

# Smart Principles for Knowledge-based Urban Development

Case Finnish Railway Station Areas

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## Abstract

Cities undergo continuous transformation processes, which have unique characteristic manifestations over time. The changes in many Finnish cities currently focus on the vicinity of railway station areas due to changes in regional structures and rail transport, as well as the densification of city centres. The enthusiasm for this kind of development is also increased by the special features of railway station areas, which seem to provide opportunities for new kinds of local economic and innovation policies. Railway station areas are also favourable locations for the application of various smart city technologies and services. In this article, we analyse the development of Finnish railway station areas as part of a wider continuum of urban development where both economic and innovation policies unify with urban planning. Case studies confirm our outlook of knowledge-based urban development transitioning to a new phase. This provides the prerequisites for interesting connections between railway station areas, the concept of a smart city and open innovation. One of the aims of our article is to bring together various themes that are brought up in smart city discussions and urban planning by introducing new kinds of spatial planning principles, which can be placed in three categories: 1) smart profiling, 2) smart design and 3) smart innovation.

**Keywords:** smart city, railway station, urban planning, urban development, innovation policy

## Railway station areas, smart city and open innovation

In the last few years, rail yards, railway stations and station areas have become increasingly important in Finland as urban development sites. In development processes they are, however, approached from the relatively narrow standpoint of transportation (compare Meriläinen and Kunnas 2014). The starting point of our article is that railway station areas could have a wider role in urban development (see Hynynen and Kolehmainen 2016).



*In this article, we analyse the development of Finnish railway station areas as part of a wider continuum of urban development where both economic and innovation policies unify with urban planning.*

The ongoing, extensive wave of development has been caused by numerous drivers of change which create pressure to regenerate railway station areas. These include, for example, changes in goods logistics, which have freed up rail yards' land for other uses (Hesse 2008, pp. 15-16), or the transformation of regional structures towards a more network-like format (YM et al. 2015), where railway station areas appear as transportation nodes of extended commuting areas and as the nodes of developing local centres (c.f. Bruinsma et al. 2008; Peters and Novy 2012a; 2012b).

Politics has also caused pressure for change since railway station areas have been raised to an important role in growth agreement procedures for Finnish cities (TEM 2016). The country's regional structures mainly take shape as growth corridors supported by efficient traffic infrastructures. The Helsinki-Seinäjoki axis, i.e. the so-called Growth Corridor Finland, forms a key corridor where the main railway operates as its backbone. The functional efficiency of the corridors requires the strengthening of public transport's modal split, but an important driver of change is also the low-carbon objectives, which states have committed to through international agreements.

At the same time, urban development organisations, which have a rather central role in the development of railway station areas, have identified the potential of these areas. The potentials typically involve the beneficial locations of the railway station areas at central nodes of transport networks, where good accessibility provides new types of operational opportunities for companies, services and housing. In addition, railway station areas are most often located in city centres, offering a variety of opportunities for economic value creation. Cities can easily see a number of regenerative opportunities in railway station areas, whether they are related to the urban image, business operations or any other attractiveness factor of the city.

The mutual interaction of land use and traffic culminates in railway station areas. Good public transport accessibility in railway station areas creates prerequisites for the placement of jobs and services as well as housing in the surrounding areas. The user flows of the stations create immediate demand for local services. On the other hand, local jobs, services and housing create demand for public transport services. Railway station areas are attractive housing areas, particularly for residents who value low-carbon development, good services and accessibility.

The role of railway station areas is important in making traffic flows more efficient. Several technology development organisations are preparing their development platforms in cooperation with cities, specifically for railway station areas. The majority of intermodal consolidation of trip chains and smooth everyday accessibility is solved at traffic nodes. Although "Mobility as a Service" (MaaS) involves changing the entire mind-set of traffic (e.g. Litman 2013; Heikkilä 2014), many of its practical applications are best actualised at railway station areas.

The MaaS way of thinking represents the growing smart city trend at its purest. Ubiquitous digital technology is considered a solution for better meeting the supply and demand of mobility services, whether it concerns parking, compiling intermodal trip chains or hiring bicycles. Under closer inspection, the smart city discussions, which we will return to later in this article, cover wider themes than the utilisation of digital technology for making cities' activities more efficient - despite technology being at the core of a smart city. A wider smart city concept is needed simply because by the time projects begin to actualise, connections will be created to cities' business and innovation policies, physical urban design, traffic design, property development and many forms of urban life. In addition, the volume of ongoing railway station area development, as well as their roles in local innovation policies, give a reason to assume that we are now transitioning to a new phase. Although the need for change in innovation policy has already been identified, its connections with urban design and development

are only just being considered. Our key thesis is that not only does the implementation of innovation policy takes place in urban contexts, it also requires them.

Knowledge-based development and the creation of innovation environments have been key themes of Finnish urban development for the last few decades. It is often perceived as part of the activities of larger urban regions, but increasingly more small and medium-sized cities have joined this trend. It has also been thought that economic success and the creation of innovations require major “institutional thickness”, i.e. educational and research institutions, technology development and utilisation companies, and financial capital and other operators of the same chain (e.g. Amin and Thrift 1995; Keeble et al. 1999). During the last decade, discussions have also focused on the importance of skilled and creative individuals alongside institutional and structural factors. The main initiator of discussions has been Professor Richard Florida (e.g. 2002; 2005; see also 2017). This perspective has further emphasised the significance of the quality of cities: the city’s physical, social and symbolic features support the creation of innovations. Alongside Florida’s approach, the terminology of a local innovation environment has also brought up the importance of individuals and their mutual dynamics in innovation operations (Kolehmainen 2004; 2008; 2016). In sum, the common denominator between current urban development and innovation is openness; it is all about engaging different stakeholders to joint, open processes in order to create something new. However, the results of these processes are usually not permanent, but constantly evolving. All this could be described with the concept of “knowledge-based urban development”. The term was first coined in the 1990s (Knight 1995), but it is still valid despite the new aspects added to it.

## The scope of this article

This article focuses on Finnish case studies and its aim is to consider how these two previously mentioned trends of urban development, i.e. the development of innovation environments and railway station areas, can connect with each other in the context of a smart city. A medium-sized city, Seinäjoki, is brought up as the main focus, where the trends mentioned in its development path are already clearly distinguishable and present, partly due to the small scale of the city. However, the story of Seinäjoki also has more general power of expression, since many other Finnish cities have travelled similar paths of development.

Seinäjoki has been strategically developed as a cluster of various micro-level innovation environments in both material and immaterial manners. The aim of the development work has been, and will continue to be, to both strengthen the urban region’s skill and innovation economy by developing it into a physical space, and also find new, more attractive urbanism from the city’s new key sectors for urban design. In this relation, the railway station area that has become an important site of urban development during the past few years provides an entirely new kind of challenge. How can the opportunities it offers be utilised in a way that expresses the requirements of the future’s innovation activities in the best possible way?

This article is mainly based on two research and development projects, which were carried out in the 2010s. In the Unicreds project, which was funded by the Interreg IVC program, consideration was made as to how universities, businesses and the public sector could develop their co-operation. The Finnish part of the project was led by the University Consortium of Seinäjoki. The other participants were the Seinäjoki University of Applied Sciences, and development organisations and authorities from six different countries. In our own portion of the project, we analysed the mutual effects of innovation policy and urban planning from the 1990s to the 2010s using Seinäjoki as our “laboratory” (Hynynen and Kolehmainen 2011). No separate empirical data was collected in the project, but instead it referred to prior literature, reports and

analyses, and to the research and development work we have completed in Seinäjoki through several projects. The Unicreds project is, however, worth mentioning since the basic approach of this article was developed in connection with that project.

The aim of the Tekes-funded SmartStation project, coordinated by the City of Seinäjoki, was to create methods, which cities can use to design and prepare the implementation of their railway station areas as part of the wider development processes of urban core areas. The project also worked on a more general procurement model for the innovative design and implementation of developing urban areas. Seinäjoki was the target city in this project as well. (Hynynen et al. 2014).

The key operating forms of the SmartStation project were three workshops organised in 2013-2014. The main aims of the workshops were to envision the future development of Seinäjoki railway station area, as well as to engage the most important stakeholders, including landowners and the city's research and development officials. In addition to workshops, 13 interviews were conducted among representatives of organisations that are vital in terms of the development of the railway station area. The interviewees consisted of landowners, property developers, constructors, representatives of building companies and organisations operating in the railway station area. The aim of the interviews was to complement the visions created in the workshops with more realistic viewpoints related to the implementation of the area. Both the workshop and interview materials were analysed by means of typical content analysis (Hynynen and Kolehmainen 2016).

Alongside and in connection with the aforementioned projects, we participated as researchers in the development processes of railway station areas in other Finnish cities, such as in Kouvola, Lappeenranta and Lahti. These took the form of individual workshops and series of a few workshops. In the Helsinki metropolitan area, we participated in the "Elinvoimaa asemansuudulle! (ELIAS)" project, where new development and investment concepts were created for railway station areas. In addition to Finnish cases, small case studies were also carried out in Swedish (Göteborg, Malmö), Danish (Örestad), German (Bremen) and Dutch (Utrecht) railway station areas (Harvio et al. 2016).

We have also participated in seminar and workshop events related to railway station development organised by the national MAL-network (land use, housing and transportation) and Tekes (The Finnish Funding Agency for Innovation). Through these projects and co-operation processes, we have gained hands-on experience with the cities that carry out development work on their railway station areas. The projects, workshops and interviews have produced various outputs that have been analysed by multi-method triangulation principles. By combining conceptual frameworks of regional studies and urban planning, we do not assume that looking at an empirical object from more than one standpoint would provide us with indisputable facts, but instead, to create a dialogue for fruitful interpretative insights (Miller 1997; see also Eskola et al 2000, pp. 68-74 and Raunio 1999, pp. 340-342).

The aims of this article are to 1) offer a credible and justifiable description of innovation policy's and urban development's common evolution and its most recent phase, 2) consider the role of railway station areas in particular as part of the continuum of knowledge-based urban development, and 3) outline general planning principles for an innovation-driven smart city. Thus, the main research question can be shaped as follows: What prerequisites should be considered in supporting innovation policy spatially by means of urban development and planning in the context of a smart city?

## Path to the smart railway station areas

### Technology centres as embodiments of their era

The development of railway station areas as part of the development wave of smart cities is set, in our view, as one phase of a longer continuum of knowledge-based urban development. The progress of development has been divided into three phases, which are described by the urban spatial embodiments of innovation policy: technology centres, creative urban fallows and smart railway station areas. Concepts that describe the different phases have been collected into Table 1.

The development of competitiveness has been at the core of urban and regional development since the 1990s despite the fact that the concept of competitiveness in the regional context is very complex and somewhat problematic (e.g. Turok 2004, Bristow 2005). As the economy has become even more knowledge-intensive and global distribution of work has deepened, this has also led to the significance of knowledge, technology and skills in urban development. Cities of various sizes have made significant efforts to strengthen their own knowledge bases within the limits their own resources. The key operators of the first wave of knowledge-based urban development were universities and polytechnics, as well as technology centres.

The construction of a regional innovation system and the development of local innovation environments have incorporated as part of the development of regional competitiveness. From the perspective of a physical city, the importance of creating attractive campus areas has long ago been identified in the development of universities and polytechnics. As an international trend for the last few years, several campuses have aimed to further open up as part of the city and urban life by, for example, bringing services to the campus area which are aimed to the entire city, not just the academic community. Already before the interest to focus on campus areas, various technology centres were built in the vicinity of universities and polytechnics. The biggest construction boom in Finland took place in the 1980s and 1990s. At that time, the main starting points and objectives for technology centres were formed as follows: 1) the clustering of property management operations and various information intensive operations, 2) operational connections to universities and research institutions, and 3) the transfer of information and technology from the previously mentioned institutions to companies (see Mäki and Sinervo 2001, pp. 25; Chan and Lau 2005, pp. 1216; Kolehmainen 2005, 256).

	<b>1990-</b>	<b>2000-</b>	<b>2010-</b>
<b>Urban space</b>	<i>Technology centres</i>	<i>Creative urban fallows</i>	<i>Smart railway station areas</i>
<b>Development policy</b>	<i>Regional specialisation, industrial competitiveness, "exploitation"</i>	<i>Related variety, creative branches, "exploration"</i>	<i>Open innovation, digitalisation, "experimentation"</i>
<b>Urban theory</b>	<i>Networked de-centralisation (Network city, Netzstadt)</i>	<i>Qualitative transformation (Zwischenstadt, Metapolis)</i>	<i>Smart city, intelligent city</i>

Table 1. Common evolution of innovation policy and urban development since the 1990s. At the moment, the different phases progress in parallel.

The aim of technology centres is, therefore, to promote interaction between various operators. The aim of design has been to create spaces where random encounters between operators are possible, and which create prerequisites for multiform co-operation. However, from the perspective of urban planning, the implementations represent a familiar modernist tradition, which divides urban space into mono-functional zones and enclaves. Technology centres promote

their own internal interaction, but they are not lively, hybrid, urban spaces where completely different influences can intermingle. On the other hand, excellent transport connections, location at the outer fringes of the regional capital cities, as well as their feasibility of being expanded are often characteristic of them (Castells and Hall 1994, pp. 244-247). The phrase networked decentralisation describes the role of technology centres in strategic urban development, and their urban theoretical dimension, very well.

### **Urban fallows, resilience and self-renewal capacity**

The current socio-economic situation emphasises the significance of the continuous reform of regions. In this respect, the concepts of regional economic resilience and self-renewal capacity are essential. According to Martin (2012, 12), regional economic resilience consists of a region's ability to resist recessionary shocks, its ability to recover, its ability to renew a growth path and its ability re-orientate. Similarly, Sotarauta et al. defines regional resilience as "adaptive capacity that endows regions with a capacity to change their destiny by adapting to changes and reshaping their own strategic capacity to act" (2012, pp. 275).

Both the concepts of resilience and self-renewal capacity are based on the idea that the development of urban regions is primarily through adaptation, which may be either unintentional or strategic. In any case, no urban region can fully change its operations or operating environment to make it the way it wants. Only part of a knowledge-oriented and innovation-oriented global economy strategy is planned (e.g. Boschma and Sotarauta 2007; Sotarauta and Srinivas 2006). Diversity is emphasised because we can never fully anticipate future development and/or take control of it with various development programs and systems or other conscious political operations. On one hand, diversity enables new and surprising development, and on the other hand, it ensures that at least some operators of an urban region are quickly capable of grasping new opportunities that open up to them.

Self-renewal capacity builds on classic distribution for seeking new, i.e. "exploration" and "exploitation", and their integration (e.g. March 1991). In the context of organisational learning, March (1991) defines exploitation as "refinement", "implementation" and "execution". Correspondingly, exploitation is characterised by him as "search, variation, risk-taking, experimentation, play, flexibility, discovery, and innovation" (ibid. 71). In a regional or urban sense, "exploration" involves the creation and search of new information and new resources and competences, which is actualised in the basic research of universities, the research and development operations of large knowledge-intensive companies, and other such operations where the future is sought for and created without clear questions (Sotarauta et al. 2007). From the perspective of economic structures, new companies, and particularly start-up companies, can be considered as "exploration agents"; they can use their operations to both utilise the markets and create them. When artistically creative and culturally oriented communities mix with various regional margin phenomena, a certain type of regional "exploration" takes place. This penetration into unknown thematic spheres may not become economically significant until later. For example, the roots of many growing and economically important creative sectors are in some type of regionally margin phenomena (Kainulainen 2005; Ruokolainen 2008; 2017).

Self-renewal and the capacity for it also have new counterparts in the physical side of urban development. Abandoned industrial areas, "urban fallows" (Oswald and Baccini 2003), in city centres are a good example of this. Small start-up companies and enthusiasts of cultural industry often seek these premises. Reasons for this include affordable rents, central locations and premises that are multi-functional and robust. There are plenty of voluntary operations in cities which gain their spatial expression when an opportunity for this arises. It is only recently that cities have begun to understand that part of these grass level operations may grow to be the anchor tenants of emerging

economic sectors (Baum 2010; Ylä-Anttila 2010). Research has also shown that the number of cultural operators in cities correlates with successful business (Markusen and King 2003).

### **Smart railway station areas for open innovation**

The development of innovation systems and environments concerning the development of an urban region's competitiveness has been based on the promotion of systematic and interactive innovation processes. Thoughts concerning the strengthening of self-renewal capacity, on the other hand, strongly emphasise the significance of exploration, i.e. seeking completely new, surprising paths of development. A so-called paradigm of open and user-centred innovation and "democratising" thoughts concerning innovation bring a new level to this idea by increasing the interactivity of innovation in relation with various economic actors and society as a whole (von Hippel 2005).

The concept of open innovation has become mainstream since 2003 (Chesbrough 2003a; 2003b), although the principles of open innovation have been more or less in use in companies already before then. The basic idea of open innovation is twofold: on one hand, companies seek information, knowledge and technology required by innovation processes among third parties rather than focusing solely on their own research and development work. On the other hand, companies also actively seek new, external commercialisation opportunities for internally developed ideas, concepts and technologies (for example licensing, sale of IP rights, spin-offs) (e.g. Chesbrough 2003a; 2003b; Gassmann 2006; Diener and Piller 2010).

Open innovation is not, however, a case of mere information exchange and various transactions between organisations. A significant resource for innovation is individuals: users, consumers and citizens. So-called user-centred innovation is one of the most interesting phenomena related to open innovation. In simple terms, it means that users of a product participate significantly in the development process of the product, service or technology, in which case the innovation or product development effort of development subject's actual process owner remains rather low in comparison with the closed innovation model (von Hippel 1986; Diener and Piller 2010).

The increase in open and user-centred innovation in particular, has created an increasingly mentioned new concept: the quadruple helix of innovation. In this case, a new operator group, i.e. users, has been added to the traditional triple helix, in other words, the interactions among the public sector, companies and universities. Living labs are the physical manifestations of such innovation operations. One of the most important characteristics of living labs is that the development of innovations takes place with genuine users in a genuine environment, and not in a laboratory (Arnkil et al. 2010). In addition to user-driven constellations, the living labs can be conceptualised as networks characterised by utiliser-driven, enabler-driven or provider-driven innovation (Leminen et al. 2012).

The quadruple helix has also been given a wider significance as a "people's community" or as a (local) citizen society (Kolehmainen et al. 2015). The interpretations of the quadruple helix that expand the concept, reflect the open nature of innovation operations and emphasise the fact that quadruple helix cooperation is a case of objective cooperation between actors in the creation and implementation of new knowledge and new innovations. It is also worth noting that open innovation and quadruple helix models aim towards a variety of innovations; they can be technological, social, product and service innovations, either commercial or public.

In sum, the concept of open innovation has been a great success and has had a tremendous impact both on innovation practices and on innovation studies. The concept has evolved over time and become more and more nuanced. It has also given impetus to other innovation concepts and practices following the

basic idea of openness and intense collaboration. The concept itself is still evolving and there are new levels of analysis ranging from individuals to ecosystems, regions and even national innovation systems (cf. West et al. 2014). Accordingly, it is only natural that the linkage between cities and open innovation has already been discovered. This is the case especially in the smart city context. It is not far-fetched to state that, in some sense, entire cities can be considered as “living labs” or “ecosystems” or, in other words, platforms for real-time tests, development and co-creation of new products and services, other innovations and smart technologies (see e.g. Paskaleva 2011, Lappalainen et al. 2015, Raunio et al. 2016).

Open innovation is difficult to pinpoint to a certain location or certain area of a city, but on the other hand, such a platform may be most intensive in the railway station areas of cities. There are good reasons for this, since railway station areas belong to all residents of a city without the exclusion of anyone or any group. Through the flow of people that the station convenes, visitors to the city are also participants of the area. Thanks to these flows, railway station areas are extremely dynamic places with potential for various competences and scales to encounter. In addition, the large number of visitors creates a platform for diverse services.

The mix of various functions and scales is thought to enable creative collisions which, as a result, produce new kinds of combinations. Openness and user-centricity of innovation are all-embracing objectives which aim for self-guiding and smartness in the production and use of an urban space and services related to it. All this is aimed to be implemented, for example, by means of digital technology and various cloud services. In all three phases, urban space is both the result of innovation and its venue. It can, however, be questioned as to what extent the processes of railway station areas’ planning, implementation and development (in their current form) manifest the significance of these areas as open innovation platforms of a smart city.

## **Spatial potentials and preconditions for a smart railway station area**

Developing “smart” railway station areas requires a more comprehensive approach than just technological development. The relatively simplified technology-centricity of a smart city, such as the overall non-specificity of the term, has been brought up in international research literature (for example, the *Journal of Urban Technology*, 2015 vol. 22:1 and *Intelligent Buildings International* 2011 vol. 3:3). Albino et al. (2015) in particular have reviewed a large number of international studies and official documents in their article which clearly indicate that the “smart city” concept, in fact, involves humane, communal and technological aspects. Smart transportation, efficiency, ecology and innovation are repeated in debates as features that are common among various smart city concepts.

In literature, there are efforts to create comprehensive indexes for evaluating the smartness of cities, but according to authors, universal assessment systems are not possible due to the diversity of cities and situations. Assessments should take into account the diverse visions and priorities of cities in such a way that “hard” and “soft” components of smartness are processed in an integrated manner (Albino et al. 2015).

This is the starting point in our article as well. For example, it is relatively common for open innovation to be understood as a part of economic policies and other kinds of development that are characteristic to a smart city, but it is seldom realised that open innovation also needs more open and flexible urban space to support it. Due to the technological emphasis of a smart city, it is deceptively easy to assume that the virtual infrastructure alone provides sufficient support. A virtual space is a ubiquitous and flexible structure that



regenerates our spatial practices and thus also gradually transforms the physical space. However, our study shows that the requirements of physical urban structures and space, and their potentials cannot be implemented without changes in the urban planning approach and related active planning interventions.

The conceptual framework of a smart city should, on this basis, be developed in such a way that it also includes spatial planning principles. Relatively recent research literature shows attempts in this direction. For example, Komninos (2011) uses the concept of “spatial intelligence”, and his aim is to expand the smart city concept towards a city’s actual development context. Case studies are carried out in three cities: Bletchley Park in North London, Cyberport in Hong Kong, and Amsterdam Smart City. However, the spatial forms of intelligence that Komninos has found represent the previously mentioned “soft” components of a smart city: organisations, networks and governance. Progress must be made towards a city’s “hard” spatiality, where intelligence could be operationalised into such planning principles that could also guide the physical planning of a city. Based on these ideas, we have divided the planning principles of smart city into three groups: smart profiling, smart design and smart innovation.

### Smart profiling

When it is a question of railway station areas and strengthening MaaS methodology, mobility and accessibility in particular are raised to the centre of attention. These criteria are also valid when considering smart city on a more general level. Railway stations are both the nodes of a transportation network, but also places which have evolved over time by local development. A central location in a transportation network creates the prerequisites for development but, on the other hand, a place, which consists of various resources, is worth supplying with efficient connections to a wider transportation network. From the standpoint of urban planning, dynamics that aim towards a balance of network (or node) potential and place potential, creates key prerequisites for development. The mutual relationship between network and place potentials also creates a fundamental development profile for the site and this concerns both the qualitative and quantitative features. Bertolini and Spit (1998) have developed a so-called Node-Place model (c.f. Figure 1) particularly for the analysis of railway station areas. The model can be utilised as either a quantitative analysis method, like Bertolini and Spit have done, or as a more qualitative evaluation framework, such as we have done in our own study. The universally applicable nature of the Node-Place model enables it to be applied to other kinds of locations than just railway station areas.

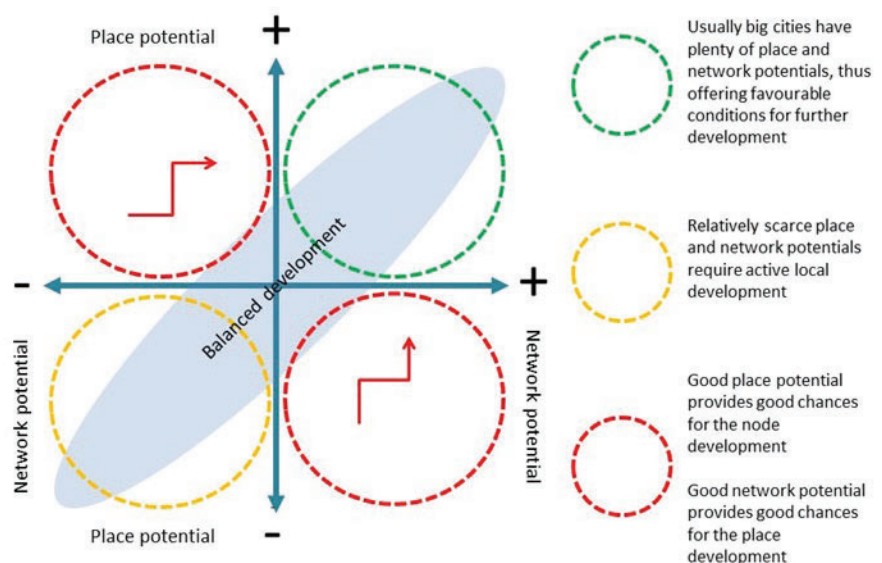


Figure 1 - Application of the Node-Place Model (c.f. Bertolini and Spit 1998)

### Smart design

As for the local scale, it can be stated that new construction most often takes place within existing urban structures. The aim of design is to, in this case, “knit” together the splintered urban structures, both fabric and networks, in order to make them functionally more efficient. The knitting can take place at different scales, as more strategic integral design, or merely reaction to a current problem. Regardless of the scale, integration belongs to the basic toolbox of today’s planner, and it can be divided into four aspects: 1) connectivity, 2) compression, 3) conversion and 4) multiscalar interface (Hynynen 2016; see Ellin 2006; see Ylä-Anttila 2010). These four concepts describe various urban design situations, which are particularly common in railway station areas. This is due to the fact that the main generator of disintegration is the growth of the scale of transport networks (Graham and Marvin 2001). The aspects of integral design are specified below:

#### *Connectivity*

In most railway station projects the primary aim is to make public rail transport more efficient and increase its share in the modal split. Synchronising various networks by developing transportation technology and services is a key method towards reaching this objective. Connectivity is not just about the node-dimension of the railway station area, it also has an important role when developing the place-dimension. As previously brought up, railway station areas, together with their railyards, easily form barrier effects in city centres, and various urban design methods are utilised to eliminate them: tunnels, bridges and bridge-like structures.

#### *Compression*

Connective constructions are often very expensive, so much so that public funds alone are not sufficient. Railway station areas must be planned in such a way that the projects provide an opportunity to create economic value. One strategy is to grow the density of the urban structure by increasing floor space and number of functions. High-rise buildings and a diversity of services are potential solution models to put in practice. The construction of a large event venue in a railway station area also increases the activity of an area and promotes economic value creation.

#### *Conversion*

Most of the railway station areas under development already exist, and they may have a long history. The functional mix of the premises may have changed several times. It is worth noting that, for example, old brick buildings of the 1800s are still in use. They are robust structures, able to withstand major changes without needing to be demolished. There is a lot here for modern day designers to learn with regard to energy and material efficiency, since railway station areas are dynamic places, often subject to strong needs for change. On the other hand, applying the principles of circular economy (e.g. Bocken et al 2016) opens future prospects to build for dis-assembling, in which case the components can be utilised or re-assembled in a different location (e.g. Jensen and Sommer 2016).

#### *Multi-scalar interface*

Connectivity requires detailed planning of technical systems and related services. The special feature of railway station areas is, however, that they are the hottest points where traffic flows accumulate and connections from one network to another must operate smoothly. However, planning of the networks and systems alone is not enough. Spatial design is also needed, so that the traffic flows can be organised in a commonly shared space. Further, it is not just a case of “flow”, but also “slow” waiting, which is an essential part of travelling. As the railway-station areas in the near future will be integrated more tightly into urban cores, the more they will need to have urban qualities.

### Smart innovation

The key features of future, as well as some ongoing smart city development are openness, a certain democracy and continuous regeneration. During this development phase, innovations can widely emerge from different forms of urban life. Referring to Huizingh’s (2011) typology of open innovations, it is

interesting to think that urban environment would be open to be shaped by its users, even after the actual implementation has been completed (Table 2). However, this should be recognised already during the planning phase. The openness of built urban space is enabled to the extent the users can participate in planning, since the preconditions of management and use of the space will be established from the very beginning of the process. In places where technical infrastructures and land ownership set conditions for future changes, if openness and flexibility is desired, the limits for “openness” must be specified and planned in cooperation with the participants. It is, of course, possible to also develop the area in a more designer-centred manner so that it is open for self-organising development afterwards. In this case, the nature of openness will be defined differently (Hynynen and Kolehmainen 2016).

Table 2 - Railway station areas as innovation platforms (cf. Huizingh 2011; Hynynen and Kolehmainen 2016)

<b>Development process</b>	<b>Result of development work</b>	
	<b>Closed, “complete”</b>	<b>Open, continuously developing</b>
<b>Initial situation has been defined, traditional planning process</b>	<p><i>Designer-centred “complete” railway station area</i></p> <p><i>Innovation platforms defined by experts, designers or companies</i></p>	<p><i>A railway station area that has been designed in a designer-centred manner, but left open for further development</i></p> <p><i>The providers and users of innovation platforms are not able to influence the basic structure of the area</i></p>
<b>More open initial situation, open planning process</b>	<p><i>A railway station area that has been planned and implemented in an open and participating manner</i></p> <p><i>Innovation platforms become more important along the development of the area; providers and users can influence the plans</i></p> <p><i>The “complete” physical structure and function create limits for the innovation platforms as the area develops</i></p>	<p><i>A railway station area that has been planned in an open and participating manner, and is open for further development</i></p> <p><i>Open innovation platforms will born (and die) depending on the needs; various actors define the needs</i></p> <p><i>The area’s physical structure is continuously changing and completing, it enables social and technical experiments</i></p>

On this basis, railway station areas can be considered certain innovation platforms. They could be key tools for local economical and innovation policies, aiming to intertwine various objectives, actors and networks through concrete co-operation. In many cases, railway station areas are at the core of urban development, and cities have the opportunity to regenerate themselves through the development of their railway station areas, if they able to realise the potentials included in them. Railway station areas offer a unique opportunity to develop and pilot new technologies, businesses and services (for example, MaaS).

## Case-studies

Below we aim to demonstrate how the introduced planning principles manifest for smart railway station areas in Seinäjoki, Tampere and Espoo. Some examples have been shown in the Table 3.

### Seinäjoki

In Seinäjoki, the railway station area became a key site for urban development when decisions to significantly increase housing in the city centre were made by the city council. Reasons that led to this include, for example, the rapid increase of the city's population, with growth rates of 1,5 percent per year (Seinäjoen kaupunki 2014).

Seinäjoki's urban strategy stems from knowledge-based development (Seinäjoen kaupunki 2013). This is particularly well fleshed-out in the objectives set for the railway station area. According to them, the railway station area will form a third physical innovation environment alongside Frami technology centre (which includes University Consortium and SeAMK) and the district of Itikanmäki (Foodwest and Rytmikorjaamo). The difference between these two is that the railway station area encompasses the entire city centre.

Seinäjoki has developed its own knowledge capital in a networked manner, reflecting the idea of quadruple helix co-operation (Kolehmainen et al. 2015). However, the networked method means that the researchers and experts travel from their main campuses that locate in other cities. Also, audiences for events come mainly from outside the city. However, the railway station area does not actively seize on opportunity, but only handles its essential functions in a rather dull and backyard-like milieu.

In the workshops of the development process of the station area, new content was envisioned for the four main functions of the area - travel, leisure, housing and work. The experience of rail travel was brought up in discussions in such a way that railway station areas could be developed into interesting destinations together with their events and services. The area's leisure functions would serve both long-distance travellers and local residents. Any dining facilities created in the area could, at best, operate as shop windows for the "food province", the spearhead economic branch of the region. Housing, on the other hand, would keep the area lively during different hours of the day as well as seasons, albeit this would require a rather heterogenic demographic structure. Therefore, residential possibilities should be versatile in terms of space, price and ownership. Mixed city principles would be essential in order to avoid the birth of a sleepy neighbourhood, and for the new district to become a vital, continuously regenerating source of innovation.

In the workshop, the future of work and work-life was discussed in terms of continuous change. The station area should be able to respond to these changes with adaptability and flexibility of spaces and infrastructures. It was seen that the area should host even small-scale production, which could be located in office buildings. Various hub-like arrangements should also be enabled, as well as apartment and office hotels for mobile work and for a new type of knowledge-intensive work. Functional mix, diversity, spatial flexibility and versatile connectivity, both within and outside a city, became the key terms for further development of the area. These features are in line with the requirements of open innovation.

In 2015, the station area was the target site for the *European13* architectural competition. Based on the winning proposal, a planning process was initiated in the spring of 2016. At present, the process is in the master planning phase. For promoting new business in the area, a project called *RESPA* (Recreating spaces) was launched with the aim to create a new type of development and innovation platform based on the functions and qualities of the station area. A competition called *Fiksu assa* (Smart station) was organised within the

framework of the project, which aimed to seek products, services and ideas to be trialled in the railway station area of Seinäjoki.

### **Tampere**

The railway station area is one of the most important urban development projects in Tampere. It consists of the central station area, the railyard crossing deck in the Sori area, as well as a multipurpose arena. The starting point of the project has been a vision of a well-functioning node for all transport modes, which is also an attractive cluster of business, workplaces, services and housing with high-quality urban architecture.

An international architecture competition was organised in the area in 2014. According to the winning proposal *Reconnecting Tampere*, the eastern and western parts of the city will be connected with an urban deck that crosses the railyard. The current station square will be extended into a north-south oriented railway station park. A travel centre will connect all transport modes and travel chains. Implementation begins with the construction of the deck and the multipurpose arena, continuing with the tower buildings on the northern side of Sori bridge. After this, the construction moves towards the north. The railway station area will form the city's most important concentration of offices. A new type of shopping and service centre will also be built on the site.

Interest among property investors has been sought by commissioning designs from world-famous architect Daniel Libeskind, as well as by organising an international competition concerning the central station area. In both cases, the tactics of compression have been applied for enhancing urban mobility and regeneration, but also for creating economical values for funding the public projects. Other projects that try to solve the railyard's disintegration problems include tunnels below the railyard, which clearly apply connecting tactics by improving the integration of the pedestrian and cycling network. On the other hand, the tunnels have been partly provided with commercial functions so, to some extent, it is also a case of compression.

### **Espoo, Kera**

Kera is a railway station for commuter trains in the industrial area of Karamalmi in Espoo, between the stations of Kilo and Kauniainen, approximately 15 kilometres from the central railway station of Helsinki. Several companies in the area have utilised rail transport, so there has also been goods transport in Kera. However, goods transport reduced in the 1990s and finally ended in the summer of 2009. AGA Oy's factory area, which was built at the beginning of the 1960s and emptied in the 1990s, as well as Inex Partners' logistics centre, which moved its functions to Sipoo by the end of 2018, are located in the vicinity of Kera station. The Kera railway station was named after former Kera Oy's ceramics factory. The factory's production ended in 1958 and new industrial operations and jobs began to form in the area. The majority of the current industrial area was constructed between 1960 and 1990.

The master plan for the area was approved by the Municipal Council of Espoo at the beginning of 2017. Kera will be a climate-friendly and lively district that attracts new business operations to the vicinity of competitive transportation connections. According to the plan, the former commercial and industrial area will become a versatile residential and commercial area between Kauniainen and Leppävaara.

Because Kera is a dense area, the service centre can be reached from the residential blocks by foot in less than 20 minutes. Leppävaara, Kauniainen, Tapiola and the Espoo centre can be reached by bicycle in the same time. In the near future, Kera could be an attractive growth node of the metropolitan area, where the light rail connection called *Raide-Jokeri* efficiently connects to the national public transportation network. The objective of 14,000 residents and 10,000 jobs enables the development of the railway station area as a new kind of city centre.

Table 3 - Smart planning principles applied to the case areas

	<b>Seinäjoki</b>	<b>Tampere</b>	<b>Kera</b>
<b>Smart profiling</b>	<i>A growing regional centre located along the main railway line; a northern terminal of the "Growth Corridor Finland"</i>	<i>The country's second city, a key node along the main railway line, located in the middle of the "Growth Corridor Finland"</i>	<i>Location in the metropolitan area creates a lot of development potential</i>
<b>Smart design – connectivity</b>	<i>Tunnel connecting the CBD and the district of Pohja; integration of the railway station area as a part of the city centre</i>	<i>Re-Integration of the city centre; railyard crossing deck, tunnels below the railyard</i>	<i>Railway connects Kera to the important centres of the metropolitan area</i>
<b>Smart design - compression</b>	<i>Housing, services, events and jobs in the railway station area; shop window for the "food province"</i>	<i>Concentration of high level construction, multipurpose arena, casino, versatile services</i>	<i>Lots of new floor space</i>
<b>Smart design - conversion</b>	<i>Utilisation of old roundhouses as culture and leisure facilities</i>	<i>Old roundhouses as hotel's lobby, restaurant and conference facilities</i>	<i>The large shut down industrial premises located in the vicinity of the station offer low-threshold opportunities for flexible spatial use</i>
<b>Smart design - multi-scalar interface</b>	<i>Integration of various transport modes with high-quality transport planning and architectural design</i>	<i>Integration of various transport modes with high-quality transport planning and architectural design</i>	<i>Integration of various transport modes with high-quality transport planning and architectural design</i>
<b>Smart innovation</b>	<i>Business trials were sought for the area with the RESPA project; the area has the opportunity for a more open and flexible spatial solutions</i>	<i>A digital company-led MaaS platform for various digital mobility services; a test site for indoor and outdoor positioning and location-based services</i>	<i>Theoretical opportunity for a more open and flexible spatial solution to be shaped continuously</i>

Because the detail planning of the area is still in the drafting phase, the starting point for development is open, which also creates opportunities for open processes. Participants and stakeholders can be defined freely. The area is

also open in terms of its qualitative objectives. The railway station area could be a continuously developing and transforming, flexible area, which could also provide open innovation platforms for various developers. Large number of residents, jobs and commuters create opportunities for a diverse, mixed railway station area, which has a diverse service structure. In this way, the innovation platform can also be diverse.

In 2015-2016, an idea competition on the development of the area of Kera was arranged. The winner, *Co-Op City* emphasised circular economy and sense of community. The logistics centre of S-ryhmä will move from Kera to Sipoo in phases. In the *Co-Op City* plan, the life cycle of the old logistics centre will be prolonged by new functions, evolving in accordance with the area's development stages. As soon as the logistics functions move away, the area could be used for arranging events and sports activities.

### Some reflections on the cases

Although these three cases are mutually quite different with regard to the size of their surrounding urban regions, their location in regional structures and national rail network, they all have clearly positive future prospects on the growth of rail transportation, and they all are located in growing urban regions. These structural starting points lead easily to very dynamic development profile. The rest depends on local development will and activity. However, in order to avoid the simplified "business-as-usual" mode, it is important that the toolbox of decision-makers and developers include smart planning principles. *Smart innovation* is an especially demanding principle to implement, and so it requires support from the *smart design* principles.

It is worth noting that only in Tampere have plans started to be implemented. The descriptions in *Table 3* therefore are mostly publicly expressed objectives for development and planning, and partly potentials brought up in our study. On this basis, our aim is to inform the ongoing debates with future possibilities now, as the development projects are flexible enough to stand remodelling.

Unfortunately, we were forced to exclude railway station areas with less dynamic development profiles. If the case is located outside of Growth Corridor Finland, a lot more development activity is needed, as well as recognising and deploying diverse development resources. Even the main national rail transportation actors like VR (the Finnish state railway company) and LiVi (the Finnish Transport Agency) are not very keen to give their support to development processes. In these cases, it is important to consider, for example, the potentials of MaaS, its smaller and subtler scale, where the traffic flows and multi-scalar interfaces are weaker, very creatively. The same type of downscaling should be applied to the other smart principles.

## Conclusions

Technology centres continue to implement the principle of "exploitation" or, in other words, they aim to produce new knowledge and technology for the benefit of business. On the other hand, the aim of the "creative fallows" is to focus more on "exploration" by offering low-threshold premises for new enterprises, among which there may be future success stories. With this same continuum, the role of railway station areas could be "experimentation", which is created in the encounter of various functions, scales and competences in a smart and open urban context. It is important to notice that this classification describes different emphases more than sharply-defined operational models. It does, however, seem as though innovation needs urban context.

In this respect, open innovation should also be defined with openness in terms of urban space, not just opening innovation processes for users or competitors. This notion is well-aligned with the recent findings of the open innovation research. It also sets apart Finnish railway station areas from the previous stages of evolution, i.e. creative fallows and technology centres in particular,

because railway station areas are only just stepping into the arena of knowledge-based urban development.

Innovation and its processes cannot be directly managed or planned, but the innovation environment can be. If we could understand the spatial pre-conditions of innovation processes, it would be possible to support them indirectly. At the moment, many railway station areas are going through their initial re-creation phases, so there is a crucial turning point under way. There is a good reason to question whether we have the patience to develop innovative railway station areas for regenerating our long-term urban economies, as the pressures for short-term development projects clearly exist. Railway station areas are special urban areas which must also be developed in a special way. At this very moment, there is a clear momentum.

Railway station areas have true potential to be the couriers of smart city development. As previously stated, this will not occur by itself, and definitely not by means of conventional mind-sets and practices. The first critical step to bypass the “business-as-usual” practices is to identify the smart potential of railway station areas. Secondly, political willingness to realise this potential must be found. It is a benefit for the smart, future-oriented development of railway station areas if we are able to formulate appropriate and clear urban planning principles for these. They will help designers and decision-makers identify the actual development requirements of the area and conceive possible development profiles. Place and network (node) potentials create different pre-conditions which exclude certain options but which, on the other hand, support other ones. In addition to this, planning principles should provide design-based models which can be used to create user values as well as financial and symbolic values. The significance of the latter two in particular is emphasised, if a new type of urban environment is sought, where the path of implementation can be more complicated and longer than normal.

If the aim is to seriously produce urban space that enables open innovation and user experimentation, the whole process of space production must be seen in a new way. There must be a transition from a product-oriented methodology to a demand and user-centred production of space. This could mean, in practice, affordable, flexible, multi-purpose and, possibly, dismantlable spaces. These do not belong to the typical objectives of current urban development. However, it is good to realise that there exist approved models for this kind of sustainable constructions if we think, for example, the robust factory buildings of 1800s and 1900s which still continue to be in use, albeit converted to other purposes. There are also indications that the rising circular economy will bring along interesting, smart solutions to our buildings and cities.

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