

Self-generative Capability of Regional Foresight and Innovation Activities

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Executive summary

This paper introduces regional foresight and innovation as a dynamic system and discusses its antecedents and criteria. The main perspective is that the competitiveness of regions is always based on success of the companies. All the companies for their part must face global competition regardless of their location. The innovative business of the companies is the core of national competitive edge, on which innovation and foresight activities of the regions is heavily connected. In this context Finland is used as an example of successful efforts and outcomes of increased competitive edge on national level. The paper suggests that the technology foresight often emphasises future trends in a manner which neglects the ability of companies and people to exchange, create and apply knowledge and information. To overcome the problems, the technology foresight activities should be planned as *dynamic processes and communication rather than static and administrative models*. Innovation is always created by a social, not technological process – even if the outcome would be technology. Innovations are always created by a system formed by actors (organisations, companies, regions) as well as communication and interdependence between these. The paper helps to identify the features and criteria for creating innovative, dynamic system, and it also gives a practical tool for assessing a regions competitive edge and renewal ability.

Introduction

The focus of this paper is regional foresight and innovation activity and its challenges, the framework for which are national as well as regional competitiveness and innovation. The paper begins with an illustration of the economic and social changes that the Western countries are going through at the moment, and how these changes influence the possibilities of technological foresight. Finland is presented as an example of heavy transformation to a knowledge and innovation -based new economy. Its advanced technology and competitive advantage serve as a good case example for the study. The main goal of the paper is to introduce a systemic and self-generative view for regional innovation and foresight activities by

- giving an overall picture of what kinds of elements, drivers, processes and structures self-generative regional activities demand
- pointing out issues that ensure effective and efficient policies toward innovation capacity
- assisting in enhancing and strengthening the regional capacity for foresight and innovation activities by introducing a self-assessment tool for regional actors.

The main concepts used in this paper are the following:

Technology foresight means activities that support the creation of regional innovation systems and strategies.

Regional competitiveness refers to the economic success factors, attractiveness and renewal capability of the region.

Innovation means the creation and application of new knowledge to achieve economic advantage. All innovation is technical, economical, social and cultural by nature.

Innovativeness is renewal taking place in all the activities of the organization, whether related to products, their marketing, production technology, company organization and management, or the relations between the company and its operational environment. Innovativeness can also be interpreted as the strategic ability to survive in a turbulent reality and to control uncertainty.

Innovation system is a complex cooperation and communication network between actors, where the focus is, in addition to the basic elements, the actors (organizations, companies, regions), especially on the amount and quality of interaction between them, as well as mutual interdependencies.

Regional innovation system consists of systemic connections between different knowledge creators (universities, research institutes), intermediary organizations (private and public innovation services), and enterprises (large, small and medium sized).

Innovative dynamics develops in a system that is capable of self-controlled renewal of itself and its activities – in other words, is able to create and sustain interaction and an operational environment favourable for innovations.

Economic and social changes

The logic of doing business and creating value has changed fundamentally during the last years. The marketplace has become increasingly turbulent, with innovations altering the business landscape. Information and communication technologies enable new kinds of relationships, and virtual network partnerships and organizations are becoming recurrent. Knowledge has taken the place of land, labor and economic capital as the main source of corporate wealth creation, and innovations have become the principal drivers of competitiveness.

Globalisation and new information technologies mean that businesses have to face world-wide competition in swiftly transforming unpredictable environments, and thus the ability to constantly generate novel and improved products, services and processes has become quintessential for corporate economic growth and competitive advantage. Performance in turbulent environments is above all determined by companies' ability to constantly modify their products, services, goals and operations, i.e. by their capacity for self-renewal. This capacity does not only mean that the company is able to keep up with the changes in its environment, but also that it can act as a forerunner by creating innovations both on the tactical and strategic level of the firm (Hamel, 1996), and thus change the rules of the market. This is not only a challenge for companies but for regions and nations as well.

Also, within the research community there exists a widespread agreement that the new, dynamic modes of competition, stemming from globalization, development of new technologies and new forms of organization, are no longer adequately explained by traditional organizational and managerial theories (e.g. Eisenhardt & Tabrizi, 1995; Sanchez, 1997; Sanchez & Heene, 1997). New approaches that recognize the complex and chaotic nature of today's business environments are required for understanding and facilitating creation of corporate competitive advantage. The knowledge society is

characterized by greater flexibility in management; decentralisation and networking of organizations, as well as being both informational and global. Productivity and competitiveness fundamentally depend on the capacity to generate, process and apply information and knowledge. The core activities of production, consumption and circulation are organized on a global scale, either directly or through a network of linkages between economic agents.

Peter Drucker (1999) argues that the fact that knowledge has become the main economic resource will fundamentally change the structure of the society. Drucker uses the term post-capitalist to portray the uprising society, but also the concepts of information or knowledge society have been used in recent macro-sociological discussion to depict the societal changes springing from the changes in meaning and importance of knowledge. These changes will entail new social, economical and political dynamics and challenges.

Successful firms have to keep innovating to stay ahead of others. Each added connection to a network's pool of knowledge multiplies the value of the whole. This results in new rules of competition, new sorts of organizations, as well as new challenges for countries and regions. Markets are the best drivers of growth and innovation, but public action can and should create conditions in which innovation can flourish. This requires updating public fiscal, investment, and regulatory policies at every level. The government should be reinvented to be as fast, responsive, and flexible as the economy and society in which it interacts. The new model of governing is decentralised, non-bureaucratic, transparent, catalytic, and empowering.

The success of regions is always based on the success of firms. All companies have to face international competition regardless of where they are located. Technology and innovations act as the driving force for regional development as well. An innovative way of doing business is the core of national competitiveness and success, which is closely linked with the development of regional innovation operations.

The competitiveness of enterprises, regions and nations lies these days not only in innovativeness but on *continuous* innovativeness, eg. *self-generative capability*. To succeed in a competitive environment where businesses are connected by various data networks, companies need team players that know the rules of the game and possess the management skills required in the new order. The life in the network is rapid: the reality in the networks is often chaotic and the formation of the links and connections is crucial. A big challenge for network management is to understand the different dimensions of network dynamics and their different challenges for the management and national support structures.

Finland in focus

In the changing business environment Finland has put a special effort in creating an environment, assets and capabilities to master the means of the new economy. With a mobile phone penetration of a little less than 80% , the world's most advanced e-services in banking and the level of technology highest in the world, Finland has often been called "the world's high-tech laboratory".

Many people are interested in how such a small country with only 5 million people can be on the top of many globally conducted scoreboards concerning the competitiveness of countries:

- UNDP's report 2001 scored Finland's TAI – index (Technology Achievement Index) the highest in the world. The TAI-index measures the ability of the countries to create and use technology in networked business.
- In WEF's (World Economic Forum) report 2001 Finland was number 1 as concerned both the competitiveness of today and potential for the future.
- In the United Nations University (2001 State of the Future), Finland's competitive advantage was the second in the world.
- In IMD's (International Institute for Management Development) yearbook 2001 Finland was number 3 in world competitiveness after the USA and Singapore.

The situation in Finland looks even more remarkable when remembering that the country was in an extremely deep depression in the beginning of the 1990s. However during the 1990s Finland went through the strongest growth period in its economic history. For the first time the structure of trade changed from being raw material, capital and energy -intensive to being information and knowledge intensive. In other words, Finland has moved from areas of slow growth and low margins to possibilities of fast growth and high margins.

The results have been gained by goal oriented governmental policies toward information society and innovation support. Finland's policy of trade has long been knowledge intensive. Over 15 years of continuously increased and successful research and development investments have created a development that has been faster and more competitive than that of other countries. The forest and metal cluster has been joined by information and communication cluster, which has become the third cornerstone of Finland's national economy. The structural change has created new job opportunities, wealth and well-being.

International comparisons show that Finland has been able to develop the competitiveness of national economy and to increase prosperity simultaneously, and technological development has had a notable role in creating these positive effects. Several studies have shown that investments in technology explain a large part of the growth of productivity. Productivity grows partly as a result of companies' own research and development activities, but also public research and development work in universities and research institutes increases productivity. This is explained by knowledge and technology transfer to all enterprises, also those whose own research and development potential is low. A one per cent increase in the product development costs of enterprises increases the growth of total productivity by 0.13%, and in public product development costs a one per cent increase means a 0.17% growth in total productivity. A one per cent increase in foreign product development costs increases the growth of total productivity by 0.44% (Quellec & van Pottelsberghe de la Potterie, 2001, ref. Tekes, 2002).

Public funding increases companies' own technology investments. This is especially true for SMEs, where 40-60% of the technology projects would not have been realized without public support. Most of the projects with public support in Finland were carried out in a more challenging way, with better resources, on a wider cooperative basis and faster than would have been done without the funding. The significance of public funding has been especially great in creating completely new and complex innovations (Tekes, 2002). The investment of one public mark creates a 10 to 30 –fold amount of new annual turnover in 3 to 8 years, most of which is export. Also the development and competitiveness of regions is greatly dependent on the research and development investments of the enterprises operating in the region. (Huovari et al., 2001).

Research results show that the technological differences between countries have narrowed down, which places e.g. Finland in a clearly new competitive situation. Also traditional businesses and enterprises will in the future find themselves in a new kind of competitive environment. To succeed and to be able to exploit the technological development of knowledge intensive business, the traditional businesses need to renew their business activities, products and production methods, and therefore invest in research and development activities of their own.

Although incentives have not been very extensively used in Finland, the way they have been used has been efficient. In comparison with other EU countries Finland has been a leading country doing innovation cooperation. The level of cooperation between the enterprise sector and research is the world's highest. Cooperation has been in the principles of research funding in Finland since the 1980s, and part of the growth has remained permanent practice. According to research results, cooperation in innovation activities improves the success of innovations remarkably.

Koski et al. (2001) have analyzed the situation of Finland in the new economy with *continuous growth of productivity* as the main criterion. They emphasize that mere technology development, production or export are not necessarily enough to ensure competitiveness in the long run. Four preconditions are presented for measures of new economy:

1. The country is a remarkable *producer* of information and communication technology (ICT).
2. The country is a remarkable *user* of ICT.
3. The *ICT-production* of the country has remarkable effects on its economy as a whole, and/or
4. *The use of ICT* in the country has remarkable effects on its economy as a whole.

The *weak* prerequisite of new economy is that ICT is produced and used. The *strong* prerequisite is that ICT has remarkable economic effects.

If success in new economy is measured by the production, export and use of information and communication technology, different countries appear as winners. Producers are the Scandinavian countries and Ireland, users the USA and Canada. The reasons behind this are the different strategies of the countries. E.g. Finland and Sweden have invested heavily in their own product development activities, in the USA the investments in development are fairly small compared to the GNT, but as a user it is the leading country in the world. In Finland the product development costs

were 3.5% of the gross national product in 2000, which after Sweden is the highest level in the world. The share of ICT of this research investment is about 55%.

The USA is the absolute number one in the world economy. The value added of its ICT is almost as big as that of the other OECD countries together. The USA has clearly concentrated on activities of high value added. Finland and Ireland are the most specialized in *exporting* ICT.

Changes in the economic environment should also change the focus from the subvention of companies over to support of the competitiveness of regions. Since the 1990s the target in Finland has been the creation of regional and local environments which would support the self-generative power and competitiveness of individuals, companies and other agents. The future possibilities are best in the regions that support innovativeness and creation of new knowledge. Thus the core question of regional development is *how to create an operational environment that supports continuous learning and innovativeness in the best possible way.*

Regional competitiveness as target

The competitiveness of regions depends on what kind of operational environment they offer for economic activities. Competitiveness means the ability of regions to create, attract and sustain operations increasing the economic well being of the region (Huovari et al, 2001)

Huovari et al. list four factors affecting the competitiveness of a region:

1. The structure of economic activity, in practice industry and the share of service industries in the region
2. The extent of innovative operations
3. Traffic connections in the region
4. Know-how of the workforce.

The indicators describing these factors explain two thirds of the fluctuations in the GNPs of the NUTS-II –regions in the EU.

Economical development and growth are derived from good competitiveness. In the simplest form, according to the theory of growth, production is created by combining work and capital in a certain production technology. The new theory of growth stresses that also human and intellectual capital is a central factor in production. Its importance is growing all the time, as the production process has become more complex, and the development of technology faster.

An environment favourable for innovations is created by the joint effect of many complex factors, many of which are difficult to measure. In addition to intellectual capital and innovativeness, also regional centralization affects the competitiveness of regions, although studies on innovativeness do not directly refer to centralization and the advantages gained through it. Centralization has, however, a very important role in regional development. Also innovation activities benefit from centralization, because the spreading of information, which is vital for innovation activities, is more efficient between enterprises and institutions located near to each other.

Huovari et al. have constructed a competitiveness index, which consists of indicators from four areas:

1. human capital
 - number of working population
 - degree of participation
 - number of students
 - number of technology students
 - number of academic degrees
2. innovativeness
 - research and development costs
 - patents
 - innovative posts
 - share of peak and high technology in value added
3. concentration
 - concentration of population
 - share of focal areas of business of the working population in the region
 - share of business services of the working population of the region
 - share of the largest area of business of the working population of the region
4. attainability
 - attainability of the markets by road
 - proximity of air traffic
 - overseas contacts of industry

The indicators have been chosen from factors that are easy to measure. The researchers stress, however, that *competitiveness consists of both economic and strategic factors*. The former consist of the resources and characteristics of the region, the latter of the modes of operation, atmosphere etc. Understanding the strategic factors (one could also say understanding systemic features) offers more tools to support regional innovation, because it works as the driving force of development – in other words it offers tools for starting the development.

What kind of town is competitive? When the economy is based on know-how and innovativeness, the central issue from the point of view of the future will be how well towns will succeed in the global attractiveness competition over new technology, information and professionals . To be attractive, towns ought to be innovative environments to companies as well as individual people. They should be nodes of innovation development, creativity, and applications.

There is a clear connection between the economic development of towns and the development of national economy. Towns can be seen as motors of economic development. In the global networking world the towns are nodes where the information and knowledge flows can be caught. Towns also offer opportunities for creating and transmitting personal contacts, collective beliefs, and common strategic awareness. They create opportunities for social and cultural interaction. Towns are in a certain dimension nodes of innovation development, creation and tracing, because they offer a critical mass of sufficiently skilled people and institutions, and social networks enabling detection of new opportunities, creation of new technology applications, and quick reactions.

A central element in the success of towns is social cohesion, since although towns are engines of the economy on one hand, on the other hand there are economical problems, poverty, social withdrawal, insecurity, etc. in them. Social cohesion is no longer seen as a phenomenon separate from the economy, and it is largely recognized that also economical competitiveness is closely linked to both social problems and to how the skills, creativity and active citizenship of the inhabitants can become part of the development of towns.

The increase of the meaning of the local operational environment to the operation of companies, as well as the tightening inter-town competition over inhabitants, enterprises, capital, information and technology has increased the need for conscious development of towns. In the tightening competition towns have to pay more attention to their competitiveness as locations of enterprises and environments for inhabitants; the scarce resources must be allocated more efficiently and modes of operation have to be continuously renewed to maintain and develop the competitiveness.

From the above points departure, development activities have often been advanced by

- developing and intensifying partnerships, in other words building networks to reach new markets or political arenas, and thus enlargen the resource basis of towns
- efficient mobilizing of the know-how and resources of towns
- deepening efficient and target oriented, but still flexible leadership
- starting strategic processes affecting the development and guiding the activities of multiple actors. (Sotarauta & Linnamaa 1999)

Elements of competitiveness

In the 1990s and beginning of the 2000s the significance of competitiveness has increased in the development of towns, and there has already been a shift from subvention and intervention policies towards competitiveness policy in the development work. The competitiveness and competitive edge of towns have become central targets of attention.

On a general level the competitiveness of urban regions can be defined as the ability to

- integrate the urban region with its actors as tightly as possible with the best possible networks
- support and develop the prerequisites for the quality of life of the inhabitants (services, education, living environment etc.)
- entice new, in their own markets competitive enterprises to the region
- create such operational preconditions that the enterprises already operating in the region are able to sustain their own competitiveness and to develop it further. (Sotarauta & Linnamaa 1997)

The competitiveness of urban regions comprises eight intertwined elements, six of which are some kind of basic elements. In addition, competitiveness is affected by the image, which is formed by one or two basic elements in a way typical to each region. The elements of competitiveness are *enterprises, human resources, the quality of the living environment, efficient development work, networking, image, and creative tension*.

Traditionally, the significance of *enterprises* has been stressed in connection with regional competitiveness. Enterprises as an element of regional competitiveness means the whole business sector of the region; the size and structure of business of the enterprises, export orientation, knowledge intensiveness, proximity of subcontractors and other business partners, etc. The enterprises –element can also contain the competitive situation of the business and the structure of the markets. In the development of the competitiveness of a region, action towards the enterprises is the most typical and traditional type of development work. Competitiveness is usually sought and created in the areas of strength of the region. On the other hand it is also important to create and look for new emerging areas and to invest in developing their competitiveness in advance.

In the beginning of the new millennium it has become customary to emphasize human capital, ie. Skilled, innovative and highly educated workforce as the most important capital of enterprises. Enterprises are presumed to be located in the future in regions where the needs of the key personnel and the enterprises meet in a suitable manner. *Human resources* as a competitive element in a region mean generally speaking the people living, studying and working in the region. In the development of human resources, the functioning of the education system of the region and the ability to react to the rapidly changing needs of enterprises in the education are important issues. To simplify a little, it can be said that earlier the work force moved to where the enterprises were. Now this relationship has become more complex, and at least in areas demanding high education, enterprises tend to move to regions where the skilled workforce likes to live. The significance of the *quality of the living environment* as an element of competitiveness is increasing.

The living environment consists of the physical environment (built-up areas and natural environment); functional environment and the services offered (health care, day care, basic education, entertainment and cultural services, sports facilities); economic environment (cost of living – prices of services, housing costs, size of the tax unit etc.), and social environment (interaction between people and the social networks people use daily). Small urban regions and rural municipalities cannot offer a similar living environment with all possible services as large urban regions, but it is possible for them to underline their own special features and create new and open-minded solutions based on them. This does not mean emphasizing only the natural environment in the marketing, but for instance creating new solutions for housing.

Infrastructure as an element of competitiveness means the physical operation environment of the region vital for enterprises. This competitive element comprises eg. traffic connections (water, air, road and rail connections, data communications), town plans, planned lots, premises and energy supply. It can also contain the attainability of natural resources and raw materials, and different cost factors, such as electricity and water tariffs.

Also the ability to cooperate, development activity and know how of the operators in the region have vital roles in developing competitiveness. *The operators and a good network of developers* as an element of competitiveness presupposes a good quality of cooperation processes and tight cooperation between the operators. It also requires for several operators to join their forces to mobilize resources and seize future possibilities. The building of competitiveness is also affected by the kind of networks the operators of the regions are involved in.

The seventh element of the competitiveness of urban regions, *image*, is not an "independent" element as such, as it can be seen to consist of the whole formed by the physical environment, enterprises, education and research institutes, living environment etc. of the urban region. Image is a factor formed by one or more basic elements.

The different elements of competitiveness need to be on a sufficiently high level, to support each other, and thus create a strong basis for the development of the region. In addition, the region ought to be able to create competitive edge on one or more elements, to be able to differentiate itself from the other regions competing in the same area. At the same time the development work needs more challenges, and creative tension becomes the core of competitiveness. *At its best creative tension challenges the existing models of thought and operation. It is a force by which the elements of competitiveness live and are renewed.* If the tension sets off something new, it is creative by nature.

Creative tension action is formed by the dynamics developing in the regional innovation system.

It is also essential to notice that all urban regions do not compete over the same matters, even though the discussion in the media often gives that impression. It is important to understand what matters the region wishes to/can compete over; ICT professionals, bio business, nature trekkers etc.

How innovations are created

Technological change has been traditionally seen as consisting of three separate phases, which are invention, innovation and spreading. *Invention* can be defined as the creation phase of new basic knowledge, *innovation* as the first application of the created knowledge, and *spreading* the stage where the new technology is widely used in production, or when new products enter the market. As a whole this traditional model can be called a waterfall model, as it is based on the idea that the amount of basic research affects the amount of technological innovation in a region, which then affects the production and through that the pace of employment growth. A central technology political conclusion drawn from the model is that more efficient resourcing in basic research will start a process which will lead to economic growth and creation of jobs. (Kautonen & Sotarauta 1999)

The waterfall model has been severely criticized (eg. Lundvall 1992, Schienstock 1994). It has been noticed that *technological change does not proceed linearly, as the model presupposes, and that it is impossible to distinguish separate stages which necessarily follow each other and have a causal relationship*. It has also been noticed that innovation processes do not contain a natural law -like inner logic, as several societal factors have an effect on the development. The most essential of these are market issues and societal demand. (Kautonen & Sotarauta 1999)

The society and the economy have changed fast and from certain viewpoints dramatically. In the core of the information society there is the view that innovations are the driving forces in industrial competitiveness (Romer, 2000, Ståhle & Grönroos, 1999,2000). Thus a knowledge intensive economy is always a innovation -drawn economy. It is a question of a large scale transformation process, where it is important to understand the dynamics sustaining the change. The possibilities in global competition have increased, and so have the challenges, but at the same time the turbulence and uncertainty of the business environment and the whole society have increased. Economic success depends ever more on the ability of companies to innovate fast and continuously. Innovation has also been seen as a strategic ability to cope with a turbulent reality and to control uncertainty. (Luhmann, 1995, Ståhle, 1998, Schienstock & Hämäläinen, 2001)

The turbulence, pace, and innovativeness of business set many challenges for enterprises, eg. continuous development of competence and peak performance in a narrow special field. Companies are also becoming more dependent on other companies' complementing knowledge capital to be able to meet the increasingly extensive service challenges of customers, and to survive in the competition. Innovations have thus increasingly become an inter-company process (Ståhle & Laento, 2000, Schienstock & Hämäläinen, 2001).

All renewal taking place in all the areas of operation of the enterprise can be regarded as innovations, whether it is connected to products, their marketing, production technology, company organization and management, or the relationships between the company and its operational environment (other companies, other organizations, changes in societal control etc.) This leads to the innovation systems becoming larger and more complex, and people have started talking about national innovation systems.

Networking and social capital

Innovations always demand widespread, multiple cooperation. That is why inter-company and internal networking has risen as a vital factor in the creation of innovations. Networking as such does not necessarily increase the innovation capacity of a region. The decisive factor is the *quality of interaction* in the network.

Three different main dimensions are found in networks, each one of which has to be considered: a structural, relational and cognitive dimension (Nahapiet & Ghoshal, 1998). Structural means connections between people and companies: how many connections there are, what are the organization and hierarchy of the network like, what kind of customer, supplier, and interest group networks the company has. Structure defines the frames within which the company can utilize the sources of knowledge and to learn new things. Structure does not show, however, how the

network operates, that is, how efficiently the company is able to utilize the possibilities offered by the structure in practice. Other dimensions are needed for that.

The relational dimension shows what kind of personal relationships the people have developed in the network during its history, and it thus contains the respect and friendship between people. The relational dimension indicates how close, open, and trusting the interest group relations are, and how well they work in practice. "The relational component of social capital ensures that the parties trust each other to the extent that they are ready to share confidential information in a way that leads to maximal learning benefits in the interest group relationship" (Autio 2000,29). These relationships fulfill the social needs of being respected and accepted, and the need of receiving support. A working network has to be able to fulfill people's social needs.

The third dimension of the network is its cognitive contents, which means common interpretations, forms of presentation and meanings for the members of the network. It is a question of the contents of the information and models conveyed by the network. The cognitive component regulates the efficiency of communication in the network, which means how well the parties understand each other.

The building of social capital presupposes continuous and personal communication, constant upkeep of connections. *The relationship between social capital and learning benefits explains why technology companies are attracted by regional centres.*

The idea of social capital opens up new views on how companies commit themselves to their operating environment. The theory of traditional business has regarded the enterprise mainly through its transactions, which is a simplified view, even misleading in many situations, as it does not take into account the social character of enterprises. As late as in the 1980s it was believed that the main advantage of technology villages to entrepreneurs would be the cost benefit achieved through negotiation power. The surveys done did not reveal this kind of benefits, and only through the theory of social capital and learning organization has it become clear why entrepreneurs are attracted by the often expensive growth centres.

A key feature in inter-company interaction is information flow. Multiform networks consisting of different actors are more sensitive than individual companies to detect changes in the environment, to recognize problems and to solve them. Important are networks that are able to combine information from different sources, (eg. the Silicon Valley). Central parts of networks have been, in addition to growing technology companies, universities, risk financiers and law firms. A vital factor has also been the partnerships of enterprise and public sectors, where dynamic growth companies have been able to utilize the resources produced by universities and public institutions through their business networks. *Cooperative and competitive* interaction between the parties in the network has thus been essential.

The smooth connections of business activities to social contacts, social structures and social institutions became a central notion in the socially oriented economic research in the 1980s and 1990s.

Regions whose social structure supports the use and application of flexible production models are able to succeed better than others in new competitive situations (Piore & Sabel, 1984; Sabel 1992; Pyhe & Sengenberger, 1992). According to recent innovation research it seems that in the development and application of new knowledge it is not so much a question of individual insights than interactive learning of developers, producers and users, and institutional environments enabling learning. Especially vital in the learning and creation of new knowledge seems to be revealing network –bound hard-to-document practical or tacit knowledge, which requires interaction between the actors, social networks and mutual trust (Nonaka & Takeuchi, 1995; Ståhle & Grönroos, 1999).

It can thus be said that the form of organization is essential in the new economy. Innovativeness certainly has a technological dimension, both from the point of view of know-how and the objective, and the technological dimension has probably been the most important driving force in the new economy. Continuous competitive advantage cannot, however, be reached nationally, regionally or company wise if the production of innovations is not seen as a social process, where organization has a central role. Different organization produces different learning environments with their own laws, restrictions, and possibilities.

Innovation system and innovative milieu

The concept of regional innovation system has been developed for about ten years now and it has a lot of common with other regional research. Cooke et al (1988) have defined a regional innovation system as one with systemic connections between

- different knowledge producers (universities, research institutes),
- intermediary organizations (private and public innovation services)
- enterprises (large, small and medium sized).

An innovation system is always a social system, and innovations are derived from social interaction between different economic actors. The innovation system is also an open system interacting with its environment, for which feedback mechanisms are necessary in developing new knowledge and technology. The system is in continuous movement and causes constant changes in itself and its environment.

The study of innovative milieux is a systemic approach, which was started in the 1980s by the Gremi group (Groupe de Reserche Europeen sur les Milieux Innovateurs). The basic idea and starting point is that an enterprise is not a sole or separate actor, but always an integral part of its environment. The hypothesis is thus the central role of the local milieu as the generator of new innovations. The main components of innovations are the history of the regions, their organization, their collective behaviour, and consensus structuring them.

From the point of view of the prospering of innovation networks the regional dimension is essential, because

- the ability to develop human capital and interaction between enterprises and educational and research institutes is usually localized
- official, and especially unofficial contacts between the members of the networks are made possible by coincidental and planned meetings

- synergy (innovative surplus) rises with the shared cultural, psychological and political views of the people working in the same special field in the same economic or regional space (Lundvall & Borras 1997, 108).

An innovative system cannot be understood on the basis of one paradigm, technology logic or hierarchic planning. It is a question of complex interaction and a communication network between actors. When innovation is regarded in the systemic context, *the focus is on the basic elements, the actors (organizations, enterprises, regions), but first and foremost on their interaction and mutual dependencies* (Ståhle, 1998).

Dynamics of a self-generative system

The social dimension of innovation was neglected for a long time, and technological innovation was considered separate from the social context. Innovations are not created according to technology logic, however. Technology is the substance or end product at hand, but innovation is always created according to a different logic: as a *result of interaction processes between actors*. Transforming knowledge to a new product or new processes always contains various social actors that are different parts of the innovation and economy system. It is too simple to suppose that technology research or scientific research would directly produce innovations. There is no linear connection between new scientific knowledge and new innovations (eg. Schienstock & Hämäläinen, 2001).

Innovation is thus not a technical process, even though it may result in new technology. People create innovations, and that is why innovation is mainly a human and social process. The innovations of today are seldom created by one person or one enterprise, but are almost without exception results of wide cooperation. That is why innovation operation has to be regarded more broadly, through the resources of the operational environment, possibilities of cooperation and communication. Innovation is about a certain type of dynamics arising between different actors. In this dynamic sphere or environment new innovations are continuously created, and it also seems to attract innovative people. This generates a self-enforcing positive circle, which seems to have formed in some regions and enterprises – in others not. It is important to understand the principles of the birth and operation of this kind of dynamics, because innovative dynamics as such cannot be copied or moved somewhere else. It is always a unique situational event created by the actors themselves in each region or enterprise.

This chapter deals with the basic conditions required for the creation of a social system generating innovations. It is always a question of a system with a self-generative capacity to renew itself and its environment – in other words it has the capability to create and sustain an operative environment where innovations are generated. It is able to produce creative tension and to uphold it. The dynamics of this kind of *self-renewing* system generates new innovations, and its principles can be applied in all social systems (Ståhle, 1998).

A system is any operational whole where the parts are interrelated and interdependent with each other and their environment. The object of inspection can thus be a group, organization, or network whose goals and visions are common enough to generate double and multilateral contingency.

How successful this kind of whole is in reaching its goals depends largely on who the actors of the system are, what kind of operation and communication methods they have, and what their relationships are like. What takes place in the network or organization forms the operational environment to all the participants in the system.

The following review on the dynamics of self-renewal is based on P.Stähle's system theoretic study on supporting continuous renewal capacity (Stähle, 1998):

The preconditions of an innovative operation environment, ie. a self-renewing system consist of four factors:

1. System and its actors: identity and special characteristics
2. Networking: connections, trust and double contingencies
3. Knowledge management : information flows and creating meanings
4. Timing and environment : situational knowledge and courage to act

In the following the contents and meaning of the above factors are reviewed in detail.

1. Actors: identity based on self-definition, system awareness, personal rapport
 - The system has to have a *clear basic idea and identity*, which separates it from others and explains/justifies its existence. It has a common enough strategy, rules of conduct and value base. On the basis of these the actors decide what is important and appropriate and are able to prioritize choices. Without these the system cannot have an identity of its own separating it from others, and its actors are not able to identify themselves in relation to the system.
 - The *identity and role* of the actors are specified in relation to the environment of the system: cooperation partners and competitors. The system is in tight interaction with both internal and external actors and organizations. Own know-how, strategy, values and possibilities are always defined in relation to them. Without a close enough connection to the operational environment, the identity of the actors cannot solidify and develop in an innovative direction.
 - The system maintains itself and receives information about the state it is in through continuous self-assessment. There must thus be *continuous discussion* among the actors on the relationship of the achievements and goals, and they have to be ready to revise and change the direction if the conditions require that. This kind of discussion increases the systemic awareness of the actors.
 - The system forms a discursing operational environment where every one is influential. *Participation and feeling of responsibility* is wide: every actor affects the operation of the system and the decisions made in it. This does not mean absence of hierarchy or management, but great autonomy and responsibility on the whole by the actors. Through participation and responsibility the actors get a feeling of belonging to the system, which is vital for the dynamics of an innovative system.

- In a self-renewing system there is always an *image*, which separates it from others. The image is often formed by the personal charisma of some actors. These actors figure as the "odd attractors" of the theory of chaos, around which there is a lot of action and new ideas. They energize the environment in their own personal way of being and acting, they activate operations, generate new ideas, encourage others, and attract innovative people. A lot happens around them spontaneously, they are like energy centres of the system.

2. Networking: Connections, trust and double contingency

- The system has several *multiple-contingent relationships*, where all the parties benefit from each other equally. An innovative system is formed only between actors connected by a real and positive contingency. This kind of relationships act as accelerators of the system. Without double contingency the system will not have enough intensity for the actors to trouble to invest in and take responsibility of the whole. The more double contingencies the system contains, the more renewable it is.
- The system has forums and practices, which support dialogue and generation of common meanings. Without dialogue there will be no common concepts and meanings, and without them there will not be enough common awareness of the whole. It is not possible to have sensible operation in the system if the whole is not perceived. It is only possible to learn from the system by taking part in it, mere information is not enough.
- *The feedback system* within the network is very fast and subtle, people receive both negative and positive feedback on their ideas, doings and outputs –continuous presence of both is a necessary prerequisite for development. Knowledge is iterated (circulates, strengthens, multiplies, develops) very fast in the system.
- The system has a lot of personal relationships containing trust and interactive support, which is vital for the risk taking and tolerance for risk of a self-renewing system.

3. Knowledge management: Information flows and generation of meanings

Knowledge management is an integral part of a self-renewing system. The system has to have both technical tools and social practices to guide information flows, to enable interaction, and to generate new knowledge. There is a need for tools, organisational structures and operating environments to guide and enrich the information flows in the best possible way (Ståhle & Grönroos, 1999,2000). An innovative system is always built on open and fluent information flow and abundant interaction. Without these factors it is not possible for the system to be dynamic.

- A self-renewing innovative system *exists in an information flow and a state of obscurity*, "far from equilibrium" (Prigogine & Stengers, 1984). This means that an absolute truth or the correct state of matters

do not exist. No one is absolutely right, and there are lots of possibilities to choose from. The system cannot be tightly managed from the above, control would make it stable, non-initiative and stiff. The control systems have to be built so that they allow for plenty of movement and decisive power to the actors themselves. Also external crises, pressures or challenges serve the innovative networks and help them to break their own models of thinking and routines.

- The role of entropy in a self-renewing system is decisive. Entropy means the *generation of unnecessary or superfluous knowledge*, testing, pondering, trying, or knowledge of which it is not known at the moment of generation whether it is essential or even important, or whether it will ever be needed. The prerequisite of innovativeness and creativity is an abundance of material, which has the possibility of getting organized into something new. Entropy also means an *amount of disorder*, which means that the knowledge must be abundant and contain contradictions. Contradictions sustain a challenging power, and thus work as the driving force of innovativeness. A self-renewing system – as well as innovation – is based on *self-organization* in the social and psychological sense. This takes place for instance in cooperation with strong experts (no one dominates alone) from different fields of science (lots of different and opposite views). In a controlled environment preplanned matters are efficiently generated, but in an innovative environment the goals are largely reached through self-organization. No one knows beforehand what the result will be. An innovative system is able to both generate entropy and destroy it – in other words the actors do not become distressed in the chaotic stage, where knowledge cannot yet be prioritized or plans cannot be made. They are able to wait for the time to be ripe, and the material to start organizing itself. At the crystallizing stage the actors need to be able to let go of even good ideas, and to concentrate the resources on the chosen target. Both stages are difficult: inability to see the direction in the early stage and dropping good ideas or modes of operation at the crystallization stage.
- There are prerequisites also for the quality of the knowledge exchanged in the network: it must contain lots of people's subjective and personal feelings, ideas and thoughts – playing safe (on factual basis) does not generate an innovative operational environment. A lot of tolerance for obscurity and confusion, spontaneity and mistakes is expected instead – from oneself and from others. The processing of common meanings is essential, and continuous dialogue and communication is the prerequisite for common consciousness and common meanings to develop sufficiently. They are not generated by mere one-way communication, but participative discussion and exchange of ideas are always needed.

4. Timing and environment: Situational awareness and bold usage of possibilities

A self-renewing system lives continuously in the rhythm between chaos and crystallization: it endures distraction and confusion when matters are not yet ready for decision making, but it is also able for quick decisions and systematic progression when the time is ripe. It must be seen when the time window is open for each matter, and act according to the situation.

Situational awareness and swift decision making are based on acute observation of the environment and the conditions. If the network does not receive information on the environment and it does not deal with it, it is impossible to make situationally aware decisions. Both the realities and the opportunities are taken into account in the decision making – which means that both have to be continuously discussed in the network. The realities and the opportunities have to be recognized, and this happens only through advanced discussion. The consciousness of one person is not enough here, a large base is needed. Situational awareness also means that the actors have to be able to do nothing if the time is not ripe.

Situational awareness and timing is the most challenging feature of the self-renewing system, because it is not possible to give principles or instructions to its execution. The more tight the interaction with the environment, the easier it is to observe the weak signals of changes occurring there and to interpret them. In innovation operations timing has a central role: exactly the same product idea or similar action can be a success or a catastrophe, depending on the point of time.

These criteria of the self-renewing system have to be regarded on both the micro and the macro level. The same principles work all the time in relationships between people, and thus determine the dynamics, quality and possibilities for innovation of the whole operational environment. On the other hand conditions are created from the macro level: the decision makers can create situations where these conditions can be realized. Important features are the structures, resources, physical environments, legislation, money etc.

These conditions can be generated spontaneously by themselves, but they can also be created on purpose. There are four major ways to support the generation of self-renewing dynamics:

1. Decision makers create structures supporting innovative dynamics (groups, premises, resources, programs, projects, operational models).
2. Decision makers have a right conception of how innovative dynamics are created (mental models act as guidelines).
3. Opinion leaders have to be better catalysts than proclaimers and commanders.
4. Opinion leaders have personal charisma which energizes and activates others.

The above points have also come up in studies concerning regional innovation. For the success of innovation supporting policies it is especially important that the decision makers have a correct outlook on development, as this is reflected to all the others. The third issue usually causes great problems, because many people have a very oldfashioned view on leadership and power. The fourth point means that it is critical to find suitable persons to launch innovation projects and networks. Recognizing suitable persons and supporting them by sufficient resources is vital, and simultaneously extremely problematic. Regions often face the problem that the operation culture does not support and offer a possibility for charismatic people to come forward. Thus the potential of these persons is not utilized, and they are not allowed space to grow. If the opinion leaders do not have a clue of operating innovation dynamics, they will start to plan and direct the operations to a wrong direction. Skillful communication and ability to support people are necessary features, in addition to personal charisma. In this respect there was some advancement in the 1990s, but there is still a lot to be done.

Challenges for the decision makers

An important part of the innovation process is moving to the next generation of technological innovations. This means first of all understanding the social and systemic processes better, which will lead to generation of technological innovations. This will enable more efficient support to the production of new technology. For the second, the next innovation generation means generating and supporting non-technological innovations in addition to technological ones. This kind of innovations are related to marketing or modes of operation, processes, or social, psychological or symbolic practices. They are based on applying new technology in an innovative manner.

The chief goal of enterprises is to be able to increase the innovation capability continuously. Essential in this work is the efficient use of information and communication technology to reach a high enough level for the abundant communication needed in innovation.. *This alone is not enough. It is equally important for the company to be able to combine the use of technology with fluent organization practices, strategy processes, organizational structures, open and trusting culture, and development of competencies. This requires a comprehensive re-organization in the concrete and mental structures of enterprises.*

In efficient and forceful development work cooperation between different actors is usually in a central position. Time and energy have to be invested in developing cooperation. Institutions have an important role in the development work, but administrative solutions just create the framework and seldom bring forth the desired effect straight away. This is why decision makers and actors need to pay more attention to developing dynamic innovation systems able to generate innovations.

Schiestock and Hämäläinen (2001) summarize the challenges of decision makers as follows:

1. The task of politics is to create and facilitate networking between organizations.
2. In the light of present development it seems that successful informational municipal politics is first and foremost taking care of strategic intermediary operations. Political decision making should be based on development political thinking drawing from local strengths, and consolidating political leadership. Most obviously those municipalities that are able to create a working discussion and leadership culture and also otherwise strengthen their social capital, will improve their relative positions in the competition between municipalities.

A tool for assessing the competitiveness of a region

This chapter presents an estimation scale that can be used as a tool for assessing the competitiveness of a region. It is based on three previously presented frames of reference for outlining competitiveness and innovativeness.

The above mentioned frames of reference include three considerations; the competitiveness of a region (1), attractiveness (2) and self-renewal ability (3).

The assessment tool includes 10 items to be assessed during the assessment process in a region.

1. Human capital
2. Innovativeness
3. Concentration
4. Attainability
5. Enterprises
6. Institutions
7. Living conditions
8. Network of developers
9. Creative tension
10. Image

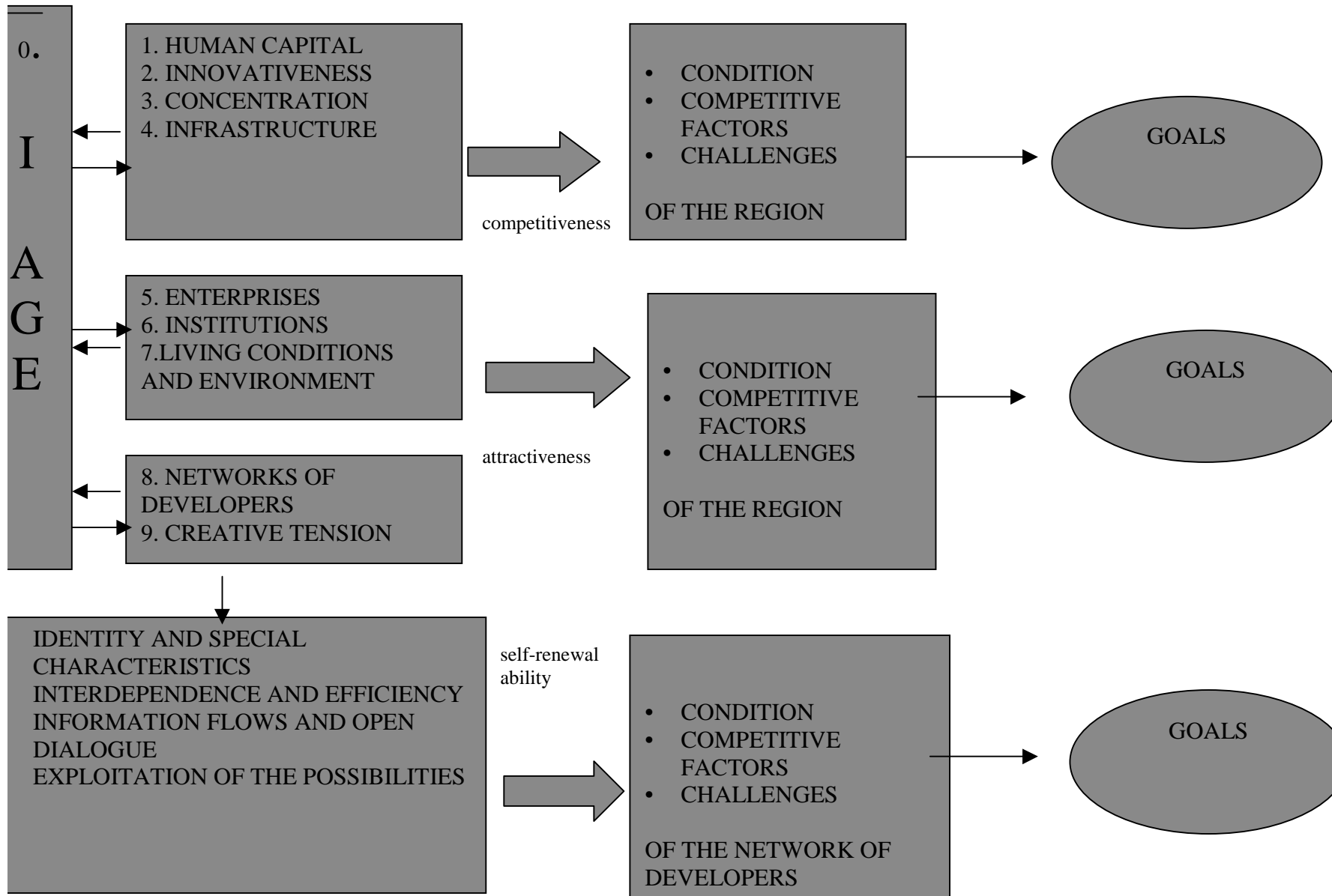
Each region will be evaluated so that a sufficient number of key individuals from the region discuss the basic areas of the region. On the basis of the discussion the

- a) condition
- b) competitive advantages
- c) challenges

of the region are crystallized (see the model). On the basis of these considerations three target groups will emerge. These target groups function as the base for the strategic development of the region and as a plan for actions.

Assessing the competitiveness of a region

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Components of the assessment tool

The group doing the assessment should discuss all the components below. On the basis of the discussion the condition of the region, the competitive factors and challenges should be crystallized.

1. Human capital

- size of the working population
- degree of attendance
- number of students
- number of technology students
- number of academic degrees

2. Innovativeness

- R&D expenses
- patents
- innovative posts
- share of peak and high technology in value added

3. Concentration

- concentration of population
- share of concentrated industries of the working population in the region
- share of business services of the working population of the region
- share of the largest area of business of the working population of the region

4. Infrastructure

- overseas connections of the industry sector
- water, air, road and rail connections
- data communication links
- town planning, lots, premises
- energy supply
- availability of natural resources and raw material
- water and electricity tariffs

5. Enterprises

- size and structure of the industry
- orientation towards exporting
- knowledge intensity
- proximity of subcontractors and other business partners
- competitive situation and structure of the markets
- new, emerging industries

6. Institutions

- universities
- polytechnics
- research institutes
- technology centres

- te-centers

7. Quality of living environment

- physical environment
(built-up areas and nature)
- activities and services provided
(health care, day-care, basic education, entertainment and cultural services, sports facilities)
- economical environment
(costs of living – prices of services, housing costs, tax percentage etc.)
- social environment
(interaction between people, daily social networks)

8. Network of developers

What kind of networks of developers there are in the region? Is there an ability to build real and active networks in which the real organisational competencies, strategies and goals can be directed towards a common goal?

9. Creative tension

At its best creative tension challenges the existing ways of thinking and operating. It is a force which helps the elements of competitiveness to live and renew themselves. If something new is created by the tension, it is normally creative by nature.

- identity and special characteristics of the region
Have the special characteristics and opportunities of the region been identified? Have the features been identified which are desired to be attracted to the region? Does the whole urban area, that is, the key strategic decision-makers and actors know what the urban area is competing for? Have the persons acting as "energy centers" been identified and are they supported? Is there an ability to mobilize the most important actors for the development of the urban area?
- interdependencies and efficiencies
Have linkages to the important networks of know-how and knowledge been established? How many economical interdependencies and partnerships there are in the network? Is there an ability to create and renew the institutions so that they support the urban area in developing its competitiveness?
- information flows and open dialogue
Are the communication channels and forums organised? How is the attaining of common goals evaluated? How actively and broadly do the actors influence collective decision-making? What kinds of discussion forums are there in the network? How is communication maintained in the network? How can the essential information be delivered to the actors fast and efficiently?
- taking advantage of opportunities
Is there an ability to make choices, and create strategies and effective development decisions? Is there an ability to focus the actions, ie. will even good ideas be given up if they are not connected to the strategy?

Do discussions concerning current issues take place? Have the windows of opportunities been identified also earlier and have the possibilities been capitalized? What kind of weak signals can be detected from the environment at the moment? What kinds of collisions of opinions are there? Are the collisions of opinions being creatively exploited?

10. Image

The image consists of the whole formed by the physical environment of the region, enterprises, research institutes, educational institutes, living environment, history and other factors, which have influenced the public image of the area. The image can also be consciously influenced through media and public events.

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