dynamics of those relationships in time and the ways various levels influence each other in the course of time. When bringing these two concepts together we may gain analytical leverage otherwise lost.

In Finland, science (and especially educational policy) has traditionally had a strong regional policy dimension. Especially from the late 1950s to the 1970s, the university system was consciously developed from a regional development point of view. At that time, founding new universities was an important tool of the government in their efforts to ensure balanced regional development. In the 2000s, however, there is a growing tension between those actors who aim to promote balanced regional development and those who aim to promote internationally competitive science. This tension dominates many of the contemporary policy debates and is far from being resolved. It remains to be seen how it changes the co-evolutionary dynamics between local and national.

During the past decades, as we have shown in this article, central government has clearly dominated the scene, with the Ministry of Education as its central policy actor. If the view towards innovation and technology policy is widened, other ministries also appear

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as important (especially the Ministry of Trade and Industry). The most important agencies in implementing these policies have been the Academy of Finland and the Finnish Funding Agency for Technology and Innovation (Tekes). However, if we approach Finnish science and innovation policies purely from a national and multi-level governance point of view, we might lose track of the significance of the local activities of the 1960s, the 1970s and the 1980s in creating local platforms for the national (and local) developments in the 1990s. Even though Finnish science policy appears more as top-down than bottom-up in nature, a long-term view reveals its co-evolutionary characteristics.

The three case studies discussed here demonstrate that if there had not been conscious efforts and initiatives at the local level to strengthen institutions and attract competent people for research and education, many central government policies would not have had a local soil for implementation. At the same time, many national policies have been reinterpreted at the local level to make them better fit the needs of a specific locality. Therefore, in the Finnish context, the making of innovation and science policies is dominated by national bodies but is not solely dependent on the financial resources or thinking of central government, due to the relatively large autonomy, taxation rights and proactive local economic development policies of the municipalities. In particular, city governments often have interests, resources and institutional power to pull new initiatives through. The cities have extended their interests towards science in cases in which there have been obvious connections to the (mostly already existing) production agglomerations in their respective regions. Local ambitions have not been to strengthen science *per se* but to strengthen the educational and research basis for and linkages to business and local economic development. At the local level, there have not been any special organizations to design 'local science policies', but there has been rather a complex process of negotiation between relevant parties from local government, business life, academia and regional authorities.

National policies have had a big influence on local development activities, not only in a financial and strategic sense, but also in terms of the increased importance of science, technology and innovation policy issues at national level, which has created enough backing and pressure to implement related policies locally. Vice versa, many feasible and successful local initiatives have fed back into the national level policy discourse.

All in all, we can conclude that those city-regions that have been able to strengthen their educational and research institutions, either due to historic reasons or due to their own activities, were better equipped in the 1990s to seize the opportunities of a rapidly emerging knowledge-based economy. They had people and organizations that had adopted views of a knowledge-based economy for some time and participated in creating optimum conditions. These actors had been a minority both nationally and locally, but as times were changing in the early 1990s, they suddenly became the core of an expanding community of promoters of a knowledge economy and the information society. They were able to quickly utilize new development opportunities and newly directed national resources. Most of the Finnish sub-regions, however, did not have these people in the 1990s. While some of the Finnish city-regions were able to adjust their policies and structures to new situations, most

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were forced to start learning a new vocabulary, new thinking, new strategies and new development tools in the middle of a difficult economic situation and changing rules.

More comprehensive analysis of long-term co-evolution between national and local policy levels might reveal how processes have differed from each other in different localities. It may well be that many of the Finnish localities are not co-evolving with national policies but simply trying to cope with changes and adapt to them. Based on the discussion above, we propose a hypothesis on which to work in order to balance the current focus behind (regional) innovation systems and multi-level governance: those regions that truly co-evolve with the economic environment and national policies are better equipped both institutionally and cognitively to face economic shocks and hence better able to adapt strategically to the changing economic landscape than those regions that simply implement national policies locally and/or react to new emerging issues.

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### Prerequisite for Innovation Capacity?

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15 as a whole, and

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17 over the past 50 years, and what

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19 have the main science, technology and innovation policies been in this process;

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30 ; i.e. how have the roles and policies of different administrative levels influenced each other

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36 What makes Finland an interesting case from innovation capacity point of view is that it,

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38 along with some of its city-regions, has been able to

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40 break out to a new path and dissociate itself from its strong economic dependence upon natural  
41 resources. Among other factors, also public policies have clearly played a role in this.

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43 In Finland, science policy is in the hands of

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45 central government, and regions/localities do not directly have any say in the formulation of science  
46 policies. However, we aim to show how Finnish

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48 city-regions have influenced national science policies indirectly, and therefore we focus on the

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development of innovation capacity and the

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ways the interaction of national and local has unfolded in time in innovation and science arenas.

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The change is vast, but its reflections vary between Finnish regions depending on the actual resources of regions and their capabilities in utilising resources internal and external to a region. All in all, a

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What makes Finland an interesting case from an innovation capacity point of view is that it, like

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some of its city-regions, has been able to

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break out to a new path and dissociate itself from its strong economic dependence upon natural resources. Among other factors, also public policies have clearly played a role in this. The economic success of Finland in new knowledge- and innovation

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-oriented global framework was partly the result

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of lucky timing, but also of deliberate government policies and corporate strategies aimed at fostering economic growth through technology, innovation, education and science (Werner 2003).

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Contrary to the other articles of this special issue, we do not focus

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solely on regional science policies but discuss the

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therefore we focus on

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the development of innovation capacity and

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We are especially interested in how different policies, local and national, have co-evolved in time.

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We decided to focus on these three cases for two main reasons. We have carried out extensive

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and where corporate and research activity is extensive and strong

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36 a) how has the innovation capacity evolved in Finland as a whole and especially in three  
37 Finnish case city-regions over the past 50 years, and what has the main science, technology  
38 and innovation policies been in this process, b) which have the main actors been in the  
39 evolution of innovation capacity and what have their main strategies been, and c) how has  
40 national and local policies and developments co-evolved in time.  
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53 , in one way or another,

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Florida (1995), for example, claimed that economic transformation makes regions into key economic units in the global economy, and according to him, globalism and regionalism are parts of the same economic transformation process.

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we are able to say that

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As Amin and Tomaney (1995) stated already in the mid-

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31 , and we might add that its regional dimensions are usually intertwined with things  
32 national and local.

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36 Therefore we focus here on the local developments instead of regional.

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31 we argue that

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35 go beyond rather static multi-level governance structures and adopt more dynamic  
36 approaches recognizing better the two-way processes that blur the borders.

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40 This interplay is understudied

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48 (see Sotarauta & Srinivas 2006.)

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23 2004

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27 ; Volberda & Lewin 2003

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43 co-evolutionary approach, when rooted in complex evolving systems (see Sotarauta &  
44 Srinivas 2006), might provide us with one possible new framework to increase our  
45 understanding o

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53 f the forces affecting regional development. It is already being recognized that (co-  
54 evolutionary thinking might have a lot to offer for regional development studies too (see  
55

e.g. Boschma 2004; Lambooy & Boschma 2002; Sotarauta & Srinivas 2006; Boschma & Sotarauta, forth.).

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(Co)evolution may turn out to be one of the keys in our endeavours to understand and explain industrial development of regions. Change in these systems happens in the context of intricate intertwining at all scales and usually we are aware of change only when different patterns penetrate the collective social constructions.

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before change at a macro level can be seen,

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place at many micro-levels simultaneously.

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4 At that time the University of Helsinki dominated the higher education and research scene.  
5 Two thirds of the university students studied at UH in 1950, and the professors of UH had a  
6 central role in the Finnish cultural life  
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37 There is not enough space here to cover all the colourful stories on both national and  
38 local strategies, ambitions, ploys and fights to get a university

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47 in some city or town. Let us, however, elaborate these developments by using

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12 ; Kostiainen & Sotarauta 2003; see also Rasila 1992, 456-461.

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39 Tampere University of Technology was from its birth known as a university for industry,  
40 and contrary to the practices of that time, the university also had the first R&D projects  
41 commissioned by the industry in 1973 (Kautonen et al. 2002, 156).

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, in practice the key individuals behind it,

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it was quite largely also about strengthening the innovation capacity by obtaining institutions engaged in exploration and about aiming to provide local people with opportunities to study in their home town. In many cases, local leadership, when combined in one way or another to national power, proved to be crucial in getting a university. During the period of geographical expansion of the Finnish university system, there were also many cities that could have aspired to have their own universities but did not consider

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it necessary or lacked the leadership to do so.

Basically there was no such thing as regional science policy; science policy was clearly defined at national level. At local and regional levels, one can find development policies aiming to integrate themselves into national science system and hence to promote local innovation capacity by strengthening explorative and problem-solving capabilities. However, t

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and focusing more on technology in general

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, and a handful of key development champions in practice,

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herefore, even though they strengthened to some extent the innovation capacity of the region, t

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If the previous period did not see much co-evolution between local and national, neither did the technology orientation phase.

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The direction of the most important policies were still mostly top down, but it is worth noting that

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there were many quite purely local initiatives made for

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strengthening the basis for technology transfer and university–

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Based on the earlier established institutions, emphasis was now on more focused issues.

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In practice, the development measures were more or less isolated, lacking co-ordination. The initiatives and decisions were based on the strong will, vision and pioneering spirit of key individuals (Linnamaa 2002, Tervo 2002, Männistö 2002; Kostainen & Sotarauta 2003). In comparison to other regional development efforts, innovation and technology still played a somewhat marginal role.

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In the cases discussed here, there was no conscious strategic plan for the development of innovation capacity, nor could anyone yet foresee the opportunities presented by ICT in these cities. The development measures were more or less isolated, lacking co-ordination.

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The key actors of Jyväskylä did not

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10 to (institutional) policy changes occurring at the level of central government either.  
11 However, the initiatives and decisions were based on the

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20 strong will, vision and pioneering spirit of key individuals (Linnamaa 2002, Tervo 2002,  
21 Männistö 2002; Kostiainen & Sotarauta 2003).

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18 This type of *conditions providing*

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36 Both cluster policy and a national innovation system had started to emerge already in the  
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43 rationale, the role of government began to shift to be more a facilitator than a driver.  
44 (Hermans et al. 2005.)

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as a condition for funding. It can be said that the former way to

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However, the rapid transition in Finland from a

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resource-dependent to a knowledge-based economy has lead to a situation in which only few city-regions prospered

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economically, Helsinki, Oulu and Tampere being the most prominent centres. Also Jyväskylä was

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e its knowledge infrastructure in the 1990s.

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To put it simply, it is possible to state

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that mainly big university cities and/or smaller towns speciali

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zed in electronics industry were able to meet the challenges of the globalizing economy and knowledge-based competition. (

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about the development of the cities, see Vartiainen & Antikainen 1998; Antikainen 2001; Huovari et al. 2001).

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8	institutionally very thin for a knowledge economy		
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22 the sense that although there may have been awareness of the importance of a certain  
23 policy issue among a small number of local champions, the issue in question is becoming a  
24 national

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10 have been able to strengthen the educational and research institutions

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34  
35 Relationships between the national and local level have not been without problems and  
36 tensions. For example, within the last ten years,  
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43 the majority of the R&D project funding has been geared to

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competitive bidding, which is generally considered to bring in both transparency and quality in decision-making, although it is sometimes also seen to favour those city-regions that are already in a strong position.

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All in all, the innovation capacity of many Finnish city-regions has increased a lot during the last decades and especially in the 90's, especially the explorative capabilities have improved and many important institutions are now better connected both nationally and internationally than earlier. In addition the capabilities in local strategy making have steadily improved, even though there is much space for further improvements too.

In the cases discussed here it is also evident that in designing and implementing new policies the self-reflexive capacity has improved and it is at least partly due to quite a close interaction between academics and policy-makers. In all the cases discussed here, Tampere, Jyväskylä and Seinäjoki, we can detect academics who have played important roles in various reinvention processes. In many cases these people have been the "interpretive force" that has been able to connect international trends, national policy-thinking and local needs and resources conceptually together and hence aided in translating them into action. Tentatively we conclude that at the local level it is a core development coalition, a group of individuals from business, local government and the Academia, who often has acted as a nexus in the unfolding co-evolutionary process between national and local. But then again, having often a short cognitive distance local development coalition may get stuck in political, cognitive and hence also structural lock-in situations and many national level agencies, National Technology Agency (Tekes) for example, have often been able to prevent these kind of situations occurring by utilizing its national institutional power. Local development activity being high in Finland, and many sub-regions competing for investments and nowadays for talented people, there always is a danger of fragmenting the scarce resources of a small

country in too many locations, and hence these kind of national balancing powers are still needed.

In a co-evolution between the national and local, a national level has been important also in a sense that although there may have been awareness of importance of a certain policy issue among a small number of local policy-makers, the issue in question becoming a national level issue and policy priority has only created enough backing and pressure to implement related policies locally. Vice versa, many feasible and successful locally initiated policies have fed into the national level policy-making.

There indeed have recently emerged more and more critical voices pointing out that the institutional thickness of the country is already too thick, i.e. constituting many structures that overlap and/or are too insufficiently provided by resources to be efficient. Earlier some overlap and, for example, a number of small intermediary organizations were seen worthwhile in order to test and learn different models of knowledge transfer and innovation commercialization, but recently a criticism has increased demanding greater efficiency from economic viewpoint and to gain more strength in efforts of internationalization. Some of the cities have already begun to streamline their development agencies along these lines. From our point of view, these kinds of policy-conversations are an essential element in a never-ending co-evolutionary process between national and local.

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