Hard Networks of Regional Development;
The evolution of technological infrastructures and urban morphology in the Tampere Region

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One method to study regional development is urban morphology. The viewpoint is historical, since the method focuses on the transformations of urban form. In this study, the development of a Nordic industrial town will be followed from the spot-like form of the late 1800s up to the present-day complex, multi-nodal urban region. The transformation will be explained by the common evolution of technical networks and industrial production, as well as the technological innovations within this evolution process. I aim to answer questions like: what kind of interdependencies there are between technical infrastructures and land use structures? Or: to what extent regional well-being and urban structures correspond to each other? And: what are the premises for urban planning to promote productive regional structures? And finally: can we outline new substantial planning methods which are sensitive to hard networks? There is also an interesting question on a more general level: can the roots of a network city be found in the history of the industrial city and, further, do they guide us to deeper understanding of present urban development?

Technological networks as transmitters of tensions and dynamics between different geographical scales
Although the concept of network has been used mostly metaphorically to describe ongoing dissolution of urban hierarchies, as well as every kind of co-operational relations, the fact is, that different geographical parts and functions of a region are actually tied together by material flows. In fact, social networks are based on these flows, too, because people have to move to meet each other, and communicate through electronic networks. If we consider regional economy and social life as a whole, the flows consist of raw-materials, goods, energy, water, waste, capital – and of course people and information. Material flows need material networks, in other words, technical infrastructures. (Simmonds & Hack 2000.)

Actually, the concept of 'technical infrastructure' denotes to physical networks, although it would be relevant to consider also the flows within those networks, if we are discussing regional development. In this case it would be more exact to talk about technical infrasystems. Physical networks and flows together could explain the developmental potentials of the networks and, on the other hand, also the inertia, that structures land use and urban morphology. It is very costly to establish new networks, which make them relatively permanent and slow structures. (Jonsson & al 2000.)

The significance of technical infrasystems for regional development is based on their basic function: to provide accessibility between resources and functions. The resources of protoindustrial era were quite rude. They consisted of natural raw-materials and energy, which had to be conveyed to production process. Human labour was the third central resource. Profitable organization of these factors was an equation, that could not be resolved without technological innovations. At the moment, resources and functions have been diversified and splintered along the industrial restructuring and deepening division of labour. This complex economical mix has been further stirred by global markets and networks as well as diversified individual life-projects. Now, as the concept of resource has extended in our informational economy, the basic problem of cities and regions has remained the same: how to put together the central resources in a right location. It depends on the viewpoint, whether the technology is seen as a solution for accessibility problems of urban sprawling, or is it one source of this problem.

Morphologically, the main task of technical infrasystems is to maintain the urban metabolism in cities and regions. They 'feed' the cities and they allow the exchange of outflowing products into inflowing resources. One outflow contains naturally metabolic waste. Materials and other resources maintain and grow urban structure and fabric.
Where local and inflowing resources encounter each other profitably, there emerges nodes. Nodes are densities of urban structure, and they consist of buildings, infrastructure and people. They are the components of physical urban form. It depends on the scale of observation, how we actually conceive the nodes. For example, on a local level the nodes are entities like building blocks and quarters. On a regional level we are talking about parts of a town, small towns or villages. (Oswald & Baccini 2003.)

Regardless of the scale, the developmental dynamics of nodes follow the same logics. Both local and ‘network’-properties have to support each other in order to enable metabolism and the quantitative, as well as qualitative, development of a node. The node has to possess some local potentials in order to entice more efficient supply of technical networks. Usually these local properties consist a suitable combination of natural resources, skilled people, institutions, economy, history, culture and living environments. On the other hand, it takes supra-local connections to keep up and develop these resources. Hard networks include developmental potential needed on the local level. So, the nodes emerge and develop in interactional processes between place-bound and network-bound properties. Actually, the concept of ‘node’ already denotes to this dynamics, since ‘noding’ is a property of a network. Consequently, we can talk about node-properties in order to describe the connectivity of some locality or node to more extensive networks. (See Oswald & Baccini 2003. See Lees & Hohenberg 1988; 1995. See Bertolini 1996; 1999; 2003. See Bertolini & Spit 1998.)

The developmental dynamics between place- and node-properties require, that one or the other has to dominate in turns. Good accessibility may promote local activity, for example business, up to the level, where better accessibility to some resources, like work force or information, is required. Sometimes the states of imbalance might last long due to macro-economic fluctuations or national politics, and their impacts are not necessarily positive. Overemphasized node-properties might emerge as heavy traffic arterial, which splinter land use and restrain organic infilling of urban fabric. Harmful node-properties could be reduced by removing the arterial somewhere else or, more realistic, taking the advantage of the node-potential by building commercial or industrial functions. In other words, the place-properties would be elevated up to the level of prevailing node-properties.

Respectively the heightened place-properties can be balanced by elevating node-properties. For example, on the West coast of Finland there are localities, which have traditionally strong local economies and business-supporting atmosphere, but due to their remote location, big telecommunications firms are not interested in building commercial ICT-broadband networks. In cases like this, the municipalities and local companies have sometimes built their own networks in order to provide access to vital informational resources.

The prerequisite for resolving these kind of developmental problems is the ability to analyze the states of imbalance in the node-place-framework and, after that, operationalise them into respective strategies. This is also the key to turn dynamics into regional success stories. It is worth of taking an active attitude towards imbalances, since they can be problematic in different scales. On a local level, the problems might come true in degradation of living and business environments, removal of better-off people and social segregation. Or they might suffocate local economy in the lack of proper connections. The problems on a regional level easily appear in the co-operational strategy processes or in municipal incorporations. The unbalanced and problematic nodes will be compared to successful ones, and this provokes political resistance in the name of regional equality. Anyway, the worse-off nodes and localities will slow down the development of the whole region.

**Urban-industrial evolution in the Tampere region**

In this article, this kind of developmental dynamics will be studied against an empirical background. The object area is the Tampere Region in Finland, which will be studied historically from the late 1800s protoindustrial era up till present post-industrialism. At the moment, the object area belongs to the triangle of the most wealthy Finland with more than 2,5 half million inhabitants. It consists of six sub-regions and 33 municipalities. 11 of them are cities, the largest is Tampere with 203.000 inhabitants, and 100.000 more if we count the urban region. The population of the whole region is 460.000 inhabitants. The average population density in the region is 32,0 inh/km². The respective number in the whole EU-area is 116,5 inh/km². The main economical branches are services, machine industry, ICT- and biotechnology. (Pirkanmaan liitto 2005.)
The study focuses on technical networks, since they have a central role in the developmental processes of node-properties. We should also bear in mind, that quite subtle local networks form an essential part of local potential, too, as they maintain the internal metabolism of nodes. And, of course, the contribution of technical infrastructures to the birth and development of industrial city is evident. Main difference between industrialism and handicraft was effectiveness and volume of the production process, as well as the range of the market area. Increasing demand fostered technological innovation leaps which, in turn, enabled new phases of urban growth. Industry could not have developed without the expansion of cities, and cities had no reason to grow without the growth of industrial production. This two-sided process was transmitted by technological infrastructures with such a sovereignty, that the historical sequences of urban-industrial development can be named according to the most central technologies of infra networks. (Jonsson & al 2000. See Adams 1988.)

Although technological innovations tended to deploy quickly to large geographical areas, there were local differences in introducing them. Especially in protoindustrial era, quite decisive were the natural resources, like energy and raw-materials, which were locally available. Also the demand of markets dictated the assortment to be produced, and through this, the whole process with its technologies and resource networks that were involved. Still, there were a lot of unifying features, since the universal resource for all industries was – and still is – the labour with its needs for transportation, housing and amenities. And further, products were to delivered to markets, and the necessary infrastructure, like shipping and classic trade routes, were global since 1500s. (See Hughes 1999.)

In the Tampere region, I have named the developmental stages as follows: 1) Hydropolis, 2) Copper-cable city, 3) City on Wheels and 4) Digi-region. The stages are clearly overlapping, since old networks do not vanish although new ones are introduced. New networks are costly until there are connected payers enough, so the old networks will serve in their original function for a while. Usually they go through certain restructuration as their functions and meanings gradually change. This can be called the layering of technical infrastructures. (Hynynen 2003; 2004.)

**Hydropolis**

The city of Tampere was founded in 1779, but long before that its predecessor, the Tammerkoski village, had become a remarkable regional market place. The nearby lakes, Näsijärvi and Pyhäjärvi, enabled a large market area within a radius of 100 km. The narrow neck between the lakes was a part of a ridge providing an easy, and important, trade route from the West-coast of Finland to St. Petersburg, Russia. Tammerkoski village had also an access to National postal routes since the 1750s (Pietiäinen 1988). Despite the favourable node-properties, the most attracting quality of the location was the waterfall, which was meant to be the main energy source for the new industry. The drop between the lakes was 18 meters, thus guaranteeing power for several industrial mills. (Unless otherwise mentioned, my description of historical Tampere until the year 1990 is based on following sources: Alhonen & al 1988, Jutikkala 1979 and Rasila 1984; 1992; 1993.)

However, it took almost 50 more years to launch industry, actually. Till then, Tampere based its economy on trade and handicraft. The basic infrastructure was in order, but the town lacked know-how and the technological impulse. In 1820s these were achieved, too, when the Scottish engineer James Finlayson founded a machine-shop and a textile factory. By 1850s, the latter was the biggest industrial plant in Finland. Cotton, its raw-material, was shipped to Finland, and drawn from the coast by horses. Ready-made products were exported mainly to Russia. The energy needed in the production process was transmitted mechanically from the waterfall to spinning machines.

Easy energy, good trade connections and availability of work-force in Tampere encouraged to found more production lines, especially paper and textile factories. All newcomers had to settle down by the falls, since only means to transmit water power for machines were mechanical. Every time the factories increased production volumes, more energy was needed, and the consequent water canals and paddle-wheels took ever more space. By the year 1860 the Tammerkoski falls were totally harnessed. All the heavy industry in the town was lumped down by the waterfront, while the other urban functions and structures spread around this central spot within a radius of one kilometre. Better-off people and goods were transported by horses, workers went by walking. From the morphological standpoint, the main resources – energy and labour – were transmitted by spot-shaped ‘networks’, which had very limited capacity to balance the overemphasized place-properties.
The unbalanced situation became unbearable, as the demand of paper grew rapidly. There was an urgent need to expand the existing factories, which was impossible due to the lack of space. Although steam machines were commonly used in sawmill industry, it was not profitable to use them in paper mills due to the great expenditure of firewood. In sawmills they used sawing waste as firewood. Paper mills had still to lean on water power and seek new falls. So, it was this expansion, which gave birth to new regional nodes and supporting networks.

The new industrial centres of the Tampere region – Nokia, Valkeakoski, Kyröskoski and Mänttä – were born in the old watermill villages. Later on, they all became important regional sub-centres. The villages had good pre-industrial infrastructures, in other words, road and water connections. Of course, the primitive networks needed a touch of modern technology in order to be able to balance the heightened place-values with efficient connections to the globalising society of capital and markets. Canals and locks were built in order to broaden the floatable water area for logs. Road networks were improved in order to ensure the access to labour-, market- and maintenance resources. Telegraph lines were built to enable on-line business communication.

Copperable city

Tampere was connected to the national railroad network in the year 1876. The railroad made the interregional flows of people and goods extremely efficient. Before this, the products were transported by ships and horses to the Hämeenlinna railway station. The prerequisite of industrial success in inland areas was the access to the railroad network. For example, the Mänttä papermill began really to flourish once the railroad to Vaasa was built in 1883 with a branch terminal line to the mill area.

The emergence of telegraph was another sign of the dawn of new industrial, metal-based infrastructures. The telegraph networks followed railroads, since the communication between stations had to be arranged somehow to make transportation efficient. This is a good example of synergism between different infrasystems, as well as the conducting role of communication systems in relation to other infrasystems. Through communication the metabolism in technical networks could be controlled and optimized. In the late 1900s telegraph was vital for globalising business, too. So, Tampere got its own line before the railroad in 1865 by the request of Finlayson textile factory.

In the local communication the telegraph had no significance, and on a regional level its period was quite short until the telephone was introduced. The telephone was good for national and international communication until the telephone- and telex-networks began to globalize. In Tampere, the local telephone network was opened in 1882, and by the end of the decade, the new mills of Kyröskoski, Nokia and Valkeakoski were wired. (Helenius 1990.)

Together with the introduction of telephone, more powerful copperable technology - at least from morphological standpoint - was taking its first steps: the electric energy. In Tampere, the new power was first harnessed to light the Finlayson machine halls. The aim was to make the production more effective by prolonging the working day in the scarcely-lit North. But the actual invention was the electric motor, which was able to replace the paddle-wheels. By the year 1920 practically all factories in Tampere were using electric power. The source of power was still in falling water, but the new technology enabled to transmit it around the town to free areas. The telephone offered synergistic benefits by providing business communication between areaantly scattered functions. These innovations were crucial in setting the spot-shaped urban form free from its strait-jacket. (Goodman & Chant 1999. Jonsson & al 2000. Anttila 1993.)

The electricity-based production needed more space for individual plants, since new processes did not have to be layered anymore. Electric motors allowed optimal one-storey lay-outs for machines instead of vertical belt-systems. In addition to this, increased production volumes required more space for storehouses causing ever extensive factory areas. Fortunately, urban structures have enormous flexibility, if it helps productivity.

Electricity had also other kinds of impacts on local place-values in Tampere. The dim street gaslights were replaced by electric light-system giving a new sense of security and amenity to urban milieu. Together with this, the town was supplied with a sewer-system, which further improved the urban environment.

Before the electricity network was extended to the nearby countryside, and finally to the whole region, it heightened remarkably the place-value of the town by enabling its growth, both quantitatively and qualitatively. The new
copper-cable networks facilitated ever more intensive and diverse land use. The growth of size meant also the growth of activity. One consequence of this was, that also the supralocal networks were utilized more vigorously. For example, the shipping routes of the lake Näsijärvi had to be complemented by a connecting transportation network in order to serve the whole countryside around the lake. This gave birth to the dense – and still existing – road network.

The scale of railroad was too large to cover the intraregional need for transportation, and furthermore, still in the turn of the 19th century, the road traffic was based on horses and carriages. So, until the car was introduced, the heart of the regional transportation network was the Näsijärvi lake. It gave the accessibility to all central resources: agricultural products, logs, fuel wood, and so on. However, the shipping went on despite the invasion of road traffic. At the moment, the ships of Näsijärvi and Pyhäjärvi lakes transport tourists, and even the logs were floated up to the last decades.

City on wheels
There emerged a need for another new technology in the beginning of the coppercable era, as the electricity relieved the factories to locate all around the urban area. Areal expansion hampered the accessibility to some other resources. For example, distances between work and home grew, and also logistics became difficult, as the material supply had to be arranged to scattered factories.

So, two more technical innovations were needed to cross the distances in the expanded city in the beginning of 1900s. The proliferation of bicycle enabled longer ways to work, and the introduction of car resolved the logistic problems. In 1920s they started the coach traffic to suburban areas of Tampere. Consequently the road network had to be improved up to the level of the new high speed combustion technology. It was these infratechnological development steps, which partly enabled the strong economic upswing of the 1930s.

The developing road traffic gradually tied all the nodes in the Tampere region into one solid regional network. From the standpoint of flexibility, trucks and coaches were superior. Goods transportation was not anymore tied to rigid time-tables of ships and trains. It was very easy to increase the frequency of departures to serve the growing number of passengers. Also the network was remarkably dense in comparison to shipping and railroad networks, and further, there was no need for separate connecting transportation. For these reasons, the road network began to define the economic region of Tampere from the 1930s. It is no surprise, that the volume of road transportation of raw-matertials and goods has grown smoothly up to present regardless of the development of railroad technology and networks. (Ajo 1944.)

During the WWII, the economy collapsed in Finland, but in the 1950s there started a new upswing. The development of technology facilitated a modernization and efficacy of industrial production, as well as the sheer restructuration of agriculture. It was a start of a massive immigration from countryside to cities, which culminated in 1960-70s. In the 1950s they started to extend the urban area of Tampere by continuing the urban fabric radially and organically. The distances grew again together with the number of passengers. At this time, the transportation problem was solved by founding a municipal bus company. Its network was based on the radial street structure at the time. The most frequently operated lines were run by electric trolley-buses.

In the 1960s, the traditional construction technology turned inefficient to solve the ever-increasing housing problem. Another problem was the lack of large building lots in locations, where the organic growth of urban fabric could have been possible. So, the problem was solved by developing a Finnish application of the garden city model. From the morphological point of view, the process was quite similar to the regionalization of paper mills in the end of 1900s: new nodes began to emerge to areas where the vital resources were available. In this case, the resources were building lots for large housing units.

New innovations were needed in construction and infrastructure technology to build extensive neighbourhoods in tight schedules. The solution was an industrial construction process: standardization and mass-production of building elements. Increased volumes intensified also the flows in technical networks, which were meant to support building and housing processes. So, new solutions were needed in this branch, too. First, a good logistic network enabled the centralized production and transportation of elements. Secondly, the new district heating system enabled the centralized distribution of heating energy. Logistically, it was not anymore reasonable to heat every building
separately. Also the economic factors supported district heating, since the prevailing source of energy was oil. As we know, its price started to rise due to the 1973 oil crisis.

At first, all the new housing nodes were supplied by their own local power plants. In 1980s they started to centralize the heating system by weaving together the separate networks. At the moment, the distribution of district heating is based on two plants, and the supply network covers the whole city area. In the beginning, the source of energy was peat, but since 1986 natural gas has been used. The main pipe comes from Russia. Usually large technical systems start from the urban centre spreading radially around, but the district heating system has started from several spots around the edge of a city. This feature is common to all Nordic countries. (Jonsson & al 2000.)

The third technology, that enabled the urban expansion, was the telephone. Since 1960s homes were commonly wired, which made also the co-ordination of domestic life possible in ever extensive areas. The fourth, and the most significant, facilitator of the decentralized garden city model was definitely car-based public and private transportation. All the main housing nodes were linked to bus networks, which were complemented by private cars since the 1960s. Private car gave unforeseen flexibility and freedom for households, although the distances had grown.

By the beginning of the 1970s Tampere had become a remarkable regional and national centre. The number of inhabitants in the town area was 160,000, and in the urban region 230,000. Rapidly increased road transportation caused harmful traffic jams, since all the main arterials converged in the centre of the city, which was located on the narrow neck of land between two lakes. Local and global networks had collided violently. The first phase of solving the problem was to built a through road down to the waterfront of the lake Näsijärvi. Local and regional traffic flows began to differentiate. This direction of development went stronger till the 1980s, since the traffic flows continued to grow, and the first ring road was built. At the moment, they are widening the first ring, and the second ring has been planned, waiting now political decisions and funding.

The automobile city makes the node- and place-properties, as well as the tensions and dynamics between them, quite visible. In the 1960s, rural population was enticed to urban areas by heightened place-values, at least in comparison to rural nodes. Due to the immigration, industrial development and versatile services, the intensity and diversity of urban land use heightened. In order to balance accelerated flows of people, goods and communication, technical networks had to be built and developed. However, when new networks were built, the respective node-values heightened. This took place especially in the intersections of different scale networks, like in crossings of radial arterials and regional ring roads, where new nodes have emerged including shopping-centres, services, maybe housing, too.

In the Tampere region, the automobile city has now aged for 100 years, and the last 40 years have been a period of accelerated development. There is no end point in sight, although the traffic congestion has turned permanent. It was already mentioned, that the volumes of road transportation are still increasing. The number of private cars is growing together with the cutting down of unprofitable bus departures. In the centre of Tampere, the parking problem is getting worse, and new underground parking halls are designed while the number of cars is planned to be diminished by introducing a regional city train.

**Digi-region**

As a result of the economic restructuration of 1980s and onwards, informational and skill-based resources are now in the centre of production processes. Consequently, the development of ICT-infrastructures has been – and still is - massive. ICT-networks have gained in Finland, and in the Tampere region, almost full areal coverage. They do not have *directly* structuring impacts on land use, if we count out the functions that are based on superefficient fiber-optical networks.

It is hard to say anything final about the *indirect* impacts of them. We can assume, that globality of ICT-networks, their good interaction between different scales and good areal coverage tend to increase the developmental potential of other technical infrasystems and nodes generally. History teaches us, that improved means of communication have always increased overall activity and consequent mobility. If we also bear in mind, that the key processes in
production consist of information, it is obvious, that ICT has impacts on land use in urban regions. (Jonsson & al 2000. Graham & Marvin 1998.)

Like all technical innovations regarding infrastructures, also the digital technology gives more flexibility in space-time-continuum. Increasing wirelessness and good coverage of networks have improved overall mobility of people and goods. However, we need still the ‘old’ structuring traffic networks for two main reasons. First, the final outcomes of production processes are still mostly material and, secondly, people have to come together to design, produce and market these products. ICT has the ability to make the traditional infrastructures more efficient and make them pulsate simultaneously. For example, in the middle of 1900s in Britain they used telegraph networks to synchronize the mechanical clocks in railway stations. Simultaneity and punctuality increased overall effectiveness. (Graham & Marvin 2001. Goodman & Chant 1999.)

ICT-infrastructures tend to relieve urban functions in relation to each other, as well as extend their effective range. On the other hand, the logistical and indirect factors, which affect mobility, have even more weight in digital economy. In Tampere region it seems, that the expanding urban structures follow clearly the main road network, shaping the whole urban form respectively. The strong emphasis on mobility concentrates structures close to respective networks, while the relative building and population density decreases in nearby areas outside the range. (See Hack 2000. Lodenius 2004.)

From the standpoint of regional development, the central morphological feature is the emptying of those net meshes. One reason for that is the EU-membership and its impacts on rural economy since 1994. Even in the affluent Tampere region the well-off areas alternate with declining areas ever frequently. The problem has been noticed in regional developmental strategies. According to them, the ‘remote’ areas have to be connected to the central resource networks of the new economy, as agriculture and forestry employs not more than 3.6% of the regional workforce. The smaller sub-centres should be strengthened in order to reinforce their mediating role between the central city and rural areas. In practice, the connectivity and attractiveness of smaller towns should be developed to make them attractive enough to function as housing nodes for Tampere. Leaning on their service infrastructures, the surrounding rural areas could develop their own economy and tourism. All this is based on regionally balanced technical networks of transportation and communication. (Pirkannan liitto 2005.)

On the other hand, the problem concerns the central city as well, since the forceful clustering of population and functions take a lot of resources, as the hard infrastructures and service structures have to be developed up to the respective level. The problem is national as well as political, since the ideas of successful areal structures oscillate between centralized and decentralized models. However, the recent national strategy is based on multi-nodal model, which strives for balancing the uneven development like written in previous paragraph. In principle, the smaller towns could develop their local potentials so as to attract supralocal networks. The rural villages in Finland are so small and scattered, that they lack institutional and morphological thickness, which are vital for proper connectivity. Instead, the mediating networks of smaller towns are able to link together global and local sparse networks. (Sisäasianministeriö 2003.)

While ICT-networks have enabled the splintering of production chains and relieved their locations – within the limits offered by structuring logistic networks – they have affected the mobility of people by two opposing ways. They force us to adapt to longer daily distances but, on the other hand, at the same time we have got more freedom in our mobility networks, as certain transactions, working stages and communication are not anymore tied to geographical locations. The layered and synergistic networks of automobile city and digi-region provide us with conditions for more mobile every-day life. It is hard to consider this ambiguous character of mobility without Lefebvre’s terms domination and appropriation of space. It is not easy to determine people spatially. They will always find ways to carry through their own life-projects, even if they have to ‘abuse’ space. And, following still Lefebvre’s philosophy, every-day spatial practices have also the power to mould space. It is these aspects, that make the indirect impacts of ICT-infrastructures on urban morphology so unexpected. (Graham & Marvin 2001. Lefebvre 1991.)

The ever extensive spatial networks, that regional every-day life offers us, have also changed our urban experience. The uninodeal city gave us one common orientation point, whereas in network city everybody gathers one’s personal city through the regional mobility network. It might be hard to conceive these mobility environments in terms of new
urbanity, since they represent neither ‘real’ city, nor real ‘countryside’. Maybe this is the reason they have not been valued to deserve ‘real’ architecture. Surely this will change, when the importance of urban environment, services and amenities to key economic branches will be thoroughly understood. Needless to say: to design mobility environments equals to creating place-values. (Sieverts 1997. Florida 2002; 2005. Kotkin 2000)

Managing the node-place-balance

Although the role of technology is pivotal in urban and regional processes, it is not capable to explain the network-like development alone. Three main factors can be distinguished here. The first is the mode of production, which, in turn, depends on macro-economic factors. Pre-industrial, protoindustrial, Fordist and Post-Fordist phases have their distinct characters based on respective products, urban spatiality and technology. The ever-increasing mobility of capital and expansion of market areas have deepened the distinctions. The second factor is the ideology of urban planning, which depends on contemporary political atmosphere as well as professional ideas concerning urban spatiality. Politics affects the relation between planning and markets: should planning promote markets, or should it balance socially and areally uneven development. Professional ideas can be read, for example, in organic or fragmentaric urban designs. The third factor is the infratechnology, which exploits innovations quite quickly. It is hard to say, if the innovations develop out of needs and growth pressures or, are the urban regions expanded, because it is technologically possible. Either way, urban structure is an inherent factor of economic productivity.

Interdependencies between infrastructures and urban morphology are very complex due to the several dimensions of the infra networks, like, for example, restructuration. When changes take place in economy, areal system or in technology, and a new technical infrasystem is introduced, the old ones do not totally vanish. Usually their positions and meanings in relation to economy changes. For instance, the shipping in the lake Näsijärvi lose its centrality as a main transport means for vital resources, but it continued to provide access to tourist resources. The other dimension is layering, which means the overlapping of different infrastructures. It is very difficult to foresee their aggregate impacts on urban form, since they all live in different phases in their life-cycles. The layering might lead to dynamic and synergistic interdependence of infrasystems, like the present bundles of road and telecommunications networks. (Graham & Marvin 2001).

Since the importance of technical networks for regional development is obvious, it would be important to better understand the relations between these networks and the central factors of functional locating and clustering. Morphological method is valid, if the time span of the study is long enough. This is the reason, why the past development is relatively easy to explain from the standpoint of technical networks, but the present morphological tranformations are extremely hard to analyse. However, it is still worth of trying. The research agenda could be something like this:

1) The aggregate impacts of infra bundles on urban morphology should be studied in order to be able to predict the main growth directions of complex urban regions. On the other hand, in declining areas it would be valuable to know, what kind of infra bundles would help to optimize scarce resources.

2) The indirect impacts of ICT-networks on the use of urban space and spatial practices should be studied. The related morphological tranformations might appear already in their initial phase, but we are not able to identify them without considering the changes in spatial practices, which take place in the spheres of citizens, economy and administration.

3) We should be able to anticipate technological development, and the impacts of new innovations on transportation and other infrasystems, at least to some extent. History teaches us, that the central problems of urban development and growth have always been resolved by technological innovations. The present problems concern social issues, since new transportation and communications networks tend to exclude some social groups. Urban sprawling is also an ecological problem, since increased mobility spends a lot of unrenewable energy resources with present technology. Degradation of living environments will be partly resolved by new sustainable transportation and production technologies, but also the regional mobility environments have to be taken seriously. They have to be understood as our new urban landscapes, which are hybrids of architecture, natural elements and technical infrasystems. Technology can not be taken anymore a necessary but unavoidable subsystem. Instead, it should be understood as an inherent part of urban landscape, which it always had been. At the moment, we need a new interpretation of that fact. (Angelil & Klingmann 1999. Strang 1996.)
4) And finally, we need new planning methods, that are capable to handle complexity and multinodality. They should be able to recognize urban regions as networks of gradually specialising nodes. These nodal networks, in turn, are glued together by complex technical networks. However, the nodes are also places. In addition to their roles and meanings as components of a network – node-value – they have their own local histories, cultures and potentials – place-value. The balance between node- and place-values is precarious, and might fall into a state of imbalance, if the infra networks do not support local economy or, on the contrary, if the infra lines and flows are disturbingly strong. The node-place-balance is essential for the regional development, since the prerequisite for affluent economy are good local and regional connections to supralocal flows. On the other hand, local economy might be dependent on nice milieus and attractive urban atmosphere as well.
References


