Node-Place-Model;
A Strategic Tool for Regional Land Use Planning

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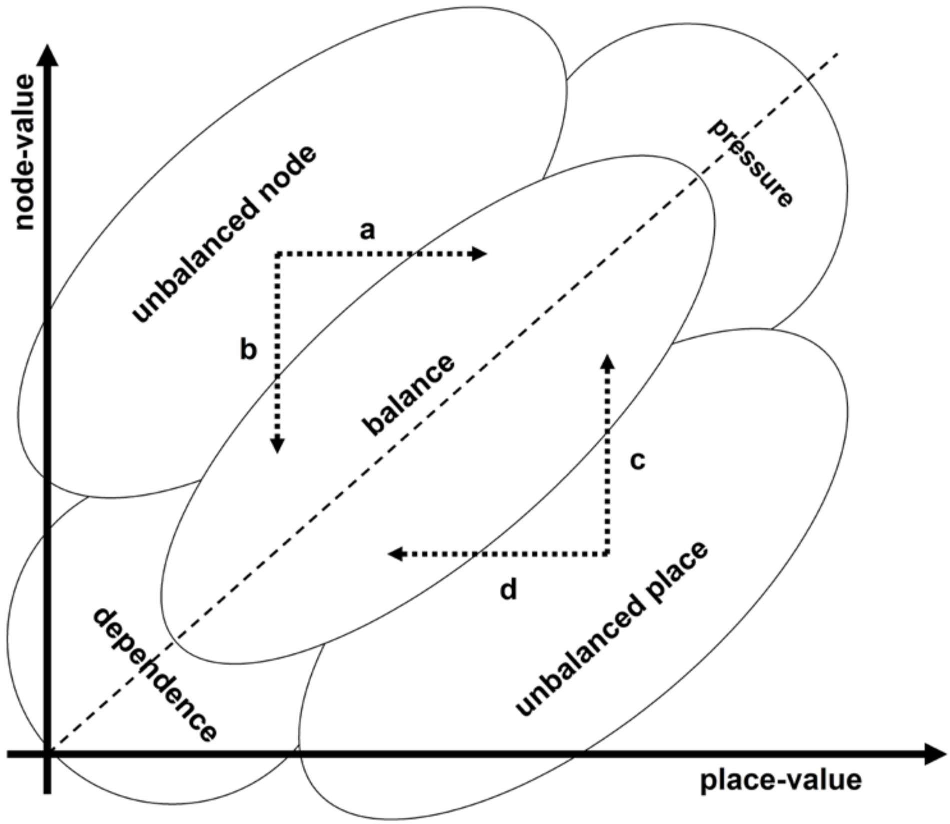
Due to mobility and consequent dynamics and networks, cities have turned out to be extremely complex objects for research (Albrechts & Mandelbaum 2005; Ascher 2004; Sieverts 2003; Graham & Marvin 2001; Oswald & Baccini 2003.). This evokes a question about developing new quantitative methods for analysing and planning urban structures. The Node-Place- model presented and applied in this article offers starting points for analysing networked urban structures and working out respective land-use strategies on a regional level. The model is based on tensions between local land use and connective potentials included in technical networks. 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 1800's protoindustrial era up to present post- (or late-) industrial phase. Historical method is needed to reveal the long-term processes behind dynamics and urban form. The study is meant to prove the relevance of the model, not to elaborate it in detail.

The signifigance of technical infrasystems for regional development is based on their basic function: to provide accessibility between resources and functions. The resources of early industry were quite rude. They consisted of human labour, natural raw-materials and energy, which had to be conveyed to production process. Profitable spatial organization of these factors was an equation, that could not be resolved without technological innovations. At the moment, resources and functions have been globally scattered due to industrial restructuration and deepening division of labour. Yet the basic problem of cities and regions has remained the same: how to put together the central resources in a right location.

Morphologically, the main task of technical infrasystems is to maintain the urban metabolism in cities and regions. They 'feed' cities and they allow the exchange of outflowing products into inflowing resources. Materials and other resources maintain urban structures and fabric, and make them grow. Where local and inflowing resources encounter each other profitably, there emerge nodes. Nodes are densities of urban structure, and they consist of buildings, infrastructure and people. It depends on the scale of observation, how we actually conceive the nodes. On a local level they are entities like buildings and blocks. On a regional



level we are talking about parts of a town, small towns or villages. (Oswald & Baccini 2003.)

A 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 supralocal connections to keep up and develop these resources. Hard networks include developmental potential needed on the local level. So, nodes emerge and develop in interactional processes between place-bound and network-bound (=node) properties. (See Oswald & Baccini 2003; See Lees & Hohenberg 1988; 1995; See Bertolini 1996; 1999; 2003; 2005; See Bertolini & Spit 1998.)

Node-Place -Model

For the needs of regional urban planning, we need a tool to analyse and manage the relation between place- and node-properties. An interesting starting point is the 'node-place-model', which has been developed in Netherlands as a method to examine the relation of multimodal transportation hubs and land use. (Bertolini 1996; 1999; 2003; 2005; Bertolini & Spit 1998).

In my regional application, the model is based on indicators, which describe the place- and node-properties of a chosen node. These will be indexed and placed in a system of coordinates, where the x-axis represents the place value, and y-axis the node value. The model reveals the node-place-balance graphically, as every regional node takes its position somewhere in the system (picture 1.). The positions can be named as follows:

1) Balance: a node and a place are as strong. Technical infrasystems and local land use profile support each other without any pressures to extend structures. The focus is on the maintenance of the systems and the environment.
2) Stress: intensity and diversity of infrasystems and activity of land use comes close to maximum. There is a lot

of potential to make the land use more efficient (a strong node), and this potential has also been realized (a strong place).

3) Dependence: There is no competition for free space, and the demand of infra flows is so low, that the necesary flows can be maintained only by the help of outside necessary interventions. There is no need for further development of infrasystems due to the lack of local potential. There is nothing to be realized by the help of infrasystems.
4) Unbalanced node: the supply of infra flows is relatively stronger than the activity of land use. The imbalance might be manifested as splintered land use by massive infralines, or environmental degradation caused by jammed traffic.
5) Unbalanced place: the activity of land use is more intense in relation to the supply of infrasystems. This kind of imbalance might come true in areas, where the atmosphere for entrepreneurship is traditionally supportive, but which is too remote for economic flows and consequent infrastructures.

In positions 4) and 5) there is a tendency to move towards a balance. This can always take place in two ways: an unbalanced node can either increase its place value (a), or decrease its node value (b). Respectively, an unbalanced place can increase its connectivity (c), or have more local orientation in its strategies (d).

The successful function of the model is dependent on the way how the node- and place properties are indicated and valued. The *node-index* should describe the overall connectivity into supralocal infra networks. The quality of this connectivity is up to the accessibility to different infra networks, but it is also dependent on the strength of the flows of traffic, information and so on. So, we have to consider both the diversity and intensity of the connectivity.

The *node diversity* describes e.g. road networks that feed different regional scales, railroad connections, broadband facilities for telecommunications and so on. The *node intensity*, in turn, describes e.g. the frequency of departures of public transportation, the 'breadth' of broadband, as well as the actual quantities of the flows within these networks.

The *place-index* describes local overall activity, developmental potentials and the quality of living environment. Respective parameters can be found in statistical databases concerning local land use, population and economy. The *place diversity* can be indexed by relating the selected figures of land use, services and other functions to the number of inhabitants or firms. When the diversity-index is meant to indicate the place in its versatility, innovativity and attractivity as a living- and working environment, the *place intensity* indicates its activity in quantities, e.g. the numbers of different branches of business, turnovers, rates of employment etc. in relation to the number of inhabitants, and further to the regional averages.

Node-Place -development in the Tampere Region

At the moment, the object area belongs to the triangle of the most wealthy Finland with more than 2,5 million inhabitants. It consists of six subregions 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 main economical branches are services, machine industry, ICT- and biotechnology. (Pirkanmaan liitto 2005a.)

The study focusses 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 geographical 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 supplied 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.)

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. (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. 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. (Unless otherwise mentioned, my description of historical Tampere until the year 1990 is based on following sources: Ajo 1944; Alhonen & al 1988, Jutikkala 1979 and Rasila 1984; 1992; 1993.)

During the 1820's a Scottish engineer James Finlayson founded a machine-shop and a textile factory in Tampere. By 1850's, the latter was the largest industrial plant in Finland. The energy needed in the production process was transmitted mechanically from the waterfall to spinning machines.

Easy energy, good trade connections and availability of skilled 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 kilometer. The growth of Tampere ceased for a while.

The unbalanced situation became unbearable, as the demand of paper grew rapidly. New papermills – Nokia, Valkeakoski, Kyröskoski and Mänttä – were born in the old watermill villages. Later on, they all became important regional subcentres. Canals and locks were built in order to broaden the floatable water area for logs. Road networks were improved to ensure the access to labour-, market- and maintenance resources. Telegraph lines were built to enable on-line business communication.

The urban node of Tampere got its birth, when certain local potentials – skilled work-force and energy – and pre-industrial mobility networks encountered each other productively. To be sure, this happened not without administrational and technological impulses. It is remarkable, that the new regional satellite-nodes began to emerge quite soon after the first industrial kick-off. This can be explained by the technology at the time, which could not allow energy networks and consequent local growth in the centre of Tampere. However, the new regional nodes were strong places, which were worth of other kind of networking.

Coppercable city

Tampere was connected to the national railroad network in 1876. The railroad made the interregional flows of people and goods extremely efficient. 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. Through communication the metabolism in technical networks could be controlled and optimized. In the late 1900's telegraph was vital for globalising business, too. Tampere got its own line before the railroad in 1865 by the request of Finlayson textile factory. 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 coppercable technology was taking its first steps: electric motors were able to replace the paddle-wheels. By 1920 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 areally scattered functions. These innovations were crucial in setting the spot-shaped urban form free of its strait-jacket. (Goodman & Chant 1999; Jonsson & al 2000; Anttila 1993.)

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 local 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.

City on wheels

Two more technical innovations were needed to cross the distances in the expanded city in the beginning of the 20th century. The proliferation of bicycle enabled commuting, and the introduction of car resolved the logistic problems. In 1920's first coach lines were introduced to suburban areas of Tampere. Consequently the road network had to be improved. These infratechnological developments enabled the strong economic upswing of the 1930's.

During the WWII, the economy collapsed in Finland, but in the 1950's began 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. In the 1960's, 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, so called 'lähiö'.

New innovations were needed in construction and infrastructure technology to build extensive neighbourhoods efficiently. 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.

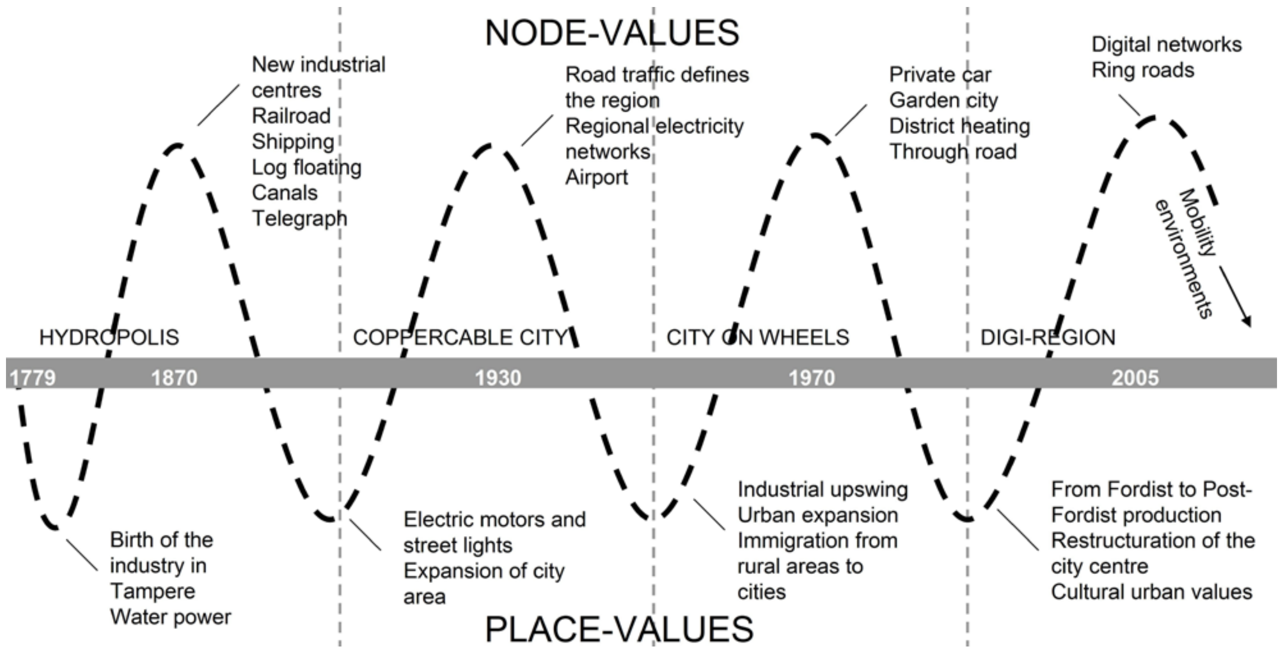
The third technology, that enabled the urban expansion, was the telephone. Since 1960's homes were commonly wired, which made also the co-ordination of domestic life possible in ever extensive areas. The fourth facilitator of the decentralized garden city model was definitely car-based public and private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

By the beginning of the 1970's 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 1980's, since the traffic flows continued to grow, and the first ring road was built.

The automobile city makes the node- and place-properties, as well as the tensions and dynamics between them, quite visible. In the 1960's, rural population was enticed to urban areas by heightened place-values. 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 networks of different scales, like in crossings of radial arterials and regional ring roads, where the new nodes have emerged including retail, services and housing.

Digi-region

As a result of the economic restructuration of 1980's and onwards, informational and skill-based resources are now in the centre of production processes. Consequently, the development of ICT-infrastructures has been massive. ICT-networks have gained in Finland, and in the Tampere region, almost full areal coverage. 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 infrasystems more efficient and make them pulsate simultaneously. (See Graham & Marvin 1998; 2001.)

ICT-infrasystems 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 ever 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; Pirkanmaan liitto 2005a; 2005b.)

Even in the affluent Tampere region, 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 subcentres should be strengthened in order to reinforce their mediating role between the central city and rural areas. In practice, the connectivity and attractivity 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. (Pirkanmaan liitto 2005a; see 2005b; Sisäasiainministeriö 2003.)

The large-scale networks are based on large regional nodes, which benefit from the growth potential provided by those networks. Minor nodes are prone to exclude without developing intermediate connective networks. However, the place-values of these smaller nodes should be heightened in order to make them attractive for new network investments. This seems to be a problematic circle, but the problem is actually quite common in local and regional politics and planning.

Managing the node-place-balance

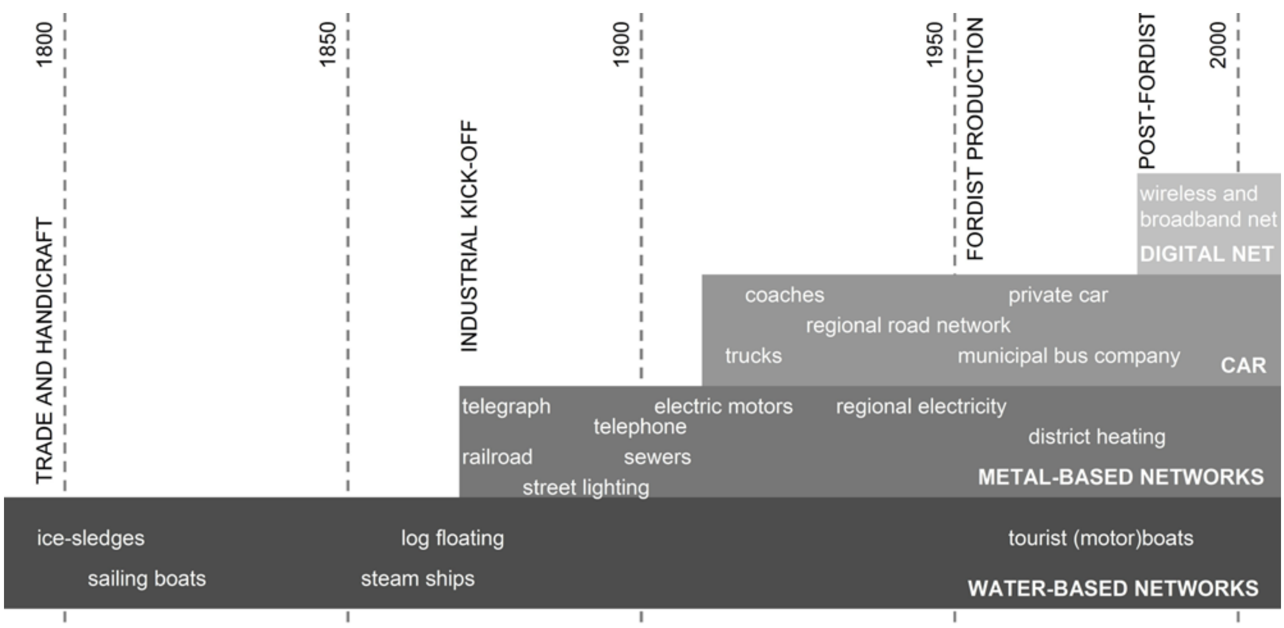
Since the importance of technical networks for regional development is obvious, it would be important to understand more deeply the relations between these networks and the central factors of functional clustering.

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 result in heavy traffic arterials or ring-roads, which splinter land use and restrain organic infilling of urban fabric. Harmful node-properties could be reduced by removing the road somewhere else or, more realistic, taking the advantage of the node-potential by building commercial or industrial functions in the vicinity. 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 developing 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 analyse the states of imbalance in the node-place-framework and, after that, operationalise them into respective land-use 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 all scales. On a local level, the problems might come true in degradation of living and business environments 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 succesful ones, and this provokes political resistance in the name of regional equality. The worse-off nodes and localities will slow down the development of the whole region.

We need new planning methods, that are capable to handle complexity and multinodality. The Node-Place-model opens one perspective to regional level. However,



the model is going to be as feasible as its user interface, in other words: is it more a theoretical framework for regional analyses, like in the case of Tampere, or is it an actual tool for elaborating real land use strategies. In the latter case, it could be based on already existing GIS-technology and -databases. Either way, the model with its indicators has to be developed further in close connection with a real planning cases.

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