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

The Co-evolution of Policy and Economic Development

A Discussion on Innovative Regions

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MIT-IPC-LIS-05-001

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Markku Sotarauta[1] & Smita Srinivas[2] [3]

1 Point of departure: Policy and Economic Development

The practical and philosophical focus of this paper is the link between emergence and intention for economic development, specifically as it relates to the development of technologically innovative regions. Hence the basic question underlying this paper is, when does economic development emerge and when, and how, can be it be shaped through intentional efforts? The great debates of most fields associated with economic development rest on emergence versus intention and the interplay between the two.

Many practitioners, and scholars too, see promotion of economic development as more or less a rational endeavor, and the typical story-line is "there were problems and/or opportunities, then we organized a strategy making process, defined a new vision for the region, and began to implement our policy, but unanticipated things happened and the outcomes were not what we envisioned". In this kind of thinking strategy is seen, idealistically, as more or less artful design, the basic premises treating strategies as explicit, consciously and purposefully developed and made in advance and without debate. (see Mintzberg 1978 and 1994; Barry 1987; Bryson 1988). Moreover, there is nothing inevitable about the path of technological innovations at a micro-level, and it requires deliberative interpretations and efforts, as many scholars have written about (more than can be simply cited here) from the standpoint of scientific and technological history and nation building (for example, Basalla 1988; Mokyr 1990; Rosenberg 1972; Nelson and Winter 1982; Nelson and Rosenberg 1993; Prakash 1999; Visvanathan 1985), industrial and economic development (typically, for developing economies, from scholars such as Gerschenkron 1952 and

[1] University of Tampere / Research Unit for Urban and Regional Development Studies (Sente). This paper is related to two Sente's projects: "Coevolution of Firms, Individuals and City-Regions [COFI-UTA] (no. 207416) funded by the Academy of Finland and "Local Innovation System" –project funded by Tekes and co-ordinated by MIT / IPC.

[2] Harvard University / John F Kennedy School of Government. This paper was completed during the Fellowship support of the UN Industrial Development Organization (UNIDO), which is gratefully acknowledged. MIT IPC funding for research on India, MIT IPC/LIS funding for research on Finland, and the Science, Technology and Globalization Project of the Belfer Centre for Science and International Affairs, John F Kennedy School of Government, Harvard University which provided a home base while writing this paper, are also gratefully acknowledged.

[3] Both authors would like to express their gratitude to Richard Lester for his support and comments, and to colleagues within the Local Innovation Systems project for fruitful discussions.

Hirschman 1958 and more recently Lall 1996, 2000; Westphal 1988; Amsden 1989; Chang 2002 and others), or specifically on technological capabilities for development (such as Bell and Pavitt 1993; Dahlman et al 1987; Lall 1996; Pack and Westphal 1986). The idea of shaping economic outcomes is nicely described by the literature on functional (not directed at specific activities with the economy) versus selective interventions, which are more directed (Pack and Westphal 1986 and Lall 1996, 2000). However, critics of the social shaping of scientific and technological innovation would argue that despite policy efforts, there is a clear momentum for broader technological impacts on society that cannot always be resisted (typically, Winner 1977; 1980, and in the development context, also Alvares 1992; Nandy 1988 and many others) and may not always pull in the same direction as desired economic development. [1]

Many practitioners and scholars do not appreciate the emergent nature of economic development and therefore they continue their efforts to better implement designed strategies or to design more "implementable" strategies. This approach allows no space for learning from developmental mistakes, nor does it recognize that policy is as much about action as it is about analysis. While prior analysis and knowledge of the situation at hand is necessary, a society cannot learn without acting. Therefore, distinguishing forms of development that are relatively spontaneous from those that have taken shape with considerable conscious policy formulation and co-ordination is an important task because it provides us with clues as to what we can direct and how, and to what extent, and under what circumstances.

In this paper, we discuss our basic premise that the gap between economic development strategies and their poor implementation cannot simply be removed by creating better intended strategies, tools or institutions. The "residual" of unexplained divergence between goal and outcome, in this sense, can be ascribed in part to the interplay, or co-evolution, between policies (intention) and self-organizing (emergent) development. Therefore, as we assert, in promotion of economic development the question is more about directing emergence rather than controlling it, and hence policy is one part of a complex system, with an important role to play. We see our exercise as complementary to those who have studied the co-evolution theory, both for development, for innovation, and for policy (for example, Mytelka and Smith 2002). We aim to tackle this question by merging notions of emergence, intentionality of policy-making, and evolutionary understanding of change, and hence we continue the efforts to provide bridges between the predominantly descriptive concerns of evolutionary theory and the prescriptive analysis of strategies at various levels (Dosi, Nelson & Winter 2000, 12; Sturgeon & Lee 2002).

Our research questions are embedded in this core focus on intention and emergence of innovative industrial concentrations: Do policy and economic development co-evolve, and if so, how? How do localized adaptation processes, institutions and intention of a policy-network drive

[1] The idea of emergence as developed in this paper is fundamentally different from the neo-liberal doctrine of free markets and/or individual rationality, but we do not explore the differences here.

strategic renewal of industrial clusters? What we aim to do here is to investigate how policy influences or (merely) witnesses development, how development feeds policy, and how this plays out in technologically innovative regions.

Development in the 20th century has been inordinately focused on teleogical development, from the Marshall Plan for Europe, to post-colonial (and ongoing) development especially in Asia and Africa, and more recently to post-EU development of less favored regions. From successful regions, ideas and models proliferate to others, perhaps none as dominantly as Silicon Valley. We therefore use it as a shadow case for discussion. Throughout this paper "region" will be used as a guide to different scales of localized, identifiable geography. Thus, nations are one type of region, but many of our examples will be drawn from city-regions, which sometimes bear policy and innovation histories that are distinct from the nations in which they are situated.[1] A variety of definitions of innovative regions have been proposed, such as those in which many innovative firms have relocated, or where innovative firms already exist, or where such firms have been able to reinvent themselves. Here we assume that an "innovative region" is one where novel goods and services are generated, and where clear and mutually reinforcing roles exist for government, universities, firms and other actors.

Co-evolutionary approach

For a variety of reasons explained below, we aim to address the questions posed above from an evolutionary perspective. In regional development studies it is being increasingly recognized that evolutionary thinking has a lot to offer in seeking answers to questions (see e.g. Boschma 2004; Lambooy & Boschma 2002). Clearly, both policy and localized emergent development have some interplay and adapt to each other, but this interplay is understudied as a two-way process. We do not assert that geography explains everything. Rather, we assert that in localized contexts emergence and directed development take separate forms and require more study. More specifically, we contemplate how evolutionary thinking, when linked to emergence, might serve empirical analysis of regional economic development.

Although the co-evolutionary approach is a heuristic device raising many questions of its own and is continually being developed in the theoretical literature, we use it because it provides us with a framework for understanding economic, technological and social change in the context of economic development. We are interested in seeing if a co-evolutionary perspective would provide us with a lens by which we could have a more comprehensive view of regional development processes. In discussing the co-evolution of policy and development, we draw on

[1] There are clearly some differences, for example, legal frameworks within a nation are often constant, but local incentives differ between city regions. This is a topic explored elsewhere. We use "region" here to develop some insights into varied localized histories, which are often glossed over in national analyses. For technological innovation, national institutions are very important, but we also witness distinct spatial concentrations and local idiosyncrasies.

varied cases from regions in Finland, India, and the USA to show heterogeneity in development, specifically technologically innovative development. The cases draw from the authors' previous works as well as cases in the Local Innovation Systems (LIS) project. The discussion is largely theoretical in nature, the aim being to open some new pathways of enquiry for empirical studies. We highlight our conceptual discussion with the cases, however, and the analyses are illustrative and descriptive in nature.

In discussing each case, a complication is that the mantle of success or failure is invariably tagged on to high GDP growth rates or population growth combined with numbers of start-up firms etc. There are few alternative development indicators linked to numbers of technological innovations, their type, their measurable impact, if any, number of people working towards these individual innovations, types of institutions involved in the history of the innovations, which policies preceded the innovation and which arose afterward. Furthermore, the extent to which innovation and technology policy and its outcomes are linked to the overall economic development of the average citizen would disqualify many cities worldwide from being considered as economically developing, even if they are considered to be technologically innovative. It is precisely because of these divergences in economic development outcomes that it is important to understand co-evolution of policy and development. Such a framework may provide us with some clues both about necessary metrics and case descriptions for further empirical study.

This paper is divided in four parts: In the next section, we briefly introduce the cases for discussion. Next, we elaborate the concept of emergence and contemplate its application in regional development studies. Third, we discuss evolutionary thinking and outline a conceptual frame to be used in the discussion of our cases, and fourth we discuss development of our case regions in the light of the evolutionary approach.

2 Introducing the main cases discussed

In this chapter we briefly outline what our cases are about, i.e. what their character is and what kind of transformations they have experienced. In our discussion we draw especially on the Finnish case-studies of the Local Innovation Systems project[1] and other research on India partly funded by the Industrial Performance Centre at MIT. In addition we draw on other studies of respective regions. The cases are deliberately drawn from a disparate sample of countries -- Finland, India and the USA -- to underscore our main point about the diversity of the paths taken as policy co-evolved with development in innovative regions. We do not elaborate the cases in detail and many important issues are not dealt with at all. Our discussion, however, is based on

[1] Martinez-Vela and Viljamaa 2004, Kostiainen & Sotarauta 2002 and Kolehmainen 2002 on Tampere; Srinivas & Viljamaa 2003 on Turku; Srinivas, 2004 on India, Sotarauta & Kosonen 2003 on Seinäjoki and Kosonen 2004 on Seinäjoki

elaborate and rigorous empirical work carried out in several empirical studies and our discussion arising from an analysis of these cases is conceptual in nature.

2.1 The Finnish cases

We discuss three Finnish cases: two major Finnish city-regions, Tampere and Turku, and one less-favored town-region, namely Seinäjoki.

When discussing the Finnish cases it should be noted that until the end of the 1980s, Finland lived according to the logics of industrial society, even though the problems in industrial life had been recognized earlier; in the 1990s a relatively fast turn of direction took place and innovation- and expertise-based development began to be stressed more or less at all spheres of society, and the national economic policy discourse began to be dominated by the theme of the knowledge economy and information society. (Kansallinen teollisuusstrategia 1993; Katsaus 1990…; Tiedon ja osaamisen… 1993.) When the knowledge economy and related issues were being discussed everywhere, i.e. in the media, conferences, literature, etc., and when the national bodies began to channel resources into it, the local "inspirers", the champions of development efforts, were thus able to utilize general societal discourse in their own argumentation and development efforts. It should be noted, however, that in some city-regions the seeds of the new era had already been planted earlier. Thus, for example, Tampere had already in the 80's focused more or less consciously on innovation and technology-based development.

Tampere is a city-region consisting of seven independent municipalities and its population is approximately 300,000 (the City of Tampere itself has a population of 205,000). It is the second city-region in Finland. Tampere has gone through a major transformational process during the past few decades. In the span of 40 years, Tampere has gone from being the leading town of industrialized Finland into one of the foremost Finnish cities of the knowledge-based economy. In 1960, there were approximately 33,000 industrial jobs in Tampere, which made up over 50 % of all employment. At that time the city was known as the Manchester of Finland, because it had a particularly strong textile industry as well as metal and mechanical engineering industries. Only in 1960 did the first university students began their studies in Tampere. By the year 2000 there were approximately 22,000 industrial jobs in Tampere, which accounted for 21% of all employment, and the number of university students was about 25,000[1]. (Kostiainen & Sotarauta 2002.)

In Tampere, three major transformation processes have taken place. First, the textile industry declined. Already before World War II the textile industry, which had been in a dominant position for over 100 years, had begun to decline. The recession of Tampere industry can thus be characterized as a recession of the textile industry in particular, because it was the textile industry

[1] Statistics Finland; see also www.tut.fi; www.uta.fi; the City of Tampere, result evaluation group.

that had been so massive and which, ultimately, lost most of the jobs. Second, of the traditional Tampere industries, only the engineering industry managed to retain its significant role. Against a background of industrial recession, it succeeded in renewing and developing technology of an increasingly high level. However, several mergers and rearrangements of ownership took place that resulted in ownerships being shifted to international corporations that are among the largest in the world. The engineering industry also knew how to exploit the possibilities that the technical university offered in its development work. Today a dozen of the engineering companies operating in Tampere are global market leaders in narrow business segments.

Third, new and rapidly growing business sectors have also emerged; particularly in the 1990's, the information and telecommunications technology clusters have grown rapidly. In less than five years, the ICT sector more than doubled in size in Tampere. In 1996 there were a total of 170 firms, employing 5,200 people. Employment increased in private firms from 3,000 in 1994 to 6,750 in 1997; an increase of 125.2 per cent. By 2000, the ICT sector employed approximately 10,000 people. If the media and new media sub-sectors and the related service and commerce sub-sectors are also included, employment rises to 15,500 people (Statistics Finland, the Tampere Region Centre of Expertise Programme 1999-2006, Kautonen et al. 2002; Kostiainen & Sotarauta 2002 and Kostiainen 2002).

Turku is the third city-region in Finland, and is a contrasting case to Tampere in its response to recession and in its lack of obvious political organizing. It consists of 17 independent municipalities and has a population of approximately 285,000 (the city of Turku has a population of 175,000). Throughout history, Turku has been one of the major ports in Finland and as the first capital city of Finland has long history in academia, culture and government. The city's traditional industries have been metalworking, shipbuilding, real estate services and construction, food and pharmaceutics and graphics and printing. Compared with other cities in Finland like Oulu and Tampere, Turku became active in proactive local economic development policy quite late. This was partly a consequence of the local industrial structure; Turku did not face industrial crises as severe as those confronted by Tampere and Oulu for example. But in the 1990's, due to national recession and fiercer global competition that resulted in a slow decline in its economic base, Turku became more active in economic development policies and attention turned to the emerging biotechnology cluster that is supported by strong university research activity in the fields of natural and medical sciences and the old pharmaceutical and diagnostic industry. Most of the new biotechnology-related companies have been established during the last 15 years. Indeed, its lack of an ICT base allowed it to find a new identity in a "high-technology" arena by merging various sub-fields of R&D using biotechnology such as food, materials and pharmaceuticals. Turku is thus less "new" in terms of its emergence, and more intentional through the creation of a new identity (Srinivas & Viljamaa 2003, 3-4).

Our third Finnish case, Seinäjoki can be characterized as a less favored town-region. Located in western Finland, Seinäjoki is a town with a population of approximately 30,000 and in the whole town-region of seven municipalities the population is about 70,000. Seinäjoki is a centre of the fairly large traditional agricultural area of South Ostrobothnia, with a population of approximately 200,000. The region's strengths and development potential lie in a traditional spirit of enterprise and a large number of small and medium-sized enterprises, the food industry, mechanical wood-processing, metal processing, and strong 'social capital' expressed in regional identity and cultural heritage. Weaknesses include resistance to change, minimal network cooperation, the dominance of primary production in the economy, a low degree of processing of goods and a low volume of exports. In addition, the region suffers a low level of higher education and research, brain drain characteristics, cut-backs in educational and research resources (see Regional Development plan 1994 and 2002; Sotarauta & Kosonen 2004.)

In South Ostrobothnia the educational level is the second lowest among Finnish regions. The innovation-supporting structures and innovation culture are weak, and most of the firms in the region are operating on short time horizons. Their development and innovation activities focus mainly on pragmatic problem-solving. Long-term R&D does not have a significant role in the majority of the regions' firms. The leading firms in the region, are at a high level technologically, but their numbers are estimated to be very low (Etelä-Pohjanmaan alueellinen teknologiastrategia 2003). The Seinäjoki case will be discussed in the light of emerging developments in the middle of and after major societal and economic transformation processes.

2.2 Indian cases[1]

India is hugely different from Finland, with a population of over a billion, a mix of agriculture, industry and services, and with some recent visible advances in the computer services sector and in pharmaceutical and biotechnologies. The march from nationhood beginning in 1947, and the years preceding it, created a legitimizing language for science and engineering as the vehicle for modernity and statehood (for example, see Nandy 1988; Viswanathan 1985; Prakash 1999). Indeed, while prestige had been associated with these disciplines since the previous century and woven into the discourse on a free India the country's future leaders, most visibly Nehru (see Nehru 1949), the professionalization of the disciplines and education, elite universities and technology as a direct means for development (and as a way to personal success) became embedded in society.

Despite the deliberate wedding of the rhetoric of science and technology to the uplifting of the masses, the outcomes have been mixed. Most Indians still live in conditions of poverty, ill-health

[1] Analysis was predominantly drawn from Srinivas, 2004 on Indian pharmaceuticals and biotechnology and various other secondary sources on Indian development. Extensive references can be found in Srinivas, 2004.

and lowered longevity. India remains a dichotomy of highly skilled professionals on the one hand, and illiterate citizens on the other. Understanding how policy co-evolves with development in innovative regions of the country is especially useful, and we discuss two Indian cities here, Bangalore and Hyderabad.

Bangalore is a city of approximately 4-5 million people and is growing rapidly, with various projections estimating 10-12 million people in the next 15 years (for a detailed empirical study and critique of the planning process for high-tech identity, see Heitzman 2004). Hyderabad is equally dynamic in terms of its output from computer services and biotechnologies. Both cities face considerable industrial pressures with their growth rates, with barely adequate infrastructure for roads, water and electricity in Bangalore, and Hyderabad coping somewhat better. Both cities have premier national research institutes and universities, such as the Indian Institute of Science, Indian Institute of Management, Indian Space Research Organisation (Bangalore) and the Indian Institute for Chemical Technology, and Centre for Cell and Molecular Biology in Hyderabad. Both cities also have large public sector companies which were pioneers in building national capabilities in pharmaceuticals, electronics, electrical engineering and telecommunications. With this concentration of skills and institutions, the cities have evolved in their scientific and technological identities, but are struggling to resolve poverty, infrastructure and education problems for the majority of the population. The peri-urban areas outside these cities are far worse off, enjoying neither the services of the cities nor the opportunities of education, to the extent they exist.

Since the 1980s, the nationwide economy has gradually been liberalizing, dispensing to various degrees with strict industrial licensing and ceilings on wealth, investment and industrial scale. Most popular discourse suggests that 1991 marked the start of the opening-up of the Indian economy. Indeed, this was a Balance of Payments crisis that forced the hand of the Indian government. This intentional liberalization is remembered more than the emergent nature of opening up that occurred earlier in the 1980s. Both occurred with policy intention of varying degrees, but the 1991 event precipitated a cascade of sorts. The development of both cities and their responses to the opening of the economy provide an opportunity to understand how policy and development co-evolve in innovative regions.

3 Framing the concept of emergence

Emergence is one of the core concepts in complexity theories (e.g. Gell-Mann 1995; Kauffmann 1995; Barabasi & Albert 1999) and is alluded to in theories of criticality (e.g. Stauffer and Aharony 1994; Grimmett 1999; Bak 1996.) These theories view systems and organizations as “complex adaptive systems (CAS)” that coevolve with each other and with their environment and identify points (times) at which a transition occurs. The progress in complexity science is

converging towards creating a theoretical basis also for coevolutionary research while criticality has been used predominantly in the physical sciences (e.g studying sand piles), but has some conceptual utility for development. (Andersson 1999; Kauffmann 1995; Barabasi & Albert 1999; Arenas et al. 2000.) Cascade effects occur when certain critical parameters and conditions are satisfied. A new system then emerges. Our view is that complex adaptive systems and their points of transition provide development studies with good points of departure, even if they raise significant methodological challenges for study. At a gut level, all scholars and practitioners know that regional development is a result of a complex web of intended and unintended actions and decisions of many agents internal and external to the region. Nevertheless, to simplify and abstract from this web of interactions, causality is often brought back in to direct development. For the purposes of further analytical development on co-evolution, we are asserting we may have to let causality go again without giving up the idea that policy-making itself is still vitally necessary even if the outcomes cannot be clearly predicted.

Complexity refers to the intricate relationships that arise from the interaction of agents that are capable in adapting in and evolving with a changing environment. Complexity provides an explanatory framework of how various agents behave; how they interact, relate and evolve with a large social ecosystem. Change in these systems happens in the context of intricate intertwining at all scales, and we can only be aware of change when different patterns become discernible. Especially important for regional development is the notion that micro-agent change leads to macro system evolution, i.e. before change at a macro level can be seen, it is taking place at many micro-levels simultaneously (McKelvey 1999; Gell-Man 1995; Holland 1995.) 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 lead to changes also at regional level; often development surprises "the developers" - sometimes the surprise is pleasant and sometimes it is less so.

According to Webster's dictionary [1] "to emerge" has the following meanings: 1) to come forth, as from water, 2) to come into view or notice, 3) to develop or evolve. Emergence thus refers to such qualities that are born as if from nowhere as a result of self-organizing processes and if looked at from the point of view of the "whole" it seems as if "things simply happen". (Johnson 2002.) Emergent properties or qualities are, as Mittleton-Kelly (2003) state, by their very nature unpredictable. They are not the sum of the parts, and a reductionist analysis of individual parts would not yield prediction of macro-level emergence. The emergent properties are created by the non-linear, non-determined connections between the parts (Checkland 1981; Holland 1995 and 1998), and as is almost habitual to note, the whole is something more than the sum of its parts. From these premises emergence can be defined as an overall system behavior that comes out of

[1] Webster's Desk Dictionary of the English Language

the interaction of many participants and it cannot be predicted or "even envisioned" from a knowledge of what each component of a system does in isolation (Holland 1998; Casti 1994; Johnson 2002). In a systems theory, emergence is especially related to the concept of the "whole" and it is stressed that any system needs to be studied as a complete and interacting whole rather than an assembly of distinct and separate elements. (Checkland 1981, 314.)

Chris Langton describes emergence in complex systems as order arising out of complex dynamical systems, in which an understanding of the interaction of 'the whole' and 'the parts' is essential. Langton states that from the interaction of the individual components -- the parts -- emerges some kind of global property, the qualities of the whole, something that was impossible to predict from what is known of the parts. The global property, emergent behavior, feeds back to influence the behavior of individuals and local interactions (figure 1). In the advanced economies, the aggregate behavior of various organizations and individuals produces the modern market economy that simultaneously provides agents with a constantly evolving overall framework in which their operations are embedded. (Lewin 1993, 12-13.)

The perspective provided to us by emergence also opens up an interesting view on the selection vs. adaptation issue. Quite often it is seen that both organizations and individuals act within an overall framework of the whole, i.e. institutions, organizations, etc., and they adapt and design strategies within the whole. Emergence stresses the fact that the global structure is actually produced by local interaction and thus agents at the same time create their environment and adapt to it. The influence of individual agents is, of course, minor, but in research, emergence opens up fresh insights on regional economic development (see Curzio & Fortis 2002). Emergent complex systems develop organically and without any predestined goals. This does not suggest that change occurs without any general laws. The capacity of emergent complex systems to learn, experiment and grow is not, however, based on the general laws governing the behavior of the whole but general laws directing the parts. (Johnson 2002.)

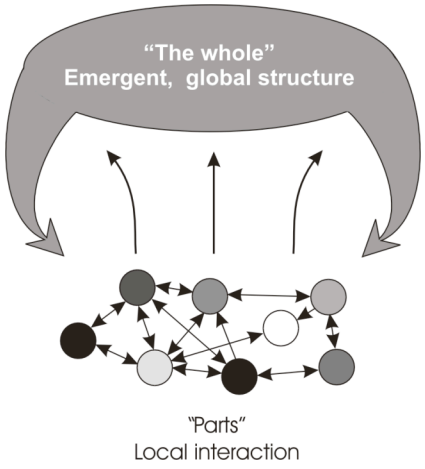

FIGURE 1. Chris Langton's view on emergence on complex systems (Lewin 1993, 13)

3.1 Linking emergence tentatively to regional development

This view of complex systems arising from interactions of the parts can be applied in many ways in regional development studies. It would be too easy simply to define the whole as a policy or set of policies and the parts as all those actors that are influenced by it. We rather see "policy" as one of the parts, nothing more, nothing less, and therefore from our research question's point of view the whole, the emergent global structure, can be seen as the biotechnology cluster of Turku, for example, and the parts, the local interactions, can be seen as various organizations and people within the respective cluster. There is no obvious mapping from one to the other in a simple additive way, but the outcome is often greater than the sum of its parts. Silicon Valley, perhaps the most famous example, is a prime example of the dynamic interaction of "the parts", of individuals, firms, universities, etc. creating something that is greater than they are by themselves.

The secret of Silicon Valley is not in any "grand design", but in the general laws directing individuals and individual organizations. We do not suggest any particular laws here but instead raise some features that affect the behavior of many actors. One of those features is a tolerance of failure, where a firm going bankrupt is seen as a learning process rather than as a stigma for the entrepreneur in question, and also tolerance of 'treachery' emerges as crucial, in the sense that entrepreneurs expect today's collaborator to be tomorrow's competitor, and quite likely the following day's partner again. In Silicon Valley, it has been stated, there is a certain risk-seeking of a restless, 'hypercompetitive' kind where the aim is to develop disruptive innovation that, albeit temporarily, dominates the field and realizes very large, rapid returns on investment. Also such features as reinvestment in the cluster, a 'civic interest' in bringing on new disruptive entrepreneurs and earning profits from 'angel' investments in the process; meritocracy where due acknowledgement is given to the quality of knowledge, ideas and innovation rather than status group membership, and product obsession or a mentality that seeks continuous improvement and discounts excessive working time as the means to secure permanent innovation, are worth mentioning (see more about Silicon Valley e.g. Saxenian 1985; Kenney 2000; Teece 1992; Sturgeon 2002; Saxenian 1994; Breshanan & Gambardella 2004; Lee et al. 2000.)

The guiding features of Silicon Valley are different from Finland where government, often in collaboration with firms and universities, heavily aims to influence the innovation activity of "the parts", firms and universities, by developing innovation system and seeking new directions by various foresight and strategy processes at every level. Being a small open economy dependent on global markets and developments there usually is a strong crisis awareness and acceptance of targeted policies in Finland. Crisis awareness refers to the fact that both people and organizations are always implicitly preparing for the worst, and thus, at every level organizations are engaged

in more or less collective strategy processes where an attempt is made to anticipate global developments. Whether these operations are effective or not, they are a sign of an accepted need for collective and proactive action to survive and prosper in the global economy. It can be noted that in Finland, there is a long tradition of aiming to guide "the whole" and thus influence parts too, and hence Finland represents a coordinated market-economy.

It is obvious that both in Silicon Valley and in Finland the whole and the parts are in a constant dynamic interaction. But this example highlights how differently innovation activity and regional development can be approached in two different parts of the world. The dynamics of this vary from region to region within countries too. Tampere and Turku, being among the major city-regions of Finland, host a variety of innovation oriented organizations and therefore they possess a better chance of developing as innovation environments in various fields than Seinäjoki, for example. In spite of quite a good organizational variety both Tampere and Turku have aimed for targeted and orchestrated policy efforts to create better local environments for innovation and hence boost innovation activity. Seinäjoki on the other hand is in a more difficult position. Its infrastructure for innovation has been underdeveloped and therefore Seinäjoki has focused on creating a local institutional basis for a local innovation environment, and networks to major universities elsewhere in Finland.

Finnish city-regions are small in a global perspective and they usually lack the variation needed for emergent developments and therefore it is generally accepted that targeted policies are needed to create proper environments for innovation and to boost innovation activities. Until the 1990's, the approach was more or less top-down and dirigiste, since then Finnish policy-making has been moving towards more communication and co-ordination based policy-making approaches where attention has been paid to co-ordination of both activities of the parts (agents at regional and local level) and parts and the whole (local agents and their relationship to national bodies and global developments).

In India, there are several features that hamper the dynamics of the parts, i.e. firms and other actors. The number of technology firms is still relatively small, and start-ups face failure stigma, challenging infrastructural constraints and a policy environment that has, necessarily, to account for investments and supports to both agriculture and industry. Cities such as Bangalore, however, are finding new identities as high-technology regions. In some sense, they remain Marshallian districts of the "old" economy (Heitzman 2004), with both innovators and policy makers struggling to find common vision, language or tools. It could be stated that even though there are many firms that are stronger than before India still lacks both the dynamics influencing the behavior of the parts.There is a need for vision and models guiding the development efforts, and there also is some acknowledgement that models other than Silicon Valley need to take hold, but many mental comparisons arise from engineers and scientists who have spent some time abroad,

or who are familiar with the models there. At the same time, historical visions of national S&T capabilities, indigenous self-reliance and distrust of large, foreign firms, all compete for acknowledgement. A high-tech firm is thus, simultaneously, embedded in both the local milieu and in national and international contexts, particularly for end products or services. The extent of local demand has influenced the different development paths of the information technology industries relative to pharmaceuticals and biotechnology, for which considerable local applications exist.

4 An evolutionary approach to economic development

4.1 The nature of evolutionary approach - limitation of current approaches in development and management

According to Boschma (2004, 1002) "evolutionary economic geography approach aims to understand actions of economic actors and paths of change in the context of time and space. It explains how behavior of agents is situated and conditioned, but not determined, by structures accumulated at the level of organizations and the environment." Actions and interaction of agents adapt, transform, upgrade, or lock-in regions, and often the result may be unforeseeable (Boschma & Lambooy 1999.) In evolutionary regional development studies the focus is especially on the dynamic interplay between agents, and between structure and agency in time, and as Boschma and Lambooy (1999) state, the aim is to analyze how human action, organizational structures and the surrounding environment interact and co-evolve in time in different spatial contexts, and therefore evolutionary regional development studies provide us with a platform to puzzle over the emergent nature of regional development and possible roles policy-making in directing it.

Theory development that is anchored in complexity, emergence and population ecology has created a theoretical footing for co-evolutionary research (Volberda & Lewin 2003). The evolutionary approach, which co-evolution studies is based on, aims to understand and analyze change processes and their dynamics instead of classifying the outcomes of those processes (Aldrich 2001, 35). Many of the development studies do not recognize confusion, ignorance and chance as forces causing and directing development. Classic science aims to eliminate uncertainty, but in evolutionary thinking systems are seen to be consisted of people who do not always know what it is that they do not know, and therefore they do not know how they will react when they will know "it" (Allen 1990, 569), and hence in this thinking ambiguity may be a source of innovation and development (see Sotarauta 1996; Lester & Piore 2004).

The evolutionary approach stresses adaptation, and as also with most ecological studies, it tends to ignore strategies and intentions of individual actors or collectives. On the other hand,

studies focusing on management, policy-making and strategies tend to ignore evolutionary forces. In management and economic development studies evolution is usually comprehended as a constantly progressing force (Nelson 1995), and in strategy literature evolution is often simply used to describe the development path. In recent strategy literature, however, by evolution is meant a unique development path shaped by learning, routines, practices, codifications, mistakes and competitions (Eisenhardt & Martin 2000.) But by necessity, most selecting events can only be recognized as such after the fact, not as strategic events for planned future responses. Evolution may have a general direction, as it often has, but as a concept evolution does not refer to change in any particular direction. In practice evolution is always dependent on the context, and thus, as Aldrich and Martinez (2001) state, from the evolutionary perspective process and the context constitute an interactive and recursive continuous process that affects the evolution of a population under scrutiny. Therefore integration of a context and a process is one of the key challenges in the evolutionary approach.

Any system under scrutiny is partly a memory of its past (Allen 1982, 110), and all evolution of human communities is an ongoing and imperfect learning process that is driven by the differences between expectations and experiences (Sotarauta 1996). In evolutionary thinking, the past provides systems with a range of possible states of the present, and in a way the choice is made in interplay of agents and environment. Each of these evolutionary phases appears as a final state of the system. This, however, proves to be a misconception as evolution continues its journey, and the ”final state” proves to be one chain in an endless chain of events, in a journey without a purpose (Ekeland 1990, 138-139.) In this kind of complex and evolutionary understanding of reality, it is not possible for agents to fully analyze their own situation or the environment, and based on those analyses to design optimal strategy. This does not mean that agents could not direct their own actions, shape the environment and influence the course of events. They can, but they always face certain restrictions. As Axelrod (1997) states, agents reconcile their strategies to those strategies that has been successful in the past, and to what and how the other agents are doing, and they also reconcile their actions with their selection environment. In addition they direct their strategies according to their own and that of others' interpretations of past, present and possible futures. From this point of view, regional development appears as interaction of ideas, visions and interests; both as competition and co-operation between them.

The question is often posed as a problem of agency, in other words how much scope people have for independent and creative action in proportion to the social, institutional and cognitive constraints. Drawing on Emirbayer and Mische (1998, 970), we define agency as “the temporally constructed engagement by actors of different structural environments – the temporal-relational contexts of action – which, through the interplay of habit, imagination and judgment, both

reproduces and transforms those structures in interactive response to the problems posed by changing historical situations".

Consequently, based on our rather constructivist understanding of agency, we aim to understand the dynamic interplay between structure and agency, and especially the interaction and co-evolution of human action, organizational structures and surrounding environment over time in different innovation environments. As Volberda and Lewin (2003, 2111) state, the extensive selection-adaptation literature covers diverse perspectives, but it still remains inconclusive on the role of managerial intentionality in organizational adaptation. We mix the "adaptation – selection" soup with a new ingredient by approaching it from regional development's point of view. If regions are seen as complex constantly evolving systems that are nexuses and platforms of many coevolutionary processes, then it may be possible to develop new understandings of intentionality and the role of policy-making in regional development too. Selection mechanisms also act to fuel entire industries, but differentiating between firms, and also localities, which succeed and those which lag is a non-trivial exercise.

For example, India's pharmaceutical sector has gone through multiple selection environments, of which the patent regime was only one part (Srinivas 2004), but even so the debates about the pharmaceutical industry's growth worldwide have been reduced to discussions of incentives through patents. Therefore to compare globally we easily oversimplify the processes locally and do both emergent and directed development a singular disservice. Similarly, in our Finnish cases, the national recession of the early 90''s acted in a selective manner and its effects played out differently across regions. Turku, for example, lacking information technology education and firms of the same caliber as some other city-regions, reconsolidated expertise in a new biotechnology identity but based on older skill sets (Srinivas and Viljamaa, 2003). Tampere, on the other hand, having quite a long history in education on information technology dating back to the 60's, emerged from the recession with a strong local concentration on information and communication technology, and digital media. In addition changes in the selection environment challenged the firms of Tampere to change and especially to increase efficiency, and as a result many of the mechanical engineering firms nowadays successfully integrate information and communication technologies with their more traditional competencies. (Kostiainen & Sotarauta 2002; Martinez-Vela and Viljamaa 2004; Kautonen et al. 2004).

To place all these regions, and many others, in the same development bucket must compel us to look at key evolutionary processes and selection environments and the ways in which policy and development emerged after each other, and in this endeavor such evolutionary concepts as selection environment, variation, selection and adaptation may prove useful in understanding how regions develop.

4.2 The key processes of social and economic evolution

In a social setting evolution is driven and occurring critical events are generated by four generic processes: variation, selection, retention, and the struggle over scarce resources (Aldrich 2001, 21). As Aldrich states, variation is a useful analytic starting point for understanding transformation from the evolutionary point of view. Any departure from routine, competencies or tradition is here seen as variation, and it is important to note that variation may be intentional or blind, in other words an actively generated alternative and solution to a problem or independently occurring and driven by environmental selection pressures. (Aldrich 2001, 22.)

The selection of new ideas and products is determined by the interplay between entrepreneurial competencies and certain environmental factors (Lambooy 2002, 1021), and all those forces that lead to differential selection or selective elimination of certain types of variations. These together generate a second essential evolutionary process – selection. As Lambooy states, new varieties that do not fit in to the perception sets of people and into the environment are bound to disappear, or raise potentially disrupting conflicts. The success of new varieties depends on the combined effects of cultural values and institutions, and opportunities to make profits in market environment. (Lambooy 2002, 1022.) Underlying the selection pressures and the search for effective variations is the scarcity of resources within organizations and between them, (Aldrich 2001, 26–33) and also between and within regions. Struggle occurs within organizations as their members pursue individual goals, and within regions as various organizations pursue their own goals, and between regions each pursuing their own goals. We propose that the struggle over scarce resources may lead to new varieties, to an overly heated "war" between agents and/or to new kinds of collaborative entities agents trying to generate more power into their own activities. All in all, the most important question in the light of co-evolution is what roles struggle and co-operation play in the emergence of new societal and economic directions that is in the processes of selection, variation and retention.

Retention, a third evolutionary process, involves the mechanisms for the retention of positively selected variations. Retention occurs when selected variations are preserved, duplicated, or otherwise reproduced so that the selected activities are repeated on future occasions or the selected activities appear again in future. According to Zollo and Winter (2002, 343), also replication is needed in the evolutionary tool-kit. It refers to the process in which new selected variations are replicated elsewhere, in another organization or in another location, i.e. in those populations that may utilize them. Replication simply refers to the fact that many actors aim to seek variations created elsewhere, to benefit from them. On the other hand, many actors, especially firms, work hard to spread their innovation to the markets.

The concept of selection environment directs attention to the fact that the intentional adaptation or a decision not to adopt often involves firm and inhabitant preferences, government

policies and/or a wide set of market factors that range from macroeconomic conditions to the leadership of individual companies. (Nelson & Winter 1982.) Selection environment consists of market, a set of non-market factors (especially institutions) and spatial structure (Lambooy 2002, 1021). Selection environment is not a static but it is constantly changing in the interplay with actors that either consciously or unconsciously aim to change it. Actors seeking to enhance their selection environment are often involved in the process of "negotiating with, convincing or placating regulatory authorities and the legal system" (Senker 1996). The spatial pattern of new successful firms and innovations is one of the outcomes of selection mechanisms. The firms that (intentionally or by accident) choose a location that offers good access to a highly-skilled labor force and high quality information and that has good logistical connections have a better chance to survive and prosper than those which cannot access these resources. As Boschma and Lambooy (1999, 414) state the location (and birth) of new firms and innovations may be quite random, determined by arbitrary factors. The firms and innovations emerge and expand in regions where the local selection environment happens to be right, i.e. where it fits into the particulars of global selection environment of respective industry and the need of firms and other organizations. On the other hand, as we discuss later, it is possible to influence the local selection environment so that it supports the emergence of firms and innovations.

The view opened up above to evolutionary thinking is summed up in the figure 2.

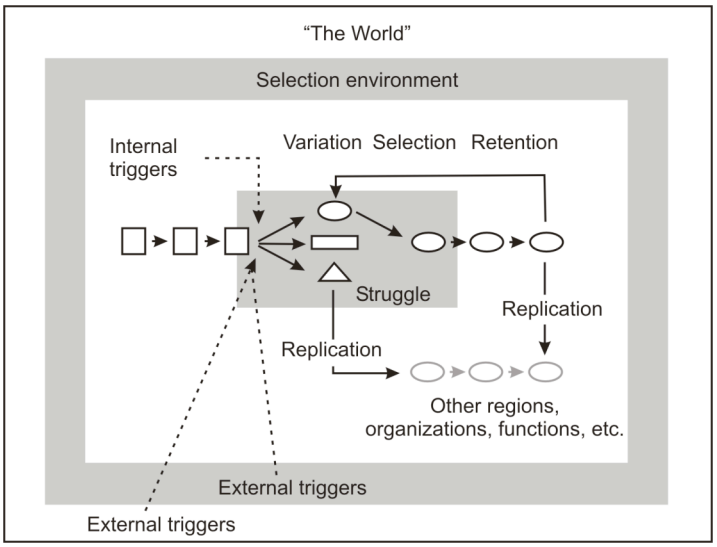

FIGURE 2. The basic conceptual frame of evolutionary approach (Sotarauta 2004)

Societies and industries "internalize" both "external" and "internal" triggers in different ways. More often than not, economics has tended to view external shifts as "shocks" to the economy, looking at long-term macroeconomic reach of equilibrium and not at specific local outcomes or by analyzing the micro-details of how societies adapt. Such analyses often ignore how selection

environments cull certain local capabilities but hone others in innovative sectors over time. Indeed, innovative capabilities themselves are often the result of this selection, and subsequent retention and variation (for the Indian case, see Srinivas, 2004). While selection outcomes are outcomes of a complex process, and clear causation is impossible, we know that some regions weather similar selection with greater resilience.

4.3 From evolution to co-evolution

In evolutionary studies competition has been seen as an essential component, and thus evolutionary studies did not earlier pay much attention to mutualism. These studies have not appreciated the fact that many entities do not struggle over scarce resources alone but in co-operation with other agents. The concept of co-evolution aims to fill this gap. (Murmann 2003.) As has already been noted above, the co-evolutionary view suggests that both environment and agency are important in the course of evolution. The selection environment influences the actors and actors, through their interaction, shape the selection environment and each other's development, consciously or unconsciously. Especially those actors that can be considered leaders or innovators change the markets, spatial structures and institutions so that it affects many other actors too. This kind of co-evolutionary process also guides and constrains, but does not determine, the competencies needed and developed by the actors.

On the general level, we see co-evolution taking 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 time in the respective agents. If an agent is merely responding to another agent's presence or activities by adaptation, we do not see that as co-evolution, because according to our understanding, 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 in time (Lewin & Volberda 1999; Murmann 2003; Volberda & Lewin 2003). Co-evolution also calls for reasonable evidence that the variations in each of the agents were a result of or were evolved from the interaction between the agents and/or their environments.

According to Volberda and Lewin (2003, 2128) most publications on co-evolution are conceptual in nature, and most of the empirical studies use a case study approach in which narration and a historical analysis are applied. They also argue that most studies with co-evolution in the title are actually not in reality empirical studies on co-evolution. Based on that observation they argue that more long-term studies of how industries and firms co-evolve and emerge over long periods of time are needed. It is also worth noting that empirical co-evolutionary research is distinct from traditional longitudinal studies of adaptation. (Volberda and Lewin 2003, 2128.) Many of the coevolutionary studies do not satisfy the certain requirements of co-evolution studies that are:

- longitudinal time series of microstate adaptation events;
- studying adaptation within a historical context;
- modeling multidirectional causalities between micro and macro co-evolution, where the outcomes of co-evolution are emergent and where changes in any one variable may be caused endogenously by changes in the other;
- analyzing for mutual, simultaneous, lagged and nested effects; being aware of path dependence (that enables and restricts adaptation);
- and using economic, social and political macro-variables that may change over time and influence the deep structure within with micro- and macroevolution operate.

  (Volberda and Lewin 2003, 2128; see also McKelvey 1997.)

Originally co-evolution was confined to co-evolution of two populations (see figure 3.B.), but it has later been used also in the analysis of co-evolution between various levels. (McKelvey & Baum 2001, 8). We suggest it is useful to distinguish between two processes embedded in a broader selection environment: the co-evolution of policy with technology and the co-evolution of policy with economic development. Our thesis is that within innovative regions, these two co-evolutionary processes come together in "successful" regions which are able to mediate their own futures for greatest local gain.

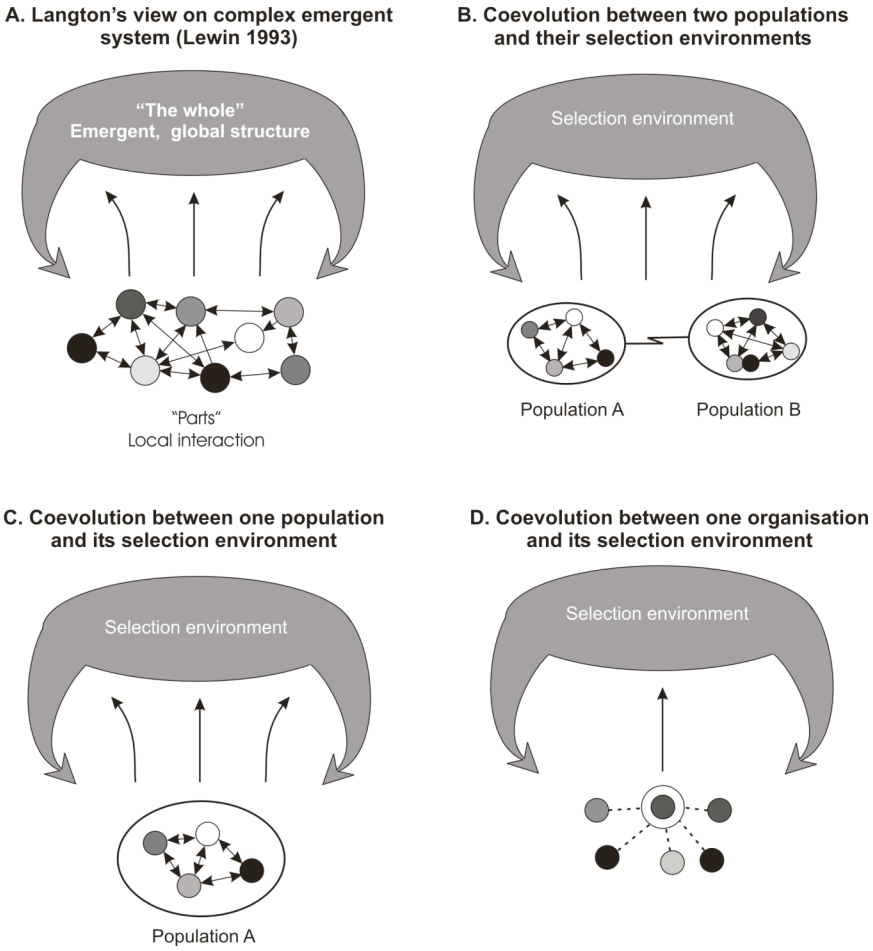

FIGURE 3 Langton's view on emergent complex systems and three possible applications in the coevolutionary studies (Sotarauta 2004)

The articulation of a compelling co-evolutionary explanation for the evolution of two populations involves two steps. First, one needs to show that they can be conceptualized as populations that undergo change through VSR processes. As part of this demonstration, one must spell out how the variation, selection, and retention processes work in each social arena. Second, the analysis needs to show that, indeed, bidirectional causal mechanisms exist that link the evolutionary trajectory of the two populations by causally affecting the variation, selection, and retention processes in each arena. Calling for new empirical research strategies and approaches the requirements for co-evolution studies are daunting indeed, and the question emerges if co-evolutionary heuristics can be used only to describe and illustrate developments but not to analyze them. Volberda and Lewin (2003, 2129), however, console by adding to their list of requirements that empirical research does not need to satisfy all of the above requirements in every study. At all events the key requirement is that co-evolutionary study should focus on the emergent properties that result from the interaction of individuals, subunits within the

organization or between organization and its environment. These emergent processes affect the variation, selection, retention and replication processes of populations under study. (Volberda and Lewin 2003, 2129.)

One of the most crucial issues in any co-evolutionary study is how to differentiate co-evolution from simultaneous development from the standpoint of "knowing when seeing it". A part of this is the issue correctly raised by some authors of the fact that the "final" population of firms can be used as evidence of both adaptation and selection, and thus the metrics become difficult to use uniformly in support of one or other hypothesis. This also suggests that the "survival as proof" plagues evolutionary studies in all fields.

5 Discussing the cases in the light of evolutionary approach

Evolutionary thinking allows us to approach our cases with the understanding that technological capabilities and localized skill sets evolve, as do the mutual interactions of policy with innovation and regional development. But metrics are relatively limited, save for some examples such as counting innovations, numbers of policy changes and types, patents (the truly limited metric) or regional growth measures. An honest appraisal must recognize that we cannot identify in each case, rigorously, the different elements that Volderba and Lewin (2003), for example, highlight of variation, selection and retention. Furthermore, the policy dialogue today (and the academic literature that follows and fuels it) that attempts to capture regional development does not explicitly recognize that an evolutionary process is underway, implicitly assuming that policy-making is a linear process, that all entering firms are homogenous, or that all institutions (such as universities) are the same etc. In terms of selection, therefore, we should hardly be surprised that some successes go through (the act of selection), some are selected out and a lot fail (low retention) since policy design has inadequately prepped these institutions for success. How can we view our cases as challenges for intelligent evolutionary policy development? Some clear trends emerge as food for thought.

To start with, in keeping with various authors (Schmookler 1966; Nelson 1992; Nelson and Rosenberg 1993), innovation also refers to the generation of products and processes new to the region, if not to the world. Clearly, the hypothesis is that an assumed learning process takes place which has broader implications for learning in the region (national or more localized). In the studies focusing on change, the most developed view is that change, emergence of variations and their selection, is motivated by triggers in a selection environment, i.e. some problem, a surprise, shift in technology or new customer may trigger changes (see March & Simon 1958; Cyert & March 1963). Indeed, throughout this paper we draw on various examples where innovation is not a clear causal outcome of policies, but arises at the intersection of more organic development

(emergent) and some economic policies (directed). Some interplay of factors, still only generally known, influences innovative outcomes.

To act as if all development arose from policies alone, or that policies were only born out of reaction to development, would of course be over-simplistic. However, we can differentiate between broad policy "regimes" at different times and the concurrent development, even if establishing cause and effect is very difficult. Even in the cases of pre-commercial innovations/inventions, the idea of the lone heroic inventor is gone, and the focus is nowadays more on the interplay of innovation environment and various networks striving for innovation and individuals and coalitions formed by them. Even the core elements of the "system" of innovation are often ex-post explanations (Arocena & Sutz 2000) when what emerging regions need are ex-ante guidelines for development. To say a successful region had a well-functioning innovation system is clearly circular reasoning, and on the other hand it also seems that development of innovation systems has been more retrospective than proactive. One might even argue that developing innovation systems is more for retention of already existing innovation activity than for creating new variations for innovation.

In Silicon Valley, new forms of organization seem to have emerged over time, linking professional identities (Saxenian 1994), but drawn from early state investments in defense R&D and local contractors and university links to the defense industry (Saxenian 1994; Markusen 1994; Sturgeon 2000; Leslie 2000). This link between universities and firms on the one hand, and both with the government and its various wings, has been gradual in development, and co-evolving all the while. What we see today is, as in all studies of development, an ex-post explanation for constant co-evolution of the "parts" and prior institutional forms. In Silicon Valley the foundation for innovation is strong and versatile; new variations occur constantly that are selected in the marketplace. In the early 21st century the economic development of Silicon Valley as a whole is quite clearly emergent in nature, and its capacity to learn, experiment and grow is based on the general laws directing firms and individuals and their interaction. Earlier public policies, defense policy for example, has influenced the emergence of the local environment as it is today but in the early 2000's variations emerge from a complex web of both local and global agents. Retention of innovation oriented and knowledge based activities occurs through dynamics of firm-firm and firm-university interaction. Replication on the other hand seems to happen between individuals and firms and aims for continuous improvement rather than direct replication of ideas created elsewhere. Indeed, if we were to re-assess Silicon Valley's own development from the standpoint of (co)-evolutionary processes, a huge spectrum of pathways for development emerge, with new actors and coalitions built and dissolved over time.

Silicon Valley clearly is one of the leading innovative regions, where the dynamics of firms and universities is at high level and explicit policies do not play a role at this stage of development. The Gerschenkronian thesis, (Gerschenkron 1962) that the later the development,

the greater the role of the State, suggests that where innovation is of low frequency or of low magnitude (success in market), governments see as integral their participation in ensuring a higher rate of innovative activity. However, the idea of spurring activity does not emerge fully formed all at once and is affected to considerable degree by the extent to which innovations themselves emerge. A city that has firms having some innovations of commercial value (e.g. a new semi-conductor chip design) or of particular relevance to solving a local problem (e.g. a treatment for some tropical disease) may pique the interest of its central government in assisting in some way, or as in Finland aim for concerted action at various governance levels. On the other hand, cities that have had no indigenous innovations may create local policies or to induce their national governments to act to improve this situation. The extent to which governments can enlist the machinery of the State to accomplish this feat varies across societies. Cities across the world have seen an intricate back and forth between their local development and policy evolution.

Regions begin to look attractive from an investment standpoint for both locals and outsiders when they have both abundant human capital, innovations occurring in firms as well as a receptive government. Normally one without the other is a more difficult 'sell' unless the government is willing to spend immense amounts of money, provide unsurpassable incentives for firms to relocate, or the wage differential is simply so attractive for firms to pass up and they move to the lower wage site whether or not much innovation or a responsive government exists.

5.1 Finnish cases translated to the evolutionary vocabulary

Our US case, Silicon Valley, is a prime example of a region where the innovation dynamics are guided by the rules governing the behavior of the parts, and both the huge variation and the struggle over resources and success, and the strength of the many companies and universities are the bases of adaptation of the whole region. At the same time it should be noted that Silicon Valley is one of those regions that is able to create the markets and thus force others to adapt to development born in Silicon Valley.

If approaching the coevolution of policy and economic development from local economic development policy point of view, it seems obvious that in Tampere development has fed many ways to policy-making and at some phases policy-making has clearly been reactionary. Especially during the industrial recession, policy-making was heavily influenced by the restructuring of the most important industrial sectors and policy making appeared more or less powerless at that time. At the same time it would be a crude simplification to state that Tampere has only been at the mercy of external developments and simply adapted to changes in its selection environments. However, it is very difficult to name the actors "who did it", because the leadership has clearly been shared both in relation to time and respective issues.

In mechanical engineering the most important actors were perhaps the firms who had to reinterpret their business and focus more clearly on their core competencies, and to integrate new technology into traditional engineering business. Many strategic choices made in the firms have been crucial in the wider selection processes too, and we might conclude that the engineering industry of Tampere was not selected out for three reasons: a) there was a long tradition and very good pool of engineering capabilities in the city, i.e. a good basis for variations to emerge and to be selected by the market forces and retained by the firms but also by local development agencies and universities, b) institutions created by the City and other major players were the foundation where new individual strategies had a possibility to grow, i.e. a good local selection environment that was responsive in times of change, and c) intense collaboration among firms, the city government and educational institutes made it possible to launch many important processes to enhance adaptation, and thus to affect also the evolutionary processes. Especially the crises were the force that brought actors together, and without going into details, it can be simplified that in different phases the main selection environment has been global economic change (oil crisis, collapse of Soviet Union etc.).

In these processes Tampere University of Technology has played an important role, and it could be concluded that when the selection environment for the engineering industry changed, the university and the firms were able to evolve together in a continuous reciprocal learning process (see Martinez-Vela & Viljamaa 2004). However, we should keep in mind that even though firms and universities were in key positions in the long transformation process of the engineering industry, and even though, at that time, the economic development policies of Tampere seemed powerless, policy-makers had already earlier (in the 50's and 60's) planted very substantial and proactive seeds for future policies. Without relocating two universities from Helsinki, it would have been more difficult to react to external changes of the 70's, and without the universities and technology centre founded in the mid 80's, it would have been more difficult to adapt to the rapidly changing selection environment and national policies in the 90's.

If we look at the other important development in Tampere, namely the rapid emergence of the ICT-cluster, we could conclude that it was made possible because the educational and research institutions provided the institutional basis for it, Nokia decided to locate many important R&D activities to Tampere, and the extremely rapid growth in the field both in Finland and beyond created such a tornado that both eagles and ostriches flew. In this case, after creating earlier the institutional foundation for ICT[1] (perhaps not actually knowing how far-reaching the decisions would be), the policy-making could later only witness the rapid developments and try to manage the rapid growth in the city.

[1] Two universities and more specifically, for example, the first Chair in computing in the Nordic Countries

On the surface the story of Turku has many similarities with the Tampere case. The decline of traditional industries forced policy-makers to identify new clusters and to forge new kind of links between universities, the public sector and firms. The difference is that institutional policy-making in Turku seems to have been more reactionary than in Tampere, and many of the new development initiatives have emerged from the private sector. Turku, however, did not experience such industrial crises in the 70's as Tampere did, and hence it did not have external triggers to force it to move into new policy-making regimes. Only in the 90's, when the economic base of Turku began gradually to deteriorate while other major Finnish cities were recovering better from the recession, did Turku's policy-makers react to changes. In a way, it could be simplified that changes in the selection environment forced the City and other main players to reinterpret their role in local economic development and to find new strategies to boost the local economy. However, it seems that rather than creating new strategies the city of Turku, in co-operation with other important actors, identified existing capabilities, aimed to create new horizontal interactions between firms and universities and thus make better commercial use of old capabilities. So, it could be stated that the new local economic development strategies of Turku were actually programmed descriptions of the current state that had not yet been identified, analyzed and internalized by the policy-makers, and thus the development strategies were especially collective reinterpretations of the economic base of the City and roles of major organizations. Therefore, in this case development feeds more to policies than policies to development, but because policies in practice have not only been plans to be implemented but very much also arenas for collective sense-making, they have substituted for new initiatives and collaborations, and therefore policies have fed back to development both directly and indirectly.

So, in the case of Turku, as in Tampere, the foundation for innovation is significantly thinner than in Silicon Valley but the global pressures are more or less the same in technology driven Finland. As in Silicon Valley new innovations emerge in Turku too, but the quantity and quality has been somewhat low compared to major biotechnology centers of the world. To face the challenge of increased innovation-based competition, Turku, as Finland in general and our other Finnish case regions too, has aimed to channel more resources to technology and innovation, to strengthen innovation infrastructure and to induce firms and universities to co-operate more and through these strategies to strengthen the foundation for variation and hence increase innovation activity. In Turku, universities have been slow to take on the mandate of more direct influence on regional development, pursuing instead individual technology programs and projects with some success. Technology projects funded by the National Technology Agency (Tekes) and the creation and implementation of the Centre of Expertise Program[1] (among other relevant development policies), have sought to induce innovation by persuading, through conditioned

[1] Co-ordinated by Ministry of the Interior (see http://www.oske.net/in_english/)

resources, universities and firms to work together. They have had mixed success (Srinivas and Viljamaa 2003).

All in all, the biotechnology cluster of Turku, and especially its institutional infrastructure has become stronger during the last 15 years. In Turku, selection has acted in at least three major ways: through national economic recession affecting all Finnish cities, through global mergers and acquisitions specific to the pharmaceutical industry, so concentrated in Turku, and through international changes particular to the science of biotechnology (see more about Turku Srinivas & Viljamaa 2003; Bruun 2002; Höyssä et al. 2004.) The local implications of these major changes in the selection environment on local capabilities both in university departments as well as small firms, were multiple, with implications for the growth of small and medium companies and their subsequent international migration, retention of larger pharmaceutical firms in the area, and regrouping of various biochemical and gene-based sub-sectors into a consolidated industrial base of new biotechnologies for a new Turku identity.

Both Turku and Tampere have aimed to strengthen their innovation capacities. A new innovation and knowledge based identity around specific industry-university interactions appears to have been more easily forged in Tampere than in Turku, and local policy-makers have been more proactive, cohesive and supportive in the former and slower in the latter. However, the political process and coalition-building that gave rise to Tampere's technological re-emergence in mechanical engineering with new skills built over time has been a long road (Martinez-Vela & Viljamaa 2004; Kostiainen & Sotarauta 2002). Both World War II as well as an early recession (relative to Turku's) in the 1970s, forced early dialogues and political coalition building that has assisted Tampere today. In Turku, the pressures to form new coalitions have been relatively recent dating to mid 90's, spurred more, one could argue, by external economic forces than internal political ones. The collective institutional responses of Tampere, then, appear more robust, and a common vision of the city-region older and hence also more focused and effective.

Seinäjoki differs in some sense from the Tampere and Turku cases, but there are also some similarities. Looking from knowledge and innovation oriented economy's point of view, it is clear that Seinäjoki has not had the institutions geared to economic success in a new selection environment. After the recession of the 90's the major city-regions of Finland (especially Tampere, Helsinki and Oulu but also to some extent Turku) outperformed smaller city-regions and rural areas thanks to their institutions and people who had lived in the 'information society' or 'knowledge economy' since the 60's, and thus there have been variations prior to recession and changing selection environment have carved some of them out, and thus it seems as if the whole city-region has been able to adapt to changing circumstances.

In the 90's, Seinäjoki faced a rapidly changing selection environment in which the capabilities of most of the firms and also policy-makers began to seem quite out-dated. Being a small town

Seinäjoki could not adapt to these changes on its own, and thus collaboration among the Town Government, regional authorities, firms and universities has played a crucial role. In Seinäjoki actors were brought together by the threat of changing economic development and a stubborn will to show the rest of Finland that "we are not yet finished". It is quite obvious that the policy-network of South Ostrobothnia (see Linnamaa & Sotarauta 2000) aimed to adapt to new situation and thus the new strategies were very reactionary in nature. Having said that, it should be noted that in spite of being reactionary new network oriented strategies created in Seinäjoki are unique in Finland, and thus, as in Tampere and Turku, also in Seinäjoki the question is quite largely about strategic adaptation. Only time will tell how well the strategies will meet the future challenges, but according to external evaluators the adopted strategies have a good chance to produce results. (Kinnunen & Eskelinen & Lehto 2004.)

In Seinäjoki, selection and retention, per se, were not the major issues of policy-making of the 90's. Initial heterogeneity and thus the foundation for variation were thin, and a critical mass of capabilities for innovation was missing and the institutional foundation for variation for radical innovation has traditionally been almost non-existent. Recognizing the importance of a new kind of skill base, and replicating some development models and hence learning from other city-regions of Finland, a new language and new development strategy was initiated in the late 90's (in co-operation with public development agencies, academics, media, and firms). Instead of rather inward looking conversations of the earlier phase, in the 90's the place of South Ostrobothnia in a more national and global environment was intensely discussed. Overall, the goal was to break away from perceived or actual path-dependency of "backwardness" and to create a new identity and skill base for "South Ostrobothnia in the information society". (Sotarauta & Kosonen 2004; Kosonen 2004.)

The main perceived threat in South Ostrobothnia was that global developments had begun to undermine the traditional industries, and there was a collective anxiety that many of the firms faced the threat of being selected out by new markets. In the 80's and in the early 90's, the main policy had been to strengthen the institutions of research and innovation, i.e. to found specialized development agencies to support firms and to induce universities to found branch units in Seinäjoki. (Linnamaa & Sotarauta 2000.) In the late 90's, even though small, these institutions provided regional policy-makers with a foundation for a next step and the focus was transferred to intensifying co-operation with universities by founding 16 new professorships that work under the auspices of five different universities and form a multidisciplinary community in Seinäjoki. (Sotarauta & Lakso & Kurki 2000; Sotarauta & Kosonen 2004). Sixteen professors and their research groups is not a major knowledge resource as such in any region. The aim, however, is that this community of scholars should link both firms and public development agencies to the major knowledge and innovation pools of Finland, and beyond, and thus strengthen the

foundation for variation and on the other hand work to retain important innovation activities in Seinäjoki.

From a policy perspective the implications of varied local, national and international developments seem unmanageable; the impacts of wider selection environments are not usually controllable. Therefore, large firms and highly skilled experts may indeed leave for better prospects elsewhere, or because international mergers might require them to. Reflecting more or less the national discourse and reacting to the gradual deterioration of industries in Turku, and the more pervasive industrial crisis of Tampere from 70's onwards, the development policies of both of these cities have aimed to strengthen the institutional foundation for variation and hence to create such a local selection environment that firstly helps to make sure that there is something in the city-region that can be selected by the market forces in the future too, and secondly to create an institutional setting that retains important functions, firms and people into respective cities as well as possible. In Turku, Tampere and Seinäjoki, a local perspective has thus focused on capability-building (or creating institutional foundations for new capabilities), i.e. on creating both educational, innovation and technology policies that focus on skills at individual organizational, and network levels (Sotarauta 2000). This focus on enhancing skills by strengthening institutions and networks deal both with selection (selecting few clusters to be made strong enough against an international weeding out process) and with retention (keeping firms local because skills are aimed to be developed abundant).

The economic development policies of these cities have more or less followed both global economic changes and national policy discourse, but a substantial amount of time and energy has been spent in creating a new local interpretation of Tampere and Seinäjoki as well as Turku, their industries and ways of promoting local economic development. By mobilizing local actors and expertise it has been attempted to develop institutions, structures and processes so that the responding ability of the city develops and the nexus to different global flows and networks improves. Hence, the objective has been to develop cities in such a way that, on the one hand, they have the ability to better retain important activities in them in order for global flows not to drain them away; and on the other hand, attract new activities to them. The question is therefore not one of the control of global resources, as is sometimes suggested (Merenne-Schoumaker according to Cabun 2001), but of the development of the cities' own ability to act as part of global networks and flows. (Kostiainen & Sotarauta 2002), and hence improve their adaptive capacity as a whole.

In a way, in all our cases, the question is about creating a local selection environment that acts as buffer between local actors and changes in the global selection environment. A second challenge is to have universities as "anchors" to further hone local capabilities for later stages of development. Nevertheless, despite the considerable differences even within Finland, a shared

thread between Turku, Tampere and Seinäjoki, was the local attempt to mobilize both local, regional and as much as possible national competences and resources to affect how selection influenced local outcomes, to retain the best resources and to systematically influence future variation and success in firms, universities and public organizations of other types. The regions have differed in their abilities to influence their futures, initial institutions for innovation and technological-specificity and international changes by sector have always swayed local abilities to do so. A narrative, often developed by policy-makers in conjunction with other actors in local society, and accepted by citizens, and discussed and co-evolving with events, has been a successful means of affecting their futures.

5.2 Co-evolution of policy with technology, not technology with local development - The case of India[1]

India, on the other hand, is a case that tells us a story about a system that was overly centralized -- the aim being to control and direct "the whole" and thus also the parts -- but that ended up lacking the dynamism of the parts, and thus local interaction has remained at a low level. Since the early 90's India has aimed to liberate its economy, and there already are strong signs of an economic recovery. India is, however, a country grappling with multiple economic identities: as poor, as sick, as scientifically sophisticated, as a technological base for off-shore services and computing, and as significantly agricultural.

In the Indian case, while external mechanisms like the WTO have had a selecting influence on specific technologies and the response of S&T institutions, a more important potential selector is basic social needs. In India, the dialogues about innovation have been more reactive to the West, and there has been less of an exploration of local markets, or for causes where there is no market, but a need. Therefore in policy-making intentional selection has focused on the question what are the clusters that the local innovation environments are developed for. This seems a reasonable question to ask. Nevertheless, we hope the cases show that there is a difference between the co-evolution of policy and innovation/technology and the co-evolution of policy with economic development, per se. Least of all is there an explicit co-evolution of technology with economic development needs, though one would hope that innovative regions could serve the local area, not just export markets, or to channel the outputs of export markets to benefit the whole locality.

The multiple ways in which India has developed (or stayed undeveloped) as a nation-state since the 1950s have been only partially correlated to the local attempts to develop within cities. An urbanite in one of India's leading cities such as Delhi, Mumbai, Bangalore or Chennai would see slums, poverty, and struggling infrastructure, but could immerse oneself in a relatively insulated identity of a "technopole". However, the inability to date for this technological

[1] The discussion here is based on India's recent developments in the IT, pharmaceutical and biotechnology sectors and case data is drawn from research conducted in Bangalore and Hyderabad in southern India.

development to find a broader economic base to serve has some serious implications for how India comes to terms with its varied identities. The technologically innovative regions try to become more like Cambridge (UK or Boston, take your pick), all the while less connected to the harsh reality of the poorer Indian, while the rest of the country observes but does not participate in this development. The co-evolution of policy with technological innovation has occurred reasonably tightly, but the co-evolution of technology with development as needed in the local context has happened rarely, if at all (for software exports, see D'Costa, 2003).

The saleable identity of Bangalore as a composite high-technology 'network city' has been recently critiqued (Heitzman 2004 and Srinivas, 2001). In Bangalore, a few research institutes have been greatly insulated until very recently from commercial enterprise or even local applications, facing problems of technology transfer, patenting and licensing and R&D focused for the market. Policy makers at the local level, and various practitioners, sourced from local industry and research institutes have been meeting in new hybrid organizations to develop the region more substantially. Here too, early policy at the national level had substantially engineered the local R&D landscape, but now is learning from local developments on how to proceed. Even those companies and universities that have had some urge to be more locally embedded, have not generated a city-wide call-to-arms, as occurred to some degree in cities such as Turku or Tampere, where the crisis was more overwhelming relative to the previous circumstances of the cities. In Indian cities, the lowest common denominator is so low indeed that any technological or industry-wide progress seems like real development and there is a danger of forgetting that for many people development is still about getting one meal a day. Technologically innovative regions and their development can never be a substitute for intelligent social policies for development. Indeed the latter concerns must surely influence the former for countries where so many basic needs are not met. Lessons from other parts of India are also trickling in for the IT sector (see, for example, Kaushik and Singh, 2004, Keniston and Kumar, 2004) and for the pharmaceutical and biotech sectors regarding innovation see Sahu, 1998 and Srinivas, 2004.)

From the purely technological side, while overall capability levels in biopharmaceuticals are reasonably high, the early scientific selection into commercial ventures through start-ups continues to be challenging. However, retention of capabilities (i.e. eventual return of individuals and firms) appears to be high, despite Bangalore's failing infrastructure. Secondly, while everyone has concentrated primarily on the impending enforcement of the product patent regime of the WTO, there has been little cohesion to policies regarding skills, the role of the universities and little open discussion on how the growth of these industries might affect other sectors or population groups such as the chemical industry, local hospital, primary health clinics, women users. Although local policy can rarely control external selection of the type of the Soviet Union collapse on Finnish cities, there are multiple instruments still available to policy-makers and to firms to respond to outer pressures. In evolutionary models, causal certainty (which has always

had the hallmarks of modeling artificiality) has to be let go, but policies cannot always be reactive to external selection, they must anticipate some of these. Indeed, in the Indian case, the selection pressures for certain industries and subsets of technologies may be shaped more by local, rather than external, factors. In Turku, the institutional responses became more coherent over time, and re-grouping of various organizations evolved, with learning as events unfolded, and with greater exposure of local individuals to international environments. Policy-makers responded through greater funding, support for more local S&T institutions such as VTT, and through increased emphasis on a Third role for universities nation-wide. But Turku began as a far more homogenous population and skill base than Bangalore can hope for. While in the Finnish cities, institutional design and formation of greater organization links to diverse groups within the innovation world was necessary, in Bangalore and other Indian cities, this effort has to be much more broad and acknowledge that innovation is occurring in a sea of need. While Bangalore has been muddling along grappling with its new fame, sagging infrastructure, exploding population influx and multiple identities, the fortunes of Hyderabad, India's other southern technology city, f have been equally interesting.

In Hyderabad, political imperatives for a regional party asserting itself nationally, created opportunities for "Cyberabad" to be born, with information and communication technologies and mid-size pharmaceuticals and biotechnology at the forefront. Producing more than 40% of India's bulk drugs capacity, Hyderabad became synonymous nationally and internationally in relevant development circles with a political leader (Chandrababu Naidu) claiming vision of high-tech transformation and local public and private labs and firms attempting to re-establish their superiority. The new election outcomes have shown that this vision was rejected by State voters, and the concept of regional development had predominantly targeted one city to the exclusion of the broader region. Although some uses of technology had clear broader impact-such as the use of ICTs for "e-governance" (accountability in government, access to public records, better bill payment schemes and food distribution mechanisms) and the local launch of Hepatitis B through two competing firms, the high-technology vision of development appears to have had limited relevance in a region where farmers were committing suicide in large numbers due to repeated crop failures and people living in dire poverty continued to be ignored by policy. The impact of older technologies and policies (more pesticides, more fertilizers and ironically, greater crop vulnerability) are a less glamorous discussion, but affect regional development more profoundly.

The issue of innovation in ICTs and biotechnology appears important, but perhaps not as grim in impact as older dialogues gone sour. An echoing of similar sentiments of the mismatch between different population groups within one society arises in Bangalore. There, with significant income disparities and divided opinions on the local importance of information technologies and biotechnology sectors for increased overall incomes, building such a narrative is complicated and unconvincing. In such cases, heterogeneous populations force us to consider

whether the idea of evolution must be re-analyzed by the dominant sector only or for regions as a whole, or from the point of view of co-evolution between the dominant sector and the whole region. Policy co-evolves it seems, more tightly with technology development (easier? more glamorous?) than with economic development. Local selection has yet to be as dominant an influence as international selection such as multilateral institutions or new technical standards. The cities have fared better at retention and variation for innovation, if skill sets are any indication. However, it remains to be seen whether this type of retention of skills/people and variation in firm-types is useful for broader city-wide problem-solving leading to economic development. The Indian education system exacerbates this by encouraging a relatively restricted range of skill types destined for certain (technical) career paths, instead of asking whether other skills might be important, or even whether these same skills could be utilized in other ways.

New policy initiatives such as the New Millennium Indian Technology Leadership Initiative (NMITLI), have tried to give shape to nationally relevant technologies in a more cohesive manner, rewarding public and private interactive research and deliberately nurturing certain technologies and skills. Much more is needed and outside the purely formal R&D institutes. The pressures of international competition on the one hand and the realities of local needs may need to be somehow reconciled before further development takes place. Certainly, more debate on such issues is needed to give locally generated vision and impetus to development (for a critical analysis of the historical link between science, technology and development, see, for example, Kumar 1991, Visvanathan, 1997 and Prakash, 1999).

The success of these two sectors may well influence the cities' futures, but have thus far done little for economic development of the average citizen. In this case, policy co-evolves less with some composite "regional development" idea, but more with sectoral specifics, when in fact, such disaggregated conceptions of development negatively influence a possible collective local narrative for the future. In Finland, this issue has also been faced as there is rather well-developed consensus that the whole country and its regions need future oriented spearheads to survive in global economy. This is, however, reflected in growing disparities between a few growing city-regions and the rest of Finland losing population (rural regions, especially, are facing increasing difficulties). In the US, the national and state government roles are less obvious than in many developing regions around the world, being visible primarily in funding, infrastructure and regulation. Yet, the governmental role continues to be important in negotiating on behalf of U.S. firms worldwide on trade, intellectual property and so forth, and thus heavily influencing the innovation and local development environment. Some of the US's most scientifically and technologically innovative universities have been land grant institutions and have had considerable impact on broader development. Ultimately, economic development is intertwined with all things political. The ability to generate political coalitions such as occurred in Tampere, and which does occur successfully in parts of India, will continue to define how policy co-

evolves with regional development. There are fewer political coalitions at the grassroots level that have forced innovative regions to take on a distinct local character for local needs, and that have given shape to how policy and development co-evolve in innovative regions. In the cases of both Indian cities profiled, there has been little in the way of shared experience, institution building or inward reflection on the city's future, as has occurred in (the admittedly much smaller) Finnish cities, although size alone cannot excuse a lack of debate.

6 The interplay between policy and economic development – some concluding observations from the cases

The question we have posed, if the basic tenets of emergence are accepted and evolutionary vocabulary adopted, is: what is the nature of policy-making, what are its roles, and how does policy co-evolve with spontaneous economic development? We have not been able to penetrate the surface, but nevertheless we next aim to present two general messages and three postulates for more rigorous empirical studies on regional development policy-making from the evolutionary point of view.

First of all, environmental selection clearly is a strong factor in the evolution of innovative regions. Rapid and often drastic changes in the global market force not only firms to find new strategies but also city-regions to reinterpret their role in the world economy and find new policies for creating a local environment that is as supportive as possible. It seems that in India those regions that have been able to adapt themselves to the global market are most of all coevolving with global economic development and less with local population. This is in contrast with Finland, where new economic development policies are, as in Silicon Valley and in India, most of all responding to new global demands but where the Nordic welfare state systems provides the new policies with the platform that keeps them integrated also to the local population, and thus, at least not yet, the economic development and economic policies have not been disconnected from local needs. There is, however, emerging debate if the foundation of the welfare state is actually crumbling and if policies only react to global developments and step by step disconnect from local realities. It indeed seems that internationally relatively little effort has been made by the scientific and technical community (besides some notable exceptions in ICTs, energy, and vaccines) to link formal institutions and innovation oriented economic policies to obvious social needs.

If the significance of global environmental selection is the first, and obvious, general message, the second point is that even though policy making is quite often adaptive and reactionary in nature, the question is, in some cases, more about strategic adaptation than pure adaptation. In strategic adaptation, both adaptation to the changing environment and the strategic choices of agents play a significant role. Strategic adaptation in general endows regions with a capacity to change their destiny by adapting themselves to changes and reshaping their local selection

environments. This approach emphasizes the policy intentionality of decision makers to function as intermediaries between organizations and their environments, and it is often reflected in new or restructured institutions, interpretations and capabilities.

The kind of view we have propagated here is not only a technical question. It is very much a question of the way policy makers perceive the world and also their role in it. As Faludi (1973, 8-9) states: "Man's understanding of this world, and his ability to act in it, depends on his constructing an imaginary in his own mind. This applies equally well to the planner's understanding of himself and his operations. Thus understanding planning as a problem really means that the planner faces the challenge of constructing an image of himself as a planner, the agencies in which he operates, their procedures, the environment as it is affected by, and is affecting, the operations of these agencies." Faludi's idea of constructing an imaginary in a mind combined with emergent developments, with increasing uncertainty, complexity and unpredictability implies that we need once again a new way of seeing problems, our own activities, policy-making, management and various actors.

It seems that policy-makers will need to become increasingly skilled in managing transition. They will have to recognize flux as the norm and develop mindsets and skills that allow them to cope with the continuous flow of new ideas, products, skills, technologies, information and interpersonal and inter-organizational relations. Policy-makers need to learn to ride turbulent conditions by going with the flow, recognizing that they are always managing *processes* and flux rather than stability and defining the order of things. Managers and policy-makers need more developed skills in identifying and understanding development as a long process, looking back and ahead, and thus evolutionary phases, breaks and the interplay between these phases appear as important centers of attention. This kind of thinking leads us to one of our main questions about the roles that policy intentionality may play in evolutionary developments. In this regard, we propose that:

> institutions provide the evolution of regions with a general framework, and hence institutions have a major directing effect on processes[1]. Institutions are major retaining forces and are important bases for new unexpected development variations to emerge.

Institutions are important, because they frame the choices and actions of many agents, and therefore they play many roles in co-evolutionary processes. Societies need some mechanism for reshaping science and engineering as professions, and reclaiming their outputs. Both the relevance and prioritization of science (recently, de Fialho and Srinivas 2004) are important issues in development discourses about whether and how science and technology have a role to play to transform technologically innovative regions into economically prosperous ones.

[1] see about the significance of institutions e.g. North 1992; Cooke & Morgan 1993; Maskell 1996; Morgan 1997

The policy rationale in the Finnish case cities has been to secure the institutional basis for selected clusters to have enough variation at least in some areas of economic activity, and to create networks to major knowledge pools in the world. This is needed, as we interpret the policies, to retain firms and individuals in the cities. In addition, founding new institutions proactively has actually provided later developments with soil to grow and thus it seems that planting the seeds for the future in the form of new organizational institutions and giving them relatively free hands to operate[1] has been one the most influential policies in our case city-regions. South Ostrobothnia is a prime Finnish example of a region that has been locked both cognitively and institutionally into the past and that has consciously aimed to remove lock-ins by reinterpreting the region and creating new institutions and networks to support this reinterpreted image of the region. We have already several times raised the importance of interpretative processes, and thus, secondly, we postulate that…

> interpretative processes play a significant role in strategic adaptation[2]. They have many forms, but they are crucial in continuous search for future directions, the roles of agents and new roles of respective city-regions in new world order.

Strategic adaptation refers to the sensitivity to recognize various changes and to adapt to them, but at the same time it stresses the abilities to create more or less collective perceptions of each phase of evolution, as well as its own "story of development" and its support. In addition, without interpretive processes institutions may have a freezing effect instead of a directing and guiding effect, and without reinterpretation of institutions too, regions may remain institutionally locked into the past development path.

In the practice of the Finnish policy-making[3] adopted in the 1990's, many strategic planning, foresight, programming, etc. processes are constantly in progress. Quite often, if not always, in spite of aiming to scan futures and create future-oriented strategies, these processes usually end up producing programmed descriptions of the current state, through which it is not possible to generate innovations and to create the best fit with the changing selection environment (Sotarauta 1996; 1997a and Sotarauta & Lakso 2000). This often frustrates policy-makers who have a traditional understanding of policy-making; they expect to have plans ready to be implemented,

[1] These are often managed by results and communication

[2] see Lester and Piore 2004 for significance of interpretative processes in firms

[3] In the 1990s, strategic planning became almost a standard method in Finnish policy making, and it seems clear that this among other reforms has reformed public sector policy making, and also created some difficulties. The strategic planning used in public policy making has been copied fairly directly from corporate practices, and as such it has not suited multi-actor and shared power regional development policies as well as was hoped for. However, approaches created in the corporate sector cannot be neglected totally, especially because of the absence of any significant advances in public sector strategic planning in recent years. Even if ideas created for the private sector (like strategic planning and dynamic capabilities) are not directly applicable, there is a lot to learn from them, but extra care must be taken in applying to apply them in shared power based interactive practices. (see Sotarauta 1996; 1997b; 2000)

and their view of policy-making is linear and rational. Even if development plans do not deliver what expected, it does not mean that strategic intentions and foresight are not needed. They are, but they are not to be seen as parts of a mechanical planning process, but interpretative forces in the emergence of something new (see Sotarauta & Lakso 2000; Sotarauta 1996; Virkkala 2002.)

The dilemma between emergence and strategic intents of the policy makers require capabilities to both adapt and to create futures, simultaneously, in the midst of the constantly emerging ”whole”. Therefore, from an evolutionary perspective, development policies play versatile roles. They may be legitimate forums for cooperation, and especially ways of making sense together, learning common language and new concepts, creating shared lines of action and thought patterns, and they also are ways of reinterpreting the development and the role of various actors in it. Hence, even the development plan is not a plan in traditional sense but a means of communication -- that is, messages from one group of actors to another group. (Sotarauta et al. 2002). Rather than aiming to control the whole or aiming for marginal adjustments to the present and programming existing strategies, strategic policy intent would be *futures seeking,* but not, as is usually hoped for in policy-making spheres, *future defining*. (see Healey 1992.)

Our Finnish cases cannot be called “success stories” as such, but in their own way they have managed to adapt strategically to new situations. Tampere has already gone through a major transformation, Turku is still in the midst of it, and Seinäjoki has shown some promising signs. Still, as we have seen, evolution actually is a never-ending emergent process, and therefore it is never finished. As stated above, according to evolutionary understanding, the ”final state” after transformation is only one chain in an endless chain of events, in a journey that in practice includes many purposes that interact and hence create the basis for the next phases of evolution to emerge. And here interpretive processes are essential for action too. The Finnish cases are examples from a small homogenous country that emphasizes collective interpretations, and where the public sector both creates forums for this kind of activity, co-ordinates it to some extent and induces firms and universities to participate in them. Silicon Valley on the other hand is a case where there is such a “buzz” in local interaction that many interpretations are born and die constantly and a “Finnish-like” co-ordination is not needed for technological innovation.

As we have seen, reinterpreting entire city-regions and their economic basis is of the utmost importance in evolutionary development. it is among the most influential directing forces based not on control but on communication, that enables strategic awareness to grow and develop. For the development of awareness it is necessary that the actors have the ability to collectively monitor and interpret events and to make sense of them. Awareness expands to be strategic when the actors have the ability to find the strategic issues essential to developing and development from the long-term perspective. From the regional development perspective it is not at all self-evident that the influential local agents are aware of their influence and/or the need to influence more deliberately their local selection environment for their own future success. For increasing

this kind of awareness and introducing new future-oriented collective sense-making processes in Finland development programs have been rather good forums. For example, in Seinäjoki, in the early 90's, there was almost no awareness of the importance of innovation but through many strategy and program-processes, and other related conversations, this kind of awareness has been born, and consequently new strategies and institutions have been developed.

Our cases also show the significance of dynamic capabilities in evolutionary processes, and hence we suggest, as Teece et al. (1997) have done for the firm, that in connection with institutions and interpretative processes, the dynamic capabilities approach is promising both in terms of future research potential and as an aid to development when cities are endeavoring to gain competitive advantage in an increasingly demanding environment. Drawing on Teece et al. (1997) we define capabilities as the organization's ability to integrate, build and reconfigure internal and external competences to address rapidly changing environments, and also as the ability to variety of organizations to develop their competencies in concert to create local nexus with external selection environment. Based on this definition we thirdly postulate that:

> at best it is dynamic capabilities that connect various actors together in a city-region, and link them to global flows and networks. On the other hand, disconnected or missing capabilities may lead to deteriorative processes.

Dynamic capabilities in this context need to be approached from three points of view: from the point of view of firms, from the point of view of education and research institutes and from the policy-making point of view. In the best case, the competences of these three spheres of life are in concert, support each other and together form regional dynamic capabilities. As this usually is not the case, more research is needed that focuses on interaction of dynamic capabilities of different actors.

To summarize: Institutions are the foundation and the guiding framework for evolutionary processes, and by reinterpreting and by shaping institutions policy-makers can direct many emergent processes indirectly. Institutions are like a river bed for "freely" flowing water. Interpretations are mental and cognitive processes that mould the development views of policy-makers. The development view also strongly influences what institutions are created and/or reorganized, and what capabilities are aimed to be developed. If institutions are the river bed and interpretations like the flowing water (often slow), dynamic capabilities refer to the abilities to direct the flow, and to constantly seek cracks in the river bank that need to be stopped up, or that provide water with new fresh routes to flow.

An underlying assumption of many discussions of development is that actors within the community who shape their broader selection environment, and in turn, help to select certain elements of local innovation to improve their lot, have the ability to truly do so. This assumes a

level of participation and freedom that we know not to be true even in the greatest of democracies. Our suggestion has been to track the ways in which policy co-evolves with technology advance on the one hand, and with broader development on the other. This should make researchers more aware of the divergences and convergences of policy's infatuation with technology as a vehicle for all development, and the conditions under which technological innovation and innovative regions can indeed lead to broader development. We are not suggesting that policies for technological innovation should take on other elements of development, which would make the policies themselves perhaps too diffuse and unworkable, but rather that policies should themselves emerge from a dialogue.

7 Conclusions

The basic message here is that in the evolutionary approach the 'touch' in regional development policy-making is different from what we are used to in more direct and regulative forms of action. As Cooke (1992, 365) points out, the theory of regulation is largely a theory of control suggesting a solution to a problem: 'how can a competitive system of economic activity remain in place over long periods without collapsing under the strain of its internal, centrifugal forces.' The answer today is: *it cannot* remain in place over long periods of time. We are continually forced to determine how to find our ways in the midst of the processes, and thus to determine not only what to do, but *how* and *with whom* to do it, and how to create such settings that innovation emerges from the processes.

To expect the Government, specifically the national government, to lead the cause for innovative regions in every case is unrealistic, except as a source of vision and commitment to resources (both undoubtedly very important). Universities, even in the instances where they are public bodies, are not necessarily pliable instruments if disconnected from other actors. It appears rare that purely local visions for development are constructed; models are invariably sourced from elsewhere, and at best they are interpreted locally to serve local needs. In fact only a few models seem to exist in common circulation. Even these models are often misinterpreted. Rarely is there an acknowledgement that policy and development co-evolve, that various involved organizations need time to experiment and learn, and that alternative yardsticks for development which are locally relevant, might be urgently needed. In short, we need alternative ways of seeing development and ways of promoting it.

In the EU, as attempts to achieve homogeneity over everything from technology policies to benchmarking indicators and university accreditation are underway (admittedly with good reason), we run the risk of losing the variation so necessary for innovation and to understand why and how emergence and direction behave the way they do. In addition, compounding the obviously limited numbers of development models that exist which hide the locally-specific

character of co-evolution and learning, policy-makers have further constrained heterogeneity. In Finland, for example, Silicon Valley has been used as a model for regional development as in many other countries. Yet we cannot find a replica of Silicon Valley in Finland but rather many Finnish variations of the original model that are local interpretations and applications of the core dimensions of innovation and knowledge based regional development models. Replication plays a major role in the evolution of regions but in successful cases replication has occurred through many interpretative processes.

In innovation, as in economic development, a general rubric of "technology policies" obscures, rather than reveals. Local actors often equate technology or innovation policy with local or national economic development, but in fact the link can be quite diffuse. Scientific or technological innovation itself may not be an explicit goal of technology policies, and economic development may be even more uncertainly linked. Yet, universities in particular, but various development organizations too, are being asked to take on economic development via technology and innovation policies (witness the proliferation of biotechnology policies in various Indian states, the Finnish attempts to trigger both innovation and development via technology projects and the common equation that Silicon Valley's technological innovations explain all its economic development).

One of the key questions in the knowledge-based economy is how in regional economic policy-making is it possible to play a role in reducing the vulnerability of regional economies, societies and environments to damaging external pressures, while promoting economic health and quality of life at the same time, i.e. how to create a local selection environment to buffer the effects of global developments on local agents. We have here raised an alternative view that regional development policy-making could be based on. If emergence is accepted and an evolutionary vocabulary adopted, in policy-making the following questions should be concentrated on: how is development evolving on a global, national and local level, and what are the possible breaks in the future? What are those present and anticipated fluctuations that may grow into breaks in the future? During the times of breaks the desired direction may be obscure and the significance of value assessments as means of finding a new direction increases. All in all, we should better understand the global, national and local soil in which policies grow, i.e. the co-evolution of policy and actual development, to prevent economic development policies from disconnecting themselves from local needs altogether. The relationship between policy and development is reciprocal even though it is often seen as, or hoped to be, a linear process proceeding from planning to decision to implementation to changes in development.

In this view, it would be essential to see regions as a giant feedback mechanisms and policy-making as a means to transform information to new interpretations and action. Having feedback should be a continuous conversation between regional development agencies and the selection environments crucial to the region's economic base but also with citizens and local needs. This

requires a new kind of open attitude together with close and sensitive links to both local and global selection environments. The base of strategies is more solid when the feedback is not only based on a few economic figures and global and national trends, but on wide conversations and a versatile range of information, and here, institutions, interpretations and dynamic capabilities are the golden triangle of the evolution of regions, and as such they deserve more attention.

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