



UNIVERSITY
OF TAMPERE

This document has been downloaded from
TamPub – The Institutional Repository of University of Tampere

Post-print

The permanent address of the publication is
<http://urn.fi/URN:NBN:fi:uta-201308011292>

| | |
|---------------------|---|
| Author(s): | Sotarauta, Markku |
| Title: | Policy learning and the 'cluster-flavoured innovation policy' in Finland |
| Year: | 2012 |
| Journal Title: | Environment and planning C: Government and policy |
| Vol and number: | 30 : 5 |
| Pages: | 780-795 |
| ISSN: | 1472-3425 |
| Discipline: | Political science; Social and economic geography |
| School /Other Unit: | School of Management |
| Item Type: | Journal Article |
| Language: | en |
| DOI: | http://dx.doi.org/10.1068/c1191 |
| URN: | URN:NBN:fi:uta-201308011292 |
| URL: | http://www.envplan.com/abstract.cgi?id=c1191 |

All material supplied via TamPub is protected by copyright and other intellectual property rights, and duplication or sale of all part of any of the repository collections is not permitted, except that material may be duplicated by you for your research use or educational purposes in electronic or print form. You must obtain permission for any other use. Electronic or print copies may not be offered, whether for sale or otherwise to anyone who is not an authorized user.

Authors' copy - for citation, please use the original: Sotarauta M, 2012, "Policy learning and the 'cluster-flavoured innovation policy' in Finland" *Environment and Planning C: Government and Policy* **30**(5) 780 – 795

Markku Sotarauta

Policy Learning and the 'Cluster Flavoured Innovation Policy' in Finland

Abstract

This article aims to shed light on the attempts that have been made to adjust Finnish policy-making to the changes in the global techno-economic environment, as well as to the meta-rationales behind the evolving cluster flavoured innovation policies (CFI). Policy learning is discussed with reference to the main cluster and innovation policy changes in Finland and related conceptual development. The main aim of this article is to paint an overall picture of Finnish cluster flavoured innovation policies and learning related to them as well as analyse how efforts to redesign the policies have been unfolding over the past 20 years. This article is based on a) secondary data, ie earlier studies and reports on the Finnish cluster and innovation policies and b) data from two empirical studies.

Keywords: Cluster policy, innovation policy, policy learning, governance, Finland

1 Introduction

This article surveys the role of learning as a mechanism of policy formation in the context of cluster and innovation policies in Finland. Policy learning is discussed with reference to the main cluster and innovation policy changes in Finland and related conceptual development. Fairly often, as Flanagan et al (2011) maintain, innovation scholars implicitly assume an unproblematic and straightforward translation of policy recommendations into the formulation of related policies. Indeed, as Laranja et al (2008) observe, much of the existing literature on the rationale for science, technology and innovation policy deals almost exclusively with ‘derived theoretical rationales’ while generally ignoring the role of ideas in the actual policy process. As the authors argue further, “the fact that a certain prescription can be derived from an academic theory and mapped onto a policy instrument observed to be in common use does not demonstrate a cause–effect relationship between the two. Where policy thinking and scholarly theory relating to innovation converge, both may be responding to other influences” (Laranja et al 2008; page 824). In acknowledging Laranja’s et al observation, this article aims to show how theory and policy formation have co-evolved over time, and how, in Finland, attempts have been made to adjust policy-making to match the changing situations.

Being a fairly early adopter of the Porterian cluster approach and a very early adopter of the concept of an innovation system, Finland presents an interesting case for an analysis of both policy learning and the evolving cluster and innovation policies for four reasons: a) After being hit by a deep crisis in the early 1990s the Finnish economy showed an unprecedented recovery (Honkapohja & Koskela, 1999), b) Finnish public policy played a key role in turning Finland into a knowledge economy (Boschma & Sotarauta, 2007), c) there are signs of simultaneous institutional rigidity and flexibility (Veugelers et al, 2009) and d) there is a danger that Finland is “at risk of becoming a victim of its economic success”, as Sabel and Saxenian (2008, page 13) provocatively argue.

The main aim here is to paint an overall picture of Finnish cluster flavoured innovation policies, and to examine their evolution, as well as analyse how efforts to redesign the policies have been unfolding over the past 20 years. As will become evident below, the target of contemplation is on the move and only time will tell how well all the reforms carried out in Finland will actually play out and contribute to the economic and societal development of the country. At this stage it is possible to assess the changes in the policy rationale and the ways that the main programmes are organised, but their impact remain uncertain.

This article is based on a) secondary data, ie earlier studies and reports on the Finnish cluster and innovation policies and b) data from two empirical studies. The most important source of data, insight and observations is the International Evaluation of the Finnish Innovation System (2008-2009) in which the author was a member of

the panel evaluating the new broad-based innovation policy. Altogether, 50 interviews were carried out and, the entire evaluation panel (18 members) collectively carried out another 50 interviews and commissioned several sub-studies on some of the aspects which were identified as crucial (see Veugelers et al 2009). Secondly, data was drawn from the eight country European project 'Constructing Regional Advantage: Towards State-of-the-art Regional Innovation System Policies in Europe' (2008-2010), which used 95 structured firm level interviews and 40 policy interviews (Finnish share only) (see more detail on data in Sotarauta et al, 2011).

2 Policy learning and new modes of governance

In an era of governance involving a wider range of actors (Peters & Pierre, 1998), simple bureaucratic, hierarchical and linear models of policy making and implementation are of little explanatory use. Indeed, both the ways in which policies are shaped and ways in which they aim to influence their targets need to respond to the shift from government to governance, and from hierarchies to networks (Powell, 1990). It has been increasingly realized that the problems of the policy programmes of a centralized and compartmentalized government lie in the fact that various networks and contemporary wicked issues refuse to be bound by administrative or regional limits. Decisions concerning issues are often made within several organisations, both public and private. Different programmes and decisions may be contradictory because they are split between various networks without perceiving the whole (Sotarauta, Horlings & Liddle, 2012) and therefore, defining the problem and designing appropriate solutions is a difficult and daunting task. Governance stresses that a number of agencies ought to be able to exchange resources and align their competencies if they are to deliver public policies effectively (Stone, 1993; Stoker, 2000, pages 91–92).

Consequently, as Liddle (2003) points out, it is difficult to understand the process involved in the formulation and execution of policy. It is also difficult to provide a logical evaluation of a policy cycle, due to the complexities of governance, and the fact that we cannot always know who formulated the policies, how they were implemented, and by whom. Moreover, it is difficult to tease out how policies arise on the agenda, how they reach the statute books (Liddle, 2003; Sotarauta, Horlings & Liddle, 2012), and how, in turn, they are implemented elsewhere in the network. To overcome these difficulties, there is a need to understand, as Laranja et al (2008, page 824) suggest, the 'rationales' that shape policy choice. Such rationales can be divided into two groups. Firstly, *governance policy* rationales are visions of how to make and effect policy action. Second, *production* rationales are those derived from specific concepts and theories, which inform the design and implementation of specific policy instruments. While these are often seen as interacting with each other on a continuous basis in order to influence policy choice, in line with Laranja et al (2008),

these two rationales are seen here as two layers of a policy rationale. Laranja et al call governance policy rationales 'meta-rationales'. These are higher-level philosophies about the proper modes and limits of government action that in practice are often informed by ideological positions. These meta-rationales influence the way in which specific ideas are taken up and translated into specific policy rationales (Laranja et al, 2008). This article focuses on the changes in the Finnish meta-rationales guiding the array of specific policy rationales.

Policy learning is believed to occur within a dynamic governance context, which includes institutions framing the policies and actions derived from them. As Mytelka and Smith (2002) point out, "the understanding of the innovation process is closely connected to the effects of learning within the policy systems. The process of policy learning cannot be separated from the development of the field of innovation itself, so that theory and policy are best seen as co-evolving" (Mytelka and Smith, 2002). Indeed, as Lundvall (2007; page 39) states, "policy learning can be viewed together with technological, organisational and institutional learning as an integrated part of the learning economy. It implies that policy making itself is a process of learning.

3 Cluster and innovation policy enters Finland

In the early 1990s, in three years, Finnish industrial production decreased by over 10 % and real GDP by over 10 %. Unemployment rose in a few years from below 4% to nearly 20 %. (Honkapohja & Koskela, 1999). It was obvious that without major structural changes Finland could not escape its economic destiny on a low-road. Production rationales and specific policy rationales were questioned and there was a need to find a new meta-rationale for industrial and economic policies. It was acknowledged that the strongholds of the Finnish economy could not significantly reduce high unemployment. Additionally, a macro-level economic policy with regular devaluations of the currency was no longer an option. As Schienstock and Hämäläinen (2001, page 34) maintain, Finland had to find a new growth path, as continuing with the old one simply was not an option. And indeed, the rapidly worsening economic situation led to a clear shift in dominant policy thinking, the meta-rationales guiding the policy mix. The government recognized that it needed to foster the international competitiveness of its industries and to do this as inexpensively as possible. (Schienstock and Hämäläinen, 2001.)

Consequently, as Honkapohja and Koskela (1999, page 400) explain, the emphasis shifted from short term macroeconomic policies to longer term microeconomic oriented policies. It was acknowledged that sustained national competitiveness is largely created at the micro level; in firms, financial institutions, and various innovation oriented organisations, instead of trusting politically guided institutions as much as had been done before (Honkapohja & Koskela, 1999, page 400; Rouvinen & Ylä-Anttila,

2003; Hermans et al, 2005, 135). All this was influenced also by Porter's cluster model (1990) (see e.g. Roeland & den Hertog, 1999).

The adoption of the cluster as one of the key organising concepts for industrial policy was a step ahead in finding new ways to promote economic development across the industries and sectors. A cluster, as defined by Porter (2000), is a concentration of companies, research institutions, public development agencies, and other organizations supporting either directly or indirectly the development of both each other and the entire cluster. This thinking responded adequately to the requirement for a more interactive understanding of economic development and industrial policy. Clusters were seen essentially as economic development tools, the main rationale of which was to identify sources of national competitive advantage (Roeland & den Hertog 1999, page 422). The main systemic failure that has been addressed is the institutional mismatch between knowledge producers and market needs and the main policy response was to enhance industry-university-research centre interaction. Also human capital development (increased levels of education) and technology transfer programmes belonged to the core of the policy repertoire.

Finland's cluster-based strategy was first outlined in the Ministry of Industry and Trade's National Industrial Strategy of 1993 (Kansallinen, 1993). The strategy was based on the extensive cluster analysis conducted by the Economic Research Centre of Finland (Etlä). Etlä's analysis followed Porter's original model very closely. This served the first cluster policy as an analytical support and a conceptual backbone. In practice, the first cluster strategy was designed by a very small group of civil servants in the Ministry of Trade and Industry (Jääskeläinen, 2000). The nationally important clusters identified in the study were: forestry (identified as a strong cluster); base metals and energy (fairly strong cluster); telecommunications, environment, well-being transport and chemicals, (potential clusters) and construction and foodstuffs (latent defensive clusters) (Hernesniemi et al, 1995; Kansallinen, 1993). The identified clusters were related fairly closely to the industrial sectors of the country. There was, however, also an attempt to understand interaction patterns within and between industries. Here, Porter inspired cluster analysis served as a useful tool for learning (see Hernesniemi et al, 1995).

Jääskeläinen argues that, as it was based on Porter's model, the Finnish cluster policy was seen as 'scientific', and as such it was seen as free of earlier political manifestations (Jääskeläinen, 2001). The attempt to ground policy making in more reliable knowledge of 'what works' using cluster analysis was enhanced by the recognized need for a more effective governance of complex economic systems. The concept of cluster may be abused, fuzzy and/or overly marketed (Asheim et al, 2006, page 22), or practitioners may use it differently from its analytical function. All in all, it has offered a new way to see industrial sectors and has served as a tool in policy learning. Indeed, whatever the outcomes of the shift in the meta-rationale guiding the policy making, the core actors of industrial policy making have clearly been engaged in

the reflexive social learning that constitutes one of the essential elements of interactive governance. The idea of cluster policy was very well received and its core ideas began to become widely spread.

4 Innovation system and policy enter Finland

Along with the concept of cluster, the concept of innovation system entered Finland in the early 1990s. As Schienstock and Hämäläinen (2001) maintain, Finland was at that time one of the few countries in the world that had begun to develop a consistent approach towards a cluster facilitating innovation policy. Prior to the economic recession of the early 1990s, Finnish public R&D policy focused primarily on individual enterprises rather than their contexts (Romanainen 2001, 381).

The new meta rationale was reflected in the idea of looking at the innovation process and policies from a broad perspective spanning education and science to the innovative activities of firms and the commercialization of technological innovations (Miettinen, 2002). Over the course of time, innovation policy began to dominate the policy discourse, while the true nature of clusters remained in the background and the concept was often used very loosely to describe very different kinds of economic concentrations. Therefore, the policy approach that began to take shape at that time is described here as a 'cluster flavoured' innovation policy instead of 'cluster policy'.

The concept of the innovation system provided policy making with a general but specific enough framework to search for a more systemic understanding of industrial and economic policy. With the rapid growth of Nokia (Ali-Yrkkö & Hermans 2002) and a strong engineering tradition (Tulkki 2001), Finnish policy makers were quick to accept that innovation is among the primary sources of economic growth in a global and capitalist economy; step by step policy explicitly started to focus on "new creations of economic significance" (see e.g. Edquist, 2005 for the concept of innovation). Consequently, cluster flavoured innovation policy began to find its place by establishing an explicit focus on institutional and political frameworks that were expected to support economic growth, renewal and innovation.

'How did it [the concept of the national innovation system] enter Finland? Well, we met Bengt-Åke Lundvall in Japan, in a conference, liked his presentation and then we kind of talked with him and thought this is something that might help us to reorganise and rethink our way of doing things ... it was quite early, don't remember exactly, 1990 or 1991 or so.'
[Senior innovation policy officer]

From the outset, Finnish innovation policy reflected the original thinking behind the concept of national innovation systems by emphasising the interaction between private and public firms, universities, and government agencies aiming to boost science and technology for economic benefits (see Niosi et al, 1993 for a concept of national innovation system). Additionally, the concept of the innovation system proved to be a useful tool for finding ways to view individual organisations as parts of the

larger whole. The new concept produced also a new political language for the policy makers (Miettinen, 2002).

Miettinen (2002) concludes that, even though the new language was quickly learnt among the policy makers, the concept of a national innovation system alone was an insufficient basis for policy-making. However, he also concludes that the concept permitted “a partial agreement in the usage of a term, thus allowing the participants from different collectives to maintain their original cultures” (Miettinen, 2002, page 19). Miettinen’s conclusion suggests that the concept of a national innovation system may well have been a useful tool in enhancing policy to see beyond conventional boundaries and to help to construct a more or less collective understanding that the public and private actors, who work to initiate, import, modify, and diffuse new technologies are not separate entities but form an interdependent network.

As Kaitila and Kotilainen (2008) observe, in the early phases of the development of the national innovation system, the key actors were all more or less public. Since then, private firms have become more important in the system and the Nokia-led information and communication technology cluster has played a particularly important role in Finland becoming one of the leading countries in the world in terms of innovation.

Simultaneously, innovation system development allowed different actors to join the new policy discourse from their own points of departure and thus interpretive flexibility was required to carry quite different meanings of the concept from time to time, place to place and actor to actor (Flanagan et al, 2011). The concept of an innovation system thus created a new vocabulary that enabled a new approach to policy making. Such new concepts as cluster and the national innovation system clearly affected the dominant social filter framing policy discussions and learning, i.e. the unique combination “of innovative and conservative elements that favor or deter the development of successful (regional) innovation systems” (Rodriguez-Pose, 1999, page 82).

With a new policy emphasis, Finland became a prime example of the search for new innovation policies that often culminated in a need to sharpen the linear flow of knowledge from science to technology to innovation, with the explicit goal of increasing R&D expenditure. All this reflects the fact that at the outset Finland followed the path of science, technology and innovation (STI) (see Lorenz & Lundvall, 2006). It is clear that the new policy emphasis was taken seriously and that the R&D expenditure grew rapidly throughout the 1990s and 2000s. Table 1 shows the growth figures nationally, in the three leading knowledge city-regions (Helsinki, Tampere, Oulu) and in one of the most rural regions of Finland (South Ostrobothnia)

TABLE 1. The growth of R&D expenditure (total, € milj.) and employment (person years) in Finland 1995-2009 (Source: Statistics Finland, PX-Web statfin database)

| | 1995 | 2000 | 2005 | 2009 | 95-09 (%) |
|-----------------------------|-------|-------|-------|-------|--------------|
| Finland | | | | | |
| R&D expenditure | 2172 | 4423 | 5474 | 6786 | 212 |
| R&D employment | 47866 | 68813 | 77275 | 79475 | 66 |
| Helsinki city-region | | | | | |
| R&D expenditure | 1027 | 1965 | 2275 | 2758 | 169 |
| R&D employment | 21928 | 29452 | 31789 | 33255 | 52 |
| Tampere city-region | | | | | |
| R&D expenditure | 189 | 606 | 835 | 1066 | 464 |
| R&D employment | 4675 | 8320 | 10552 | 10446 | 123 |
| Oulu city-region | | | | | |
| R&D expenditure | 174 | 493 | 688 | 1008 | 480 |
| R&D employment | 4032 | 6668 | 8145 | 8538 | 112 |
| South Ostrobothnia | | | | | |
| R&D expenditure | 9 | 25 | 30 | 30 | 214 |
| R&D employment | 118 | 349 | 393 | 312 | 164 |

The breaking of traditional silos has had mixed success but, with a new meta-rationale, the role of government started to change from being a driver to being a facilitator. As Georghiou et al (2003) conclude, this kind of cluster flavoured innovation policy has been accompanied by the government's highly solution-oriented and pragmatic attitude, which is reflected in the growth of close cooperation between the private and political sectors as well as with the universities. In spite of all the changes in policy thinking and practice, there was no master plan to restructure the Finnish economy and industry. Instead, an array of policy measures was working to the same end over an extended period of time (see Georghiou et al, 2003), and the emerging meta-rationale was the glue that held them together.

5 Towards a broad-based innovation policy

5.1 Meeting the strategic issues with a proposal for a new innovation strategy

In the early 2000s, after a decade of the launch of the cluster flavoured innovation policies, there was again a need to search for a new policy. This time the search culminated in a recognized need to sharpen the science, technology and innovation mode (STI) of innovation policy and to broaden the innovation policy spectrum towards the doing, using and interacting modes of innovation policy (DUI) (see Jensen et al 2007). Finland has translated STI/DUI division into policy language.

Finland thus began to move towards a broad-based innovation policy that stresses demand and users side by side with science and technology. This was outlined in the proposal for a new innovation strategy (Ministry of Employment and the Economy, 2008) and the Government's Communication on Finland's National Innovation Strategy to the Parliament (2008). The main policy objective of these documents was to create a broad-based and multifaceted innovation policy and to strengthen its implementation. According to the proposal, "a broad-based innovation policy facilitates the development and renewal of competence based competitiveness of industry, economy and the regions. It also advances the utilization of innovation activities in the public sector and society" (Proposal for... 2008). The opening words of the proposal reflect both the ambition and the concerns, which have motivated the new Finnish innovation policy:

"The position of a pioneer requires renewal ... long-term investments of Finland in expertise and technological research & development have produced good results, and its successful science and technology policy has created a basis for many successful industries. This provides a good basis for constructing the future. However, the challenges of growth and competitiveness can no longer be tackled only by means of a sector-based, technology-oriented strategy. Instead, a demand-based innovation policy must be strengthened alongside a supply-based innovation policy."

The Government's proposal defines innovation as "a utilised competence-based competitive advantage that can emerge from scientific research, technology, business models, service solutions, design, brands or methods of organisation and production". Consequently, a broad-based innovation policy derived from this definition is seen to "support the reform of policy sectors (such as social affairs and health, energy, transport, the information society, education and training, and regional development) through innovation". The DUI mode strongly advocated by the new innovation strategy requires a broader understanding about the innovation system than the STI mode. The broad definition of the innovation system emphasizes the wider setting of organisations and institutions affecting and supporting learning and innovation, including those actors that are not usually involved in R&D functions (see Asheim & Gertler, 2005 for more in depth conceptual discussion).

The broad definition of an innovation system is based on a general acceptance that innovation policy has wider objectives than science and technology policy while it incorporates elements of both (Lundvall & Borrás, 2005). Consequently, an innovation system can be said to cover a wide range of initiatives that are linked to the generation of practice-based knowledge and its utilisation (see Melkas & Harmaakorpi, 2012). The policy may focus on public procurement, creation of lead markets, boosting living labs, etc. In this kind of innovation policy practice various policy initiatives may be deliberately left at a generic level, even vaguely defined so that emerging needs and purposes can be widely supported (Sotarauta & Kosonen, 2012). This kind of innovation policy practice comes close to the thinking of Hamel and Välikangas (2003),

who propose that innovation can be encouraged via a decentralized funding system that emulates open markets. They claim that, just as nature conducts many evolutionary experiments in order to create a successful species, so many innovation projects should be funded to see which ones win out. Consequently, instead of being a linear process flowing from research to policy design to implementation, the policy aims to create a vague and shifting innovation space that is open to quick action and fresh interpretation of the constantly emerging landscape (see Sotarauta & Kosonen, 2012). In a way, the main idea is to cultivate all the perfectible ideas by supporting experimentation and then filtering the most potential and valued ideas from the whole myriad of ideas and finally passing them to the most suitable national level for funding channels and supporting systems.

Our interviews clearly show that, even though the proposal for a new innovation strategy and the call for the adoption a broad view of the innovation system as well as demand and user oriented innovation policies, many of the key actors approach the new openings with a narrow understanding of the innovation system. There seems to be a mismatch between the bold ambitions and philosophy of the new strategy and the actual reforms. (Edquist et al, 2009.) This confirms Laranja's et al (2008, page 825) argument that policy rationales are not necessarily directly substituted for each other but that new perspectives influence the evolution of policy rationales and that new layers of policy are overlaid over existing ones. The authors argue that the increased complexity of policy making and a tendency for policy instruments to become institutionalised over time explains why there sometimes is a surprising degree of continuity and contradiction in the many levels of a 'policy-mix'. (Laranja et al 2008, page 825)

5.2 Why a new innovation strategy?

Several issues have pushed Finland to look for a broader innovation policy. *Firstly*, there was again a recognized need to renew the strongholds of the Finnish economy. As Sabel and Saxenian (2008) state, "the core products of both industries – pulp, paper and packaging for the one, cell phones for the other – have become commodities in the fast growing markets in the rapidly expanding economies of the developing world." They conclude that the "... prospects of longer term growth in Finland will require rethinking ... [The system] that fuelled successful innovation ... appears to have become self-limiting in the global environment of the 2000s". *Secondly*, it started to become obvious that the once celebrated national innovation system was no longer capable of meeting the new requirements of a global economy. Indeed, as the international evaluation of the Finnish innovation system concluded, there are serious strategic issues challenging 'the Finnish model': a) Nokia conducts nearly half of the R&D business in Finland and even though 'it is not only Nokia', other R&D strongholds are needed; b) Finland is mediocre at non-technical innovation; c) the presence of the

Finnish scholars on the international scene is limited; d) the innovation system of Finland (including the higher education system) is still inherently national and inward-looking and e) the system is complex and too fragmented an entity, containing many small agencies with resources that are too limited (Veugelers et al 2009). All this has forced policy makers to search for new modes of policy making, and to learn both new meta rationales and instruments to support them. This process has not been without difficulties.

‘There was kind of panic, a policy panic. We did not know what to do but we simply thought that something new must be done, new on a global scale. It is a bit chaotic, but perhaps something is coming out of this all’ [Junior innovation policy officer]

Increasing international interest in ‘the Finnish model’ was sparked by high rankings in the World Economic Forum Growth Competitiveness Reports, as well as by the positive international media and research coverage. All this created anxiety among the key innovation policy makers in the government, the Ministry of Employment and the Economy as well as in the regions and localities. The question raised was whether the innovation system of Finland was actually as good as it was praised as being abroad. As one of the interviewees put it:

‘There is an endless row of groups from abroad wanting to learn our secret. What secret I ask... There is no secret. It would take a lot of time to host them all. We are selective about who to meet and what to tell them, and we don’t want to maintain any illusions [senior innovation policy officer].

Thirdly, the combination of the celebrated but stagnating national innovation system created a pressure to renew the policy and ‘seek for something new’ in a country that had for decades aimed to catch up with the leading economies but not to show the way internationally. Suddenly, an increasing international recognition and an almost compulsive need to show the international policy and research communities that Finland actually is as good as is it believed to be forced policy makers to renew their policies and strive to meet expectations.

6 The flagship programmes

There is no space here to cover all the reforms, designed to support the new meta-rationale, extending from the new University Act to structural reforms in the university system to a new flagship programme to restructuration of sectoral research to efforts to boost public sector innovation. The flagship policy initiatives that are briefly discussed here are those that have the cluster and innovation orientation; i.e. the Strategic Centres of Excellence for Science, Technology and Innovation programme and the Centre of Expertise programme. They were formulated in collaboration between national, regional and local policy actors as well as representatives from firms, universities and other research centres. The actual implementation of the policy was

carried out in a network connecting all the main players in Finland and was coordinated by selected actors located in the strongholds (cities) of the respective clusters.

6.1 Strategic Centres of Excellence for Science, Technology and Innovation

The Science and Technology Policy Council of Finland, renamed in 2009 as the Research and Innovation Council (RIC) and chaired by the Prime Minister, suggested in the summer of 2006 that the Government of Finland should start a new programme named the Strategic Centre of Excellence for Science, Technology and Innovation (a Finnish acronym SHOK is used as it is often used in the international context). Since RIC's role is to be a high-level advisor to the Finnish government and its Ministries' issues related to research, technology, innovation, this suggestion translated quickly into action. The first Centre, Forestcluster Ltd, was set up in spring 2007. It is believed that SHOKs will provide a new way of coordinating dispersed research resources to meet targets that are important for Finnish business and society. The overall objective is to promote the growth and renewal of the economy and to generate employment. (Nikulainen & Tahvanainen, 2009)

'There is a need to intensify and enhance the focus of university-industry co-operation. Of course, everything is so small and fragmented here. We launched SHOKs to find a better industry led focus in research. Specialisation and better focus, yes, that's what SHOKs are for.' [Senior innovation policy officer]

The SHOK areas selected by the Science and Technology Policy Council of Finland are forestry, ICT, metal products and mechanical engineering, energy and environment, health and wellbeing and the built environment. Each of the centres needs to be established in collaboration between companies, research organisations (universities, research centres) and funding agencies (most importantly Tekes¹ and the Academy of Finland [a joint agency for all the research councils]). At the core of every SHOK is a non-profit limited company that is responsible for organising and managing all the activities of a respective SHOK. The company is then responsible for mobilizing the relevant actors in the field with the aim to launch collaborative projects among Finnish and international partners.

Nikulainen and Tahvanainen (2009, 3) explain the operational mode of SHOKs as follows: "In each SHOK companies, universities, research institutes, and other partners will first agree on a joint strategic research agenda, basically a vision of the projected needs of companies regarding the development of technology and innovations five to ten years into the future. The SRA is then jointly operationalised into several long-term

¹ The Finnish Funding Agency for Technology and Innovation (Tekes) is a public funding and development organisation under the Ministry of Employment and the Economy, and with a budget of 552 million EUR (in 2009) it has a mission to enhance the development of the Finnish industry and the service sector through technology and innovation.

research programmes including their segmentation in individual projects... In the programmes, participants develop shared know-how, technology and service platforms and utilize shared research environments and research tools. The research programmes serve the purpose of laying a strategic foundation of knowledge and form a basis for the development of applications”.

Among the key motives in launching the programme is the idea of allocating new and existing resources in a new manner. In spite of cluster focus, public investments in Finland had traditionally been distributed rather evenly over all innovative activity on a project by project basis. With the SHOK programme the aim is to break this tradition and lay more emphasis on the predicted economic relevance of innovation activity without forgetting the significance of research as a prerequisite for it. According to the initial vision SHOKs would account for roughly 12-20 % of Tekes’ annual public support (total appr. € 552 milj.) for R&D and innovation by 2012. (Nikulainen & Tahvanainen, 2009; Edquist et al, 2009.)

There has been considerable enthusiasm for the programme among the innovation policy makers at a national level but critical voices have also surfaced. For example, Edquist et al. (2009) maintain that the first choices of SHOKs were largely based on the existing industrial strengths of Finland, and therefore the SHOK programme is actually a tool for enhancing and renewing the knowledge base and skills in traditional areas and in incumbent (mainly large) firms rather than aiming to renew the Finnish industrial structure. The design of the programme does not support particularly well the emergence of the kind of revolutionary knowledge that might make the existing knowledge and skills base redundant and thus enhance the renewal of the economy. (Edquist et al, 2009.)

Edquist et al (2009) also note that the lead in designing the research has been taken mainly by large companies (the major industrial owners of the SHOK limited companies) so that fairly conservative approaches may be adopted. The basic premise of the SHOK program seems to be that better fine-tuned innovation policies are needed to serve the needs of the industrial core of a cluster. The question now is whether the fine-tuning of existing strongholds and policy instruments will solve the recognized problems of the Finnish economy and the national innovation system. SHOKs may become too inward-looking as entities by allowing external parties to participate in the programmes only after the agenda has been formulated. It may be that external radical ideas and actors will not have access to the activities of a SHOK. (Edquist et al, 2009.) If the SHOKs dominate their fields in Finland, and if the access is limited, there will be a danger of shortening the cognitive distance and the creation of future lock-ins. Additionally, the balance between industry-led innovation and basic science is under heated debate.

‘It is not only SHOKs, the whole thing is beginning to be biased towards innovation. Where is science policy? Without science we shan’t have innovation in the long run, or shall we?’

Demand is a good emphasis but we should not forget science. Who actually knows what the needs are in a long run?' [Senior science policy official]

Also, university researchers have reacted to the new programme fairly sceptically and, according to a large survey (Tahvanainen & Nikulainen 2010), it is fairly commonly perceived that the reforms support the commercialization of research (Business) at the expense of academic endeavours (Research).

The Strategic Centre for Science, Technology and Innovation programme is an example of how the dominant meta-rationale translates into a major policy programme. However, the SHOK programme is in fact based on the existing meta rationale from the 1990s than the one which emerged in the late 2000s and the 2010s. All in all, as a concentrated, focused and customized scheme, it is an explicit effort to create a managed and co-ordinated multi-scalar approach to link all the main actors in selected fields in designing and implementing a shared R&D programme. This is multi-scalar because it does not explicitly focus on any spatial level but draws partners from different policy levels, business and research spheres. It aims to institutionalise dialogue between companies and research institutions by extensive industry lead research programmes.

6.2 The centre of expertise programme

The Centre of Expertise (CoE) Programme was first initiated and launched in 1994 as an objective programme under the terms of the Regional Development Act. Häyrynen-Alestalo et al (2006, 10) argue that '...the programme revolutionized regional policy thinking: thus far the leading principle had been to support the weak regions and to level out differences between the regions, whereas now the strongest know-how was taken as the object of development. The idea was to promote the already strong regions and fields of expertise and thus strengthen the knowledge-based economy'. Indeed, the CoE programme marked a change in policy thinking but in practice it was a continuation of many local development efforts (see Sotarauta & Kautonen, 2007). In the 1990s, innovation and technology moved to the core of many local and regional development efforts, with CoE programme providing a framework for these efforts.

'CoE is a national bottom-up programme. Regions design their strategy and select what clusters to focus on. Of course, they have their own partners and all. We (the ministry) simply screen, co-ordinate and aim at keeping the bar high enough.' [Senior regional policy officer]

In spite of all the investments local government and other local and regional development agencies have made in the innovation capacity in their respective regions, the national innovation policy does not fully recognize the role of local and regional development efforts (Suorsa, 2007). Still, without earlier local development efforts, a national Centre of Expertise Programme with strong local emphasis would

not have yielded positive results. With the launch of the SHOK programme, some tension between SHOKs and CoEs is now emerging, due to visible overlaps in their activities.

‘What’s the difference between SHOK and CoE, a good question [laughing]. Well, there are differences, of course there are. SHOK is a focusing device and CoE is a mobilizing device. SHOKs have a lot of state money, CoE much less, SHOKs are closed, at least more than CoE that is an open programme. Nevertheless, the target clusters are fairly close to each other’ [Senior innovation policy officer]

For some time, the CoE Program was the only national level development programme focusing both on clusters, regional economic development and innovation (though it did not use this concept at the outset). From eight regions (city-regions in practice) of the first programme period (1994-1998) the second CoE programme (1999-2006) expanded to cover the range of activities in regions that were significantly smaller and less knowledge-intensive than before (14 regions and two networks involved). At the same time, the non-technological fields of expertise, such as cultural business, chamber music, experience industry, design and new media, were incorporated into the programme. In a way, at that time the CoE program was a step towards a broad based innovation policy in a science and technology dominated policy environment (Asheim et al, 2011). The further expansion of the programme into new regions took place in 2003, when the number of centres implementing the CoE programme in 2003–2006 totalled 22, of which 18 were regional centres and four were networked centres with operations in more than one region.

The third CoE - programme period (2007-2013) introduced a new operational model and moved to stress the pooling of regional resources and competence at a national level and, for these purposes it introduced a new concept and focus. In the current phase of policy evolution, ‘competence cluster’ became the main organising concept and the key focusing device in efforts to enhance regional specialization and to boost cooperation between regions. At the same time, the belief is that a competence cluster enables a more efficient utilization of national resources scattered in different regions, and increases the critical mass needed in innovation activity to create CoEs with a stronger international appeal. Moreover, it is argued that a cluster-based model may lead the attention of regional players away from competition between regions and towards tightening international competition.

‘CoE is about specialisation between regions and pooling the small scattered resources. Regions are thinking small and acting small. This is one way to get them work together, and aim for something bigger. [Senior regional policy officer]

If the first two CoE periods were clearly part of the regional development policies, the third period introduces a closer connection to the national innovation policy. Partly this is due to the fact that the national coordination of regional development issues was transferred from the Ministry of the Interior to the newly founded Ministry of

Employment and the Economy, which is responsible both for regional development and innovation policies. The National Programme involves 13 national Competence Clusters, which include 21 regional Centres of Expertise.

The CoE programme aims to create a co-ordinated multi-scalar co-operation in the policy domain but in a quite different way from the SHOK programme. While SHOK is designed to enhance selected clusters by having an explicit industry focus with a strong emphasis on R&D, the CoE programme builds simultaneously on nationally important clusters while regionally embedded expertise aims to mobilize and network regional actors. Whereas the SHOK programme aims to boost innovation within selected clusters, the CoE programme is more predominantly a regional development tool.

TABLE 2. The national competence clusters and regional centres of expertise (coordinating cities highlighted with italics)

| | | |
|--|---|--|
| Living business <i>Helsinki</i> , Joensuu, Hämeenlinna, Lahti | HealthBio <i>Turku</i> , Kuopio, Oulu, Helsinki, Tampere | Digital Content <i>Helsinki</i> , Hämeenlinna, Tampere, Kouvola |
| Food Development <i>Seinäjoki</i> , Kuopio, Helsinki, Turku | Forest Industry Future <i>Lappeenranta</i> , Joensuu, Jyväskylä, Kajaani, Kokkola, Mikkeli, Turku | Health and well-being <i>Kuopio, Oulu</i> , Helsinki, Tampere |
| Ubiquitous computing <i>Oulu, Tampere</i> , Jyväskylä, Pori, Helsinki | Tourism and Experience Economy <i>Rovaniemi</i> , Helsinki, Savonlinna, Turku | Maritime <i>Turku</i> , Lappeenranta, Pori, Vaasa, Raahе |
| Nanotechnology <i>Jyväskylä, Helsinki</i> , Joensuu, Kokkola, Mikkeli, Oulu, Tampere | Energy Technology <i>Vaasa</i> , Joensuu, Jyväskylä, Pori, Tampere | Intelligent Machines <i>Tampere</i> , Hyvinkää, Hämeenlinna, Lappeenranta, Seinäjoki |

According to the Interim evaluation of the programme, the third phase of the CoE programme has integrated local aspects better into national aspects than earlier (see Pelkonen et al, 2010). It has simultaneously been one of the key ways in which the links between the universities, industry and public organizations have been consciously intensified. Additionally, the Centre of Expertise Programme has fairly successfully directed local, regional and national resources towards the development of selected internationally competitive areas of expertise. Realisation of the benefits in cluster-based activity, and proving them to various actors, has, however, taken more time than anticipated and practical implementation has not always succeeded as expected, and the success of operations has varied markedly from one cluster to the next. (Pelkonen et al, 2010).

All in all, the CoE programme has been an important tool in raising the strategic awareness of the significance of innovation and in building learning and innovation capacities throughout Finland. The cluster-based policy has motivated regions to consider more carefully their strengths and roles as parts of the wider networks. It has also encouraged the establishment of projects across fields of competence and application. All in all, as Kuitunen and Kutinlahti (2007) observe, the main goals of the CoE Programme have evolved with the changing economic landscape and the meta-rationales of policy making. The early stages of the programme were based on a sectoral technology policy, but in 2011 the CoE programme has been inundated by the search of practices for the broad based innovation policy.

7 Conclusions

According to Flanagan et al (2011), the innovation policy literature seems to imply that theory based rationales somehow might be the primary drivers of policy development. From this point of view, the policy process is believed to proceed in linear discrete stages, implying, as Flanagan et al (2011) point out, “a one to one mapping between scholarly ideas and policy rationales, and between policy rationales and policy instruments”. All this may lead to understanding a policy maker as being simply a passive recipient of given recommendations in an expert driven and technocratic policy process (Flanagan et al, 2011). This article contrasts the view, made visible by Flanagan et al, with a notion that policy making is a learning process in which theory, policy practice and feedback from the ‘real world’ co-evolve constantly. At all events, scholarly theories are seldom adapted “wholesale in a one-to one transfer of ideas to policy” (Laranja et al, 2008). In line with Mytelka and Smith (2002), the argument here is that there is a close connection between theory and policy, but that theory and policy ought to be seen as an integrated, co-evolving and interactive learning process (Mytelka & Smith, 2002).

The evolution of the Finnish cluster flavoured innovation policy can be seen as a continuous search for new tools and ways of thinking and acting. Finnish policy making in itself has comprised an evolutionary story. It illustrates the emergence of new theories and the policy instruments derived from them, including experimentation and selection, and finally the retention of new meta-rationales and policy instruments. However, beyond any doubt, the notion of a ‘broad-based innovation policy’ is not yet well specified and at this stage it is one of those ‘fuzzy policy-concepts’ that is as much a source of confusion as direction but is also a source of new questions and learning. All this is a problem from a linear policy making point of view but, from a policy learning point of view, new but fuzzy concepts may turn out to be good tools for acquiring new meta rationales as well as specific one. Well-known key concepts are ways to simplify a complex economy and integrate multiple sources of knowledge for policy choices. The rank ordering of knowledge sources is thus a fundamental pre-

decision, and the meta rationales here both implicitly and explicitly guide the selection policy instruments. Therefore, in a policy process, theories and key concepts are the pre-condition, a social filter, for the actual policy choices and the design of instruments. In future studies on innovation policy processes, there is a need for more in depth analysis of the knowledge hierarchies, which reflect scholarly and socio-economic-political circumstances. This will be needed to gain more insight into questions about which pieces of information penetrate the social filter, what kind of knowledge sources the policy learning processes are based on and what kind of knowledge will not penetrate the firewall generated by the influential key concepts.

References

- Ali-Yrkkö J, Hermans R, 2002, *Nokia In The Finnish Innovation System*, The Research Institute Of The Finnish Economy, Discussion Paper No. 811 (Yliopistopaino; Helsinki)
- Asheim B T et al, 2006, *Constructing regional advantage: Principles, perspectives, policies, Final report* (European Commission, DG Research; Brussels)
- Asheim B T, Coenen L, 2005, "Knowledge bases and regional innovation systems: Comparing Nordic clusters" *Research Policy* **34**(8) 1173-1190
- Asheim B T, Gertler M, 2005, "The geography of innovation: Regional innovation systems", in *The Oxford Handbook of Innovation* Eds J Fagerberg, D Mowery, R Nelson (Oxford: Oxford University Press) 291-317
- Asheim B, Isaksen A, Moodysson, Sotarauta M 2011, "The changing and diverse roles of RIS in the globalizing knowledge economy: A theoretical re-examination with illustrations from the Nordic countries", in *Dynamic Geographies of Knowledge Creation and Innovation* Eds H Bathelt, M P Feldman, D F Koegler (London and New York: Routledge)
- Boschma R, Sotarauta M, 2007, "Economic policy from an evolutionary perspective: The case of Finland", *International Journal of Entrepreneurship and Innovation Management* **7**(2-5) 156-173.
- Cluster policy in Europe - A brief summary of cluster policies in 31 European countries*, 2008, Europe Innova Cluster Mapping Project. Oxford Research AS.
- Crevoisier O, Hugues J, 2009, "Territorial knowledge dynamics: from the proximity paradigm to multi-location milieus" *European Planning Studies* **17**(8) 1223-1241
- Edquist C, 2005, "Systems of innovation", in *The Oxford Handbook of Innovation*, Eds J Fagerberg, D C Mowery, R R Nelson (Oxford University Press, Oxford) 181-208
- Edquist C, Luukkonen T, Sotarauta M, 2009, "Broad-based innovation policy", in *Evaluation of the Finnish National Innovation System - Full report*. (Taloustieto Oy, Helsinki University Print: Helsinki) 11-54
- Enright M J, 2003, "Regional Clusters: What We Know and What We Should Know", in *Innovation Clusters and Interegional Competition* Eds J Bröcker, D Dohse, R Soltwedel (Springer-Verlag; Berlin) 99-129

- Etzkowitz H, Leydesdorff L, (Eds) 2000, *Universities and the Global Knowledge Economy. A Triple Helix of University Government Relations* (London; Pinter)
- Flanagan, K, Uyarra, E., Laranja, M. (2011) "Reconceptualising the 'policymix' for innovation", *Research Policy*, **40**(5) 702–713
- Georghiou L, Smith K, Toivanen O, Ylä-Anttila P, 2003, *Evaluation of the Finnish Innovation Support System*. Publications 5/2003 (Ministry of Trade and Industry; Helsinki)
- Gordon I, McCann P, 2000, "Industrial clusters: Complexes, agglomeration and/or social networks?" *Urban Studies* **37**(3) 513-532
- Häyrynen-Alestalo M, Pelkonen A, Teräväinen T, Waltari S-T, 2006, "Integrating regional policy with technology policy – the experience of Finland", *Fennia* **184**(1) 3–17
- Hermans R, Kulvik M, Ylä-Anttila P, 2005, "International mega-trends and growth prospects of the Finnish biotechnology industry: Recent economic research and policy implications", *Journal Of Commercial Biotechnology* **11**(2) 134–145
- Hernesniemi H, Lammi M, Ylä-Anttila P, 1995, *Kansallinen kilpailukyky ja teollinen tulevaisuus* [National competitiveness and industrial future] (ETLA & SITRA; Helsinki)
- Honkapohja S, Koskela E, 1999, "The economic crisis of the 1990's in Finland", *Economic Policy* **14** 400–436
- Jääskeläinen J, 2001, Klusteri tieteen ja politiikan välissä: Teollisuuspolitiikasta yhteiskuntapolitiikkaan, ETLA A:33 (Etlä; Helsinki)
- Jensen M, Johnson B, Lorenz E, Lundvall B-Å, 2007, "Forms of knowledge and modes of innovation", *Research Policy*, **36**(5) 680-693
- Kaitila V, Kotilainen M, 2008 "Not Just Nokia: Finland" in *Small Country Innovation Systems* Eds. C Edquist, L Hommen (Cornwall; Edward Elgar) 355-402
- Kansallinen teollisuusstrategia* [National industrial strategy], 1993, Kauppa- ja teollisuusministeriön raportteja 1/1993 (Kauppa- ja teollisuusministeriö; Helsinki)
- Ketels C, 2009. *Clusters, Cluster Policy, and Swedish Competitiveness in the Global Economy*, Expert report no. 30 to Sweden's Globalisation Council
- Kuhlmann S, 2001 "Future governance of innovation policy in Europe—Three scenarios", *Research Policy* **30**(6) 953-976
- Kuitunen, S. & Kutinlahti, P. "Johdanto: miten lähestyä osaamiskeskusohjelman lisäarvoa muuttuvassa politiikkaympäristössä?" in *Osaamisklusterit innovaatioyhteisöjen rakentajina: Näkökulmia osaamiskeskusohjelman lisäarvoon* Eds S Kuitunen M-L Niinikoski (Oske; Helsinki) 7-16
- Legendijk A, 2000, "Learning in non-core regions: towards intelligent clusters; addressing business and regional needs" in *Learning Regions, Theory, Policy and Practice* Eds R Rutten, S Bakkers, K Morgan, F Boekema (Edward Elgar; London)
- Laranja M, Uyarra E, Flanagan, K, 2008, "Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting", *Research Policy* **37**(5) 823–835
- Lorenz E, Lundvall, B-Å (eds.) 2006, *How Europe's Economies Learn: Coordinating Competing Models* (Oxford; Oxford University Press)

- Lundvall, B A, 2007, *National Innovation System: Analytical Focusing Device and Policy Learning Tool*, Working Paper 2007:004. ITPS – Swedish Institute for Growth Policy Studies.
- Martin R, Sunley P, 2002, “Deconstructing clusters: Chaotic concept or policy panacea?”, *Journal of Economic Geography* **3**(1) 5-35
- May, P J, 1992, “Policy Learning and Failure”, *Journal of Public Policy*, **12**(4) 331-354
- Melkas, H. & Harmaakorpi, V. (eds.) *Practice-based innovation: Insights, applications and policy implications* (Springer)
- Metcalfe J S, 1995, “Technology systems and technology policy in an evolutionary framework” *Cambridge Journal of Economics* **19**(1) 25–47
- Miettinen R, 2002, *National Innovation System: Scientific Concept or Political Rhetoric* (Edita; Helsinki)
- Mytelka L K, Smith K, 2002 “Policy learning and innovation theory: an interactive and co-evolving process”, *Research Policy* **31**(8-9) 1467–1479
- Neuwelars C, 2001, “Path-Dependency and the Role of Institutions in Cluster Policy Generation”, Ed Mariussen, Å. *Cluster Policies – Cluster Development? Nordregio Report 2001:2* (Nordregio; Stockholm)
- Niinikoski, M-L, 2011, *Innovation: Formation of a Policy Field and a Policy-making Practice*, Aalto University publication series, Doctoral Dissertations 40/2011, (Helsinki; Aalto University)
- Nikulainen T, Tahvanainen A-J, 2009, “Towards demand based innovation policy? The introduction of shoks as innovation policy instrument”, The Research Institute of the Finnish Economy, Discussion Papers 1182 (Etlä; Helsinki)
- Niosi J, Saviotti P, Bellon B, Crow M, 1993, “National systems of innovation: In search of workable concepts”, *Technology in Society* **15**(2) 207-227
- Ormalä E, 1999, “Finnish innovation policy in the European perspective” in *Transformation towards a learning economy. The challenges for the Finnish innovation system*, Eds G Schienstock, O Kuusi, Sitra 213 (Helsinki; Sitra)
- Pelkonen A, Konttinen J, Oksanen J, Valovirta V, Boekholt P, Leväsluoto J, 2010, *Osaamisklusterit alueiden voimien yhdistäjänä – Osaamiskeskusohjelman (2007–2013) väliarviointi* (MEE Publications innovation 44/2010; Helsinki)
- Porter M E, 1990, *The Competitive Advantage of Nations* (Macmillan/ London)
- Porter M E, 2000, “Location, competition, and economic development: Local clusters in a global economy”, *Economic Development Quarterly* **14**(1) 15–34
- Proposal for Finland's National Innovation Strategy*, 2008, (Ministry of Employment and the Economy; Helsinki)
- Rodriguez-Pose A, 1999, “Innovation prone and innovation averse societies: economic performance in Europe”, *Growth and Change* **30**(1) 75-105
- Roelandt, T J A, den Hertog P, 1999, “Cluster Analysis and Cluster-Based Policy-Making: The State of the Art” in *Boosting Innovation: The Cluster Approach*, OECD Proceedings, 413-427
- Romanainen J, 2001, “The Cluster Approach in Finnish Technology Policy”, *Innovative Clusters: Drivers of National Innovation Systems* (OECD; Paris)

- Rouvinen P, Ylä-Anttila P, 1999, "Finnish Cluster Studies and New Industrial Policy Making", in *Boosting Innovation: The Cluster Approach*, OECD Proceedings, 361-380
- Sabel C, Saxenian A-L, 2008, *A Fugitive Success – Finland's Economic Future*, Sitra Reports 80 (Sitra; Helsinki)
- Schienstock G, Hämäläinen T, 2001, "Transformation of the Finnish innovation system: A network approach", Sitra Reports series 7 (Hakapaino Oy; Helsinki)
- Sotarauta M, Kautonen M, 2007, "Co-evolution of the Finnish national and local innovation and science arenas: Towards a dynamic understanding of multi-level governance", *Regional Studies* **41**(8) 1085-1098
- Sotarauta, M., Horlings, I. & Liddle, J. (2012) "Putting leadership in the sustainable regional development context" in *Leadership and Change in Sustainable Regional Development* Eds M Sotarauta, I Horlings, J Liddle (Abingdon; Routledge)
- Suorsa K. 2007, "Regionality, innovation policy and peripheral regions in Finland, Sweden and Norway" *Fennia – International Journal of Geography* **185**(1) 15-29
- Tahvanainen A-J, Nikulainen T, 2010, *Tutkimusympäristö muutoksessa –Tutkijoiden näkemykset SHOK:n, korkeakoulukeksintöläin ja yliopistolain vaikutuksista*, the Research Institute of the Finnish Economy, Discussion papers (Helsinki; ETLA)
- Tulkki P, 2001 "The Finnish way to the information society: Expanding engineer educations", *European Journal of Engineering Education* **26** 1 39–52
- Veugelers R., Aiginger K, Edquist C, Breznitz D, Murray G, Ottaviano G, Hyytinen A, Kangasharju A, Ketokivi M, Luukkonen T, Maliranta M, Maula M, Okko P, Rouvinen P, Sotarauta M, Tanayama T, Toivanen O, Ylä-Anttila P, 2009 *Evaluation of the Finnish National Innovation System – Policy Report* (Taloustieto Oy. Helsinki University Print; Helsinki)