Smart Urban Futures: Outlining the Smart City Planning Project

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Cities are constantly evolving complex systems, and ongoing digitalization is making them even more complex. The toolkit for urban scientists is expanding with computational methods from AI to machine learning, data mining and advanced spatial analyses. Together with vast amount of data of urban phenomena and new lifestyles emerging from virtuality and cybernetic systems, this 'smartification' makes the planning and analyses more challenging while providing new tools to respond to them. In this article I propose a project for better understanding and guiding the future smart city based on dynamic urban theories such as those studying complex adaptive systems, urban morphology, urban economy and mobility systems. I argue that we need to carry out empirical research on ongoing change to learn about novel, becoming spatial and functional patterns in the city, and apply both theories and imaginary visions to be able to grasp the likely qualitative transition in humans' life following the ubiquitous use of technology. The project is built around three coupled modules, urban space, mobility and urban economics, and it will be carried out in the city of Tallinn, Estonia. The expected results would help planners, decision makers, urban scientists and developers to better understand the transition we are facing, to be able to support the change and steer it towards better social and economic outcomes.

Keywords: *Smart city, Models, Spatial Analytics, Urban Planning, Complexity, Uncertainty*

INTRODUCTION

Currently ongoing global extensive urbanization makes cities more important than ever economically, culturally and socially. Simultaneously, cities are facing a revolutionary transition to become technology mediated environments where digital systems and algorithms increasingly guide our lives in an unforeseen manner (Brenner & Schmid, 2012; Townsend, 2013; Batty, 2018).

This transition, not unlike the industrial revolution, is by default unpredictable. Cities are complex systems in a sense that from time to time they evolve through

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sudden ruptures emerging from small interdependent, dissipative events, resulting in a qualitatively new dynamic state (Castells, 1996; Portugali 1999). Such intrinsic features embrace uncertainty that makes them difficult to control (Batty, 2007) and to predict (Batty 2018). However, urban planning and management is necessary to guide urban systems for sustainability, economic viability and quality of everyday life. Relevant "complexity planning" approaches have been suggested (e.g., Portugali et al., 2012; de Roo & Hillier, 2016). Consequently, we need to see cities in a systemic manner. This article builds on these, extending the technological aspects of future city both in regard to technologically mediated urban realities, and the digital, algorithmic and other tools applicable to embrace these intrinsic systemic features.

From a systemic perspective, like ecosystems in the nature, cities cannot be produced or controlled, but just guided (Partanen, 2018; Walker & Salt, 2012), as will be explained later. This would mean, first, hindering of the *nonpreferable phenomena* and let the rest operate. Second, urban management needs to take place in an iterative procedure of small initiatives, carefully monitoring and correcting maneuvers (Walker & Salt, 2012; Allen, 1998). Furthermore, since future is by default uncertain and urban theories probably apply only to an extent (Batty, 2018), a plausible approach could be to apply credible visions of urban life, for example, mobility or the future of work. These may imply embryonic innovations, such as autonomous vehicles, energy production from renewable sources, virtual presence and beyond. Hence, in this article a methodological approach to the character of complex urban systems, and the necessity to guide it towards preferable goals, is framed and formulated.

The ambitious enterprise of creating an intrinsically trans-disciplinary research project agenda has a long history. However, this paper considers complexity theories as well as the (eco)system view of smart urban technologies. Complexity can be considered by embracing particle interaction and its emergent, sometimes surprising impact of systems' dynamics, and other related dynamic theories with credible future scenarios, to explore possible (or probable) futures and their implications in urban environment. Applicable technologies and related analytical methods that would emerge from urban theories may be emphasizing dynamic change, including computer models and simulations, spatial data analytics, machine learning or other tools considering urban non-linear dynamics hence being capable of embracing multi-agent dynamics in trans-scalar manner – considering the impact of distributed individual actions on a higher (neighborhood, urban, or regional) scale. The research question is hence:

> What kind of systemic structure for a research project would embrace the multifaceted and uncertain nature of urbanity for more adaptive planning?
> What type of general results could be expected from such an approach?

By outlining guidelines and principles for such a model this paper may demonstrate current understanding of possible future development paths and their management options, e.g. trends in mobility, work and lifestyle, to enhance the economic viability and the quality of life. Furthermore, novel tools and methods for data integration and analysis are expected to support the viable, constantly renewing urban planning. In this becoming smart urbanity, ubiquitous digital technology is often implicit, perhaps imperceptible. New understanding and methods are expected to explicitly promote urban qualities, business and urban life, setting examples locally and globally.

General aims for a model for smart urbanism would be as follows:

To *enhance understanding* of urban dynamics and the impact of technology in Smart City avails; suggesting (1) *new methods and tools* for urban planning and management regarding new ways of life, new work and new mobility; which would (2) *support constantly renewing urbanity* for viable business and high-quality urbanism.

BACKGROUND AND THEORY

Increasingly Complex Cities

In recent decades, theories of complex adaptive systems (CAS) have enhanced our understanding of the surprising and unpredictable nature of a wide variety of systems in the world (Kauffman, 1993; Batty, 2009; Mitchell, 2009; Bettencourt & West, 2010). Complexity thinking has been applied in a variety of fields, from study of natural ecosystems to economic and social systems, including cities (Mitchell, 2009). Characteristic of complex systems, cities are dynamic networked systems that change constantly from actors' interaction within the frame of plans, laws, and other regulation. Interactions between myriad actors – firms, institutions, organizations, individuals – result in self-organizing emergent patterns, networks and regular dynamics that feed back to operation of the system. Such patterns may appear as clusters of firms, services or retail nodes, cooperation networks or mobility patterns. They emerge from dissipative decision making from bottom up, forming often surprisingly resilient configuration. Consequently, the urban systems appear dynamically stable for long periods of time (Portugali, 1999; Holland, 2000). However, such complex systems typically evolve via ruptures initiated from external forces (e.g. natural disasters, pandemics, shifts in global economy) or from internal premises such as (sometimes small) changes in systems' configuration. Major innovations can also be considered as forces launching eventually a transition (Capra, 1996). Industrial revolution or emergence of knowledge-based society provide examples of such a change: innovations in communication and transportation technology pushed the system to a novel trajectory, changing society and urban life drastically (Harvey, 1999). New technologies and innovations in ICT and transport, along with rising standards of living, enable longer trips and more efficient commuting and communication within shorter time span. An urban region can even be considered to shrink regarding time-space.

Urban Metabolism and Morphological View

In complex cities, flows of goods, information and people play an essential role in urban spatial configuration (Ascher, 2004). Flows follow the accessibility landscape of the urban region, where highly accessible locations create potentially attractive places for urban activities and services (Oswald et.al., 2003; Hillier, 2007). Activity nodes and clusters attract more flows – customers, employers, freight traffic – feeding back to the spatial configuration in a circular manner (Ascher, 2004; Oswald & Baccini, 2003). Such dynamics can be considered to resemble *metabolism* in natural organisms, providing an applicable metaphor for the urban system (Ascher, 2004). Furthermore, as the *urban morphological* perspective highlights the primary role of routes, the interaction between road networks and the *urban tissue* they nourish enables a circular relationship between processes and patterns: formation of urban spaces and steered by the myriads human activities – economic, cultural, social (Caniggia & Maffei, 2001; Batty & Marshall, 2009). Such dynamics is naturally promoted and affected by individuals' decision making and planning, while the most crucial emergent results appear on the higher scale.

Urbanity on the Threshold of a Transition

Cities seem to be facing yet another major transition: emergence of ”smart” urbanity embedded with ubiquitous, immersive technology founded on almost infinite sea of datum (Hayles, 2004; Gabrys, 2014; Engin et. al., 2020). Digitally enabled novel features, such as virtual presence, autonomous transportation, augmented realities, 3d-printing and robotics guided by algorithms and artificial intelligence might be able to condense the city again, diminishing the time-space related distances as transportation and many other (remote) activities are obviating the material presence of humans, or liberating them for other tasks while, e.g., travelling. Changes enabled by innovations in communication and transportation technologies, and consequently social welfare and many other aspect of urban life, are forcefully joint with industrial revolutions. Accordingly, this will be reasonable to assume that human life and its choreographies would change as well. Moreover, applying complexity concepts, it is fair to estimate a *phase transition* through the smartification of cities; a certain qualitative impact of the digital revolution. From myriads of today's competing embryonic digital, algorithmic, data driven solutions, it is impossible to know which one(s) will *enslave* the others, defining the global scale characteristics of future cities' *steady state*.

Urban theories against which empirics can be reflected would herein establish urban phenomena. However, at the time of transition, should theories be revised or firmly apply to changing regularities (Batty, 2018)? For example, the significance of geographic proximity as a prime promoter of urban dynamics, particularly for economic actors, is unravelling to an extent, while the role of face-to-face contact will probably endure (Batty, 2018; Ascher, 2004). In such complex ecosystems, the long-term future is intrinsically unpredictable, setting challenges to the planning of urbanity in a constant flux.

Planning Encounters Complexity

A useful option to plan the future is to consider urban, complex ecosystem to an extent similar to its counterparts in nature, consisting of a vast number of self-organizing agents on nested levels of subsystems and networks, interacting with their environment. Such systems cannot be built from the start, controlled nor optimized without hindering their capacity to self-organize, i.e., renew and survive. The best option for such systems would be to recognize preferable self-organizing systems – in cities, cooperative actor networks, dynamic clusters or other resilient patterns – and restrain non-preferable phenomena, for example, progress apparently leading to segregation, monofunctional or dangerous urban environment.

Hence plausible possibilities for urban planning would be, first, to learn from the system(s) (novel) features and dynamics, through scientific research, the urban self-organizing, interdependent, and dynamic phenomena. Second, as a methodological frame, planning should focus on allowing or supporting preferable dynamics while hindering harmful ones, revising city operation. Such endeavor requires utilizing and developing new tools and approaches ranging from simulations to spatial analyses applying geographical information system (GIS), mathematical and statistical models, data mining and AI. Third, planning could promote qualitative research, design research, and experiments, for example, those resembling 'urban acupuncture´, by trial and error, adopting procedures of constant evaluation and swift correction maneuvers, for experimental qualification of urban space.

Consequently, a complementary approach could be to envision and imagine the city: while we cannot predict, we can forecast the potential directions to an extent; we can explore cities via imagination and even with visions from art, literature and cinema. By adopting and revising well-grounded visions together with (revised) urban theories, we can estimate their consequences and preferability to possible urban future(s) (Figure 1).

Potential theoretical approaches implying complex behaviors as presented in Figure 1 may include the followings:

Urban self-organization is one of the theories under complexity sciences; self-organization is related to measurements reflecting scaling, fractality or entropy in the system. In the framework of complexity theories originating from natural sciences, self-organization refers to a capability of non-living and non-conscious entities (cells, particles, biological systems, but also urban systems) to form organized patterns and structures without guidance from outside the system. The self-organizing patterns often enslave the agents as is also the case in the metabolic city: human processes produce road networks and activity clusters, which start to guide how people move, behave and invest, accelerating the dynamics. Although individual actions are planned, no one has a complete knowledge of the whole, and the system behavior appears to resemble similar behaviors of natural systems. Self-organizing structures need steering since they are not good or bad as such – human value system must be implied to assess them. However, the positive ones should be allowed to grow since they are impossible to build from scratch (Portugali, 2012; Batty, 2009).

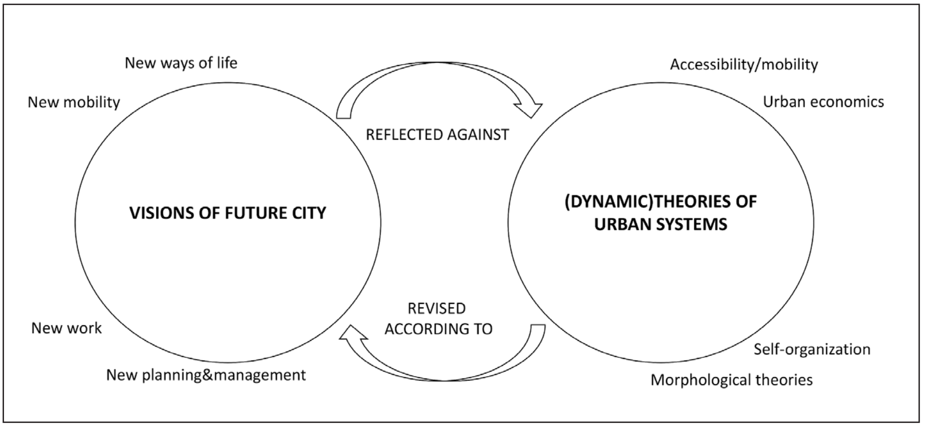

Figure 1: Possible actions imply using existing urban dynamic theories in the interplay with (plausible) visions and sphere of innovations.

Urban economics and evolutionary economic geography, particularly when related to the theory of self-organization and embrace a micro-economic perspective, imply dissipated decision-making by actors according to their best knowledge, resulting in path-dependent progress and resilience. Progress is emergent, i.e. higher-level patterns/dynamics (e.g. activity clusters, downward spirals or land prices) created by single entities (firms, individuals) planning their actions according to available information. Since full information about the whole system is difficult to acquire, patterns appear unpredictable (Bochma & Martin, 2010; Krugman, 1996).

Urban morphology includes theories of dynamic city formation, implying the coupled relations between processes and patterns, and emergent urban form (Caniggia & Maffei, 2001; Conzen, 2004; Moudon, 1997). Urban morphology as a theoretical approach has its roots in architectural theories originally not related to complexity or systemic view as such. However, urban morphology makes identical notions regarding cities, their emergence, evolution, and dynamics, much as complexity theories of cities – or the parallel view emphasizing urban metabolism (Ascher, 2004). In urban morphology it is pointed out that cities typically emerge from the bottom up, routes and mobility (that is, metabolic flows) play an essential role in the emergence of urban enclaves, and the relationship between activity (process, function) and urban form (pattern, structure). The approach is however more corporeal and stresses urban space, and urban design.

Mobility research is, according to current understanding, based on multi-agent dynamics and implies that the traffic system is a complex adaptive system *per se*. Hence the research often concentrates on emergent, non-linear phenomena taking place in transport networks, such as formation of transportation jams, stop-and-go waves, hysteresis, and phase transitions (Wang et. al., 2012). The emergence in mobility system occurs typically through self-organization, and is heavily depending on network topology, along with individual agents' decision making. Mobility theories range from approaches implying complexity and self-organization to network theories and space syntax, often applying models and simulation (Hillier, 2007; Albert & Barabasi, 2002; Watts & Strogatz, 1998; Li et al., 2007).

Cities today face new challenges. Complexity and the dynamics of urban systems are the foundations on which to study the impact of smartification and datafication on behaviors – and on urban forms.

SUGGESTED STRUCTURE OF THE RESEARCH

Systemic view emphasizes the interaction between the system's parts, and the interaction between the system and its environment, along with feedback from the patterns to the agents that produce them. A system is always depended on strategic interpretation of the world (Cillier, 2005). Hence it is necessary to delineate which variables, subsystems or processes are crucial in embracing the essential characteristic and behavior of the system at issue; an analysis based on key principles in complexity thinking, urban metabolism and urban morphology.

According to this theoretical framing, the proposed model concentrates on the interrelated, co-dependent (sub)systems of *flows*, *spatial system,* and *human actors*, considering their self-organizing pattern formation and feedback. The first sub-system of flows would include mobility in traffic networks considering different transportation modes and their interaction via mode choice. The second sub-system would concern spatio-functional configurations referring to intertwined built structure and urban activities, implying the above-mentioned relationship between urban socio-economic processes and resulting spatial patterns (Giddens, 1984), such as emergence of clusters and networks, and dynamics of their change. However, as described above, urban morphology provides a unified foundation for both subsystems, mobility flows and spatial configuration.

The third sub-system concerns human actors, subject to influences of urban processes, particularly in the economic context and in location decisions of firms in the urban region. Humans as subjects of influence, on the other hand, would raise questions of participation/exclusion, social equity and socio-economic well-being. These systems and their relationships are presented in Figure 2.

Figure 2 includes a fourth sub-system, social equity. However, the focus in this article is on the first three categories – mobility flows, spatio-functional systems, and urban economics – thus leaving the fourth for future research for its pervasive and extensive scope.

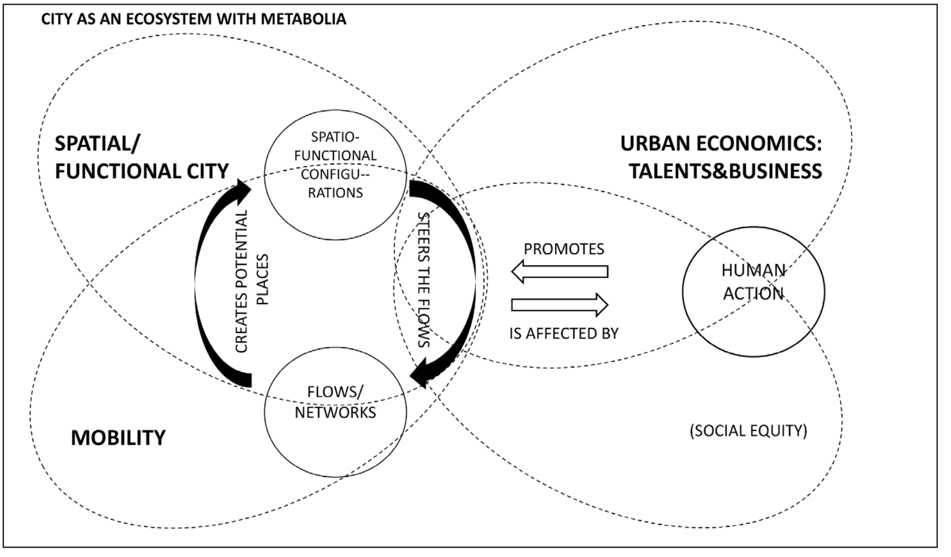

Figure 2: The delineation of the sub-systems: Mobility, spatio-functional city, and human action. The systems are partly overlapping, nested and highly interconnected (the fourth sub-system, social equity, is indicated in the figure due to its breadth and crucial importance but, for these very same reasons, extends the scope of this paper).

The Case of Tallinn, Estonia

The city of Tallinn, Estonia, is a suitable "living laboratory" for this study due to its flexible, progressive adoption of smart systems and extensive data collection. After investing remarkably on smart systems, Tallinn is today among the leading cities in the provision of online e-services, e-voting and e-residency (see, e.g., E-Estonia https://e-estonia.com/tallinn-smart-capital-digital-nation).

The data variables presented in Table 1 are classified into types and methods (quantitative and qualitative), processing levels (e.g., available and modified data), and sources.

Geographic Information Systems (GIS) and census data (a in Table 1) would form a basic data set. Data may be fully available, processed, or computed and complemented with additional geocoded materials such as addresses in socio-economic data, data from multiple external data sources (e.g. travel card systems, credit cards).

The spatial data layer includes street networks (b in Table 1) with information about modes of transportation, cycling networks and public transport. Additional data layers include information about households, employment, services, firms, industries; energy use (from buildings to urban scale); potential tourisms (hotels, Airbnb); or general nationwide trends.

		Type and source	existing	gathered	quantitative	qualitative
a	Land use, census data	GIS				
b	Mobility data: Networks	GIS				
c	Mobility data: Behavioral	Cellular phone				
d	Cognitive and behavioral: Attitudes, norms	Surveys, indicated preference				

Table 1: Classification of most important data types, their status, and their use. Note: Colour codes: Green: mostly used/necessary type; Light green: potentially used/additional; White: not necessary/not available

Mobility and behavioral data (c in Table 1), available through cellular phones and other sources for location and passenger data, would complement the spatial layers and be used for validation. Main data sources are the City of Tallinn, Statistics of Estonia, phone operators, and various service providers (e.g., Positium).

Cognitive and behavioral data (d in Table 1) about the sub-system studying human economic actors is both quantitative and qualitative, covering open-ended and free form (structured or semi-structured) interviews and consists of surveys, given that the number of responses is adequate. For validation, it would be compared to quantitative results. More detailed description of the data and their application for exact purposes are classified in detail in the following sections.

SUB-SYSTEMS: GENERAL PRINCIPLES

Each sub-system is intrinsically trans-scalar, (e.g., neighborhood, regional scale, or a scale of a particular system--certain traffic system or functional enclave). The scales essential to the particular systems' operation need to be contemplated for observing emergent impact of agents' interaction and other similar pattern formation processes.

The three sub-systems have certain characteristics that would form a general framework for the research. The starting point for the overall approach would be that cities are in a flux. Urban complex spatio-functional systems, mobility and urban economics are evolving dramatically due to rapid progress and innovations in energy, ICT and other fields of technology, along with life-style changes resulting from these. While the role of corporeal urban environment will retain, it will transform. Urban transformation is intertwined with emerging phenomena such as virtuality and autonomous transport guided by AI and enabled by extremely fast telecommunication (5G) connections.

Hence, in all three sub-systems discussed here, technology is considered not only as a driver of change, but also as a provider of tools and methods for better understanding and guiding the transformation. Overall, approaches from data analytics to simulation and machine learning are required to respond to emerging challenges in urbanity. Furthermore, it is necessary to stress that for uncertainty of the future, *making* the city becomes crucial, along with new tools and methods in urban planning and design.

General aims for the research project presented in this article – i.e., *understanding* the city, *developing* planning methods and tools, and *enhancing urban quality* – apply to all sub-systems. Although the sub-systems are presented as separate entities, their scope would be overlapping and complementary, implying remarkable amount of collaborative work in research operation (e.g., sharing data, results, joined research operations, and feedback).

Urban Mobility Sub-system

This sub-system aims at knowledge of systemic features and dynamics within traffic systems, computational tools to evaluate the impact of decisions regarding transport modes and changes in activity nodes to the overall behavior of the flows in the network. Following the metabolic ideas of the city's operation, the approach focusing on flows is reflecting spatial behavior and spatial configurations, and hence very much is intertwined with other sub-systems of urban space and human actors. Consequently, the scope of the research is the analysis and design methods for transforming mobility and urban morphology.

Description

The research would focus on the topology and (anticipated) use of transportation networks considering novel, emerging modes of transportation in an innovative manner. Furthermore, the resulting changes in mobility, traffic flows and "urban metabolism" in the corporeal city in general are studied with appropriate methods, for example using dynamic, distributed models and simulations or network theoretical methods. The research problems may concern characteristics of future mobile, multi-location and virtual work, individual decisions regarding transportation mode (public, private, current, future modes, and potential threshold values; or relations between the network topology and its actual use, e.g. the emergent, cumulative role of individual drivers in congestion; and the role of new network hubs. Due to the intrinsically high level of complexity of the mobility system, computational tools are necessary, and it is suggested to apply a micro-simulation modelling approach capable of embracing emergent impact of myriad individual dissipated decisions of drivers.

Due to ongoing urban transition and digitalization, changes are expected in the number of daily trips, making them more unpredictable or multimodal. Network characteristics and emergent transportation modes will play a role in congestion and load management.

Potential data

In addition to the data presented in Table 1, information about commuting and work place will be collected through interviews, surveys and sources such as Tallinn Smart Card data; land use and parking data in the area of Ülemiste, Tallinn; and previous questionnaires about mobility preferences, mobility questionnaires for Ülemiste area workers, tram passengers data, and public transport accessibility analysis.

Expected results

A computational tool (simulation model) is introduced to estimate the emergent impact of individual mobility decisions on a higher (neighborhood, city and/or regional) scale, and the role of the network structure in that. The results are reflected to relevant theories of urban systems and urban management to propose guidelines for planning and application of the built tools.

Spatio-functional Sub-system

The aim of the research contemplating this subsystem would be to gain new knowledge and understanding particularly of urban spatio-functional configurations, emerging patterns and their changes over time, and other self-organizing regularities (e.g. rhythms of how people use the city currently, or in future). The term spatio-functional refers here to the dynamic relationship between emerging order manifested in space, and the activities (public and private services, residential and other use) generating the spatial patterns.

Description

The research would focus on dynamic morphological and spatio-functional aspects of cities, hypothesizing that while our ways to use the city will evolve along immersive technology, urban activity landscape and morphology inevitably respond to this change. The research problems would circle around both making and reading the city: the relationship between the urban morphology (density, form) to energy consumption and distributed production in different urban scales (from building to city level); the impact of new lifestyles to the metabolism and spatio-functional configurations of the city, and more.

Potential data

In addition to the data presented in Table 1, data of energy use in buildings/neighborhoods/larger units and 3D data of buildings (morphology) and CAD-building data will be collected.

Urban Actors' Sub-system

The studies exploring this sub-system delve into the so-called future of work, implying to novel industries, emerging ways to work remote or multiple places, apply virtual and/or mobile work environment, including changing attitude and understanding of "work". The ongoing transition of urban systems towards "smart" urbanity could consider, for example, the future key industries and actors in the emerging techno-urbanity; their preferences regarding location decisions in urban regions; the impact of these choices to future urban economic geography; or the role of geographic and other types of proximities in the era of virtual, multi-location work. How to attract firms or creative individuals, how are the preferences of the future 'smart city' talents regarding their environment differ, and what is their understanding of the concept of work. These revised motivators and attractions would affect the dispersion of activities in urban area.

Expected results

This research scheme is expected to result in building plausible scenarios concerning new understanding of work, along with its implications to overall mobility, urban spatial configurations and the way of life particularly in the case city of Tallinn, applying statistical and spatial analyses methods.

DISCUSSION

The practical research schema based on the conceptual model presented here would provide multifaceted understanding of plausible urban dynamics in the near future. Implementation of the research operations could take place in phases, building incremental knowledge emerging also from the experimental research operations. The phases and their tentative results along the sphere of influence are presented in Figure 3.

The results from the research project presented in this article would benefit urban planners, urban management and developers by producing applicable knowledge and visions of smart city dynamics in complex environment, regarding mobility, built environment and urban economics. This knowledge could take place in the form of new guidelines, proposals or policies for urban development such as more adaptive planning methods, models, simulations or beyond. The next steps for the research would be to build more detailed research plan for implementation of the project in the case city of Tallinn. Furthermore, it would be necessary to build a systematic monitoring and evaluation frame for the project to estimate its potential for generalization in various unique urban regions on a different stage of digitalization.

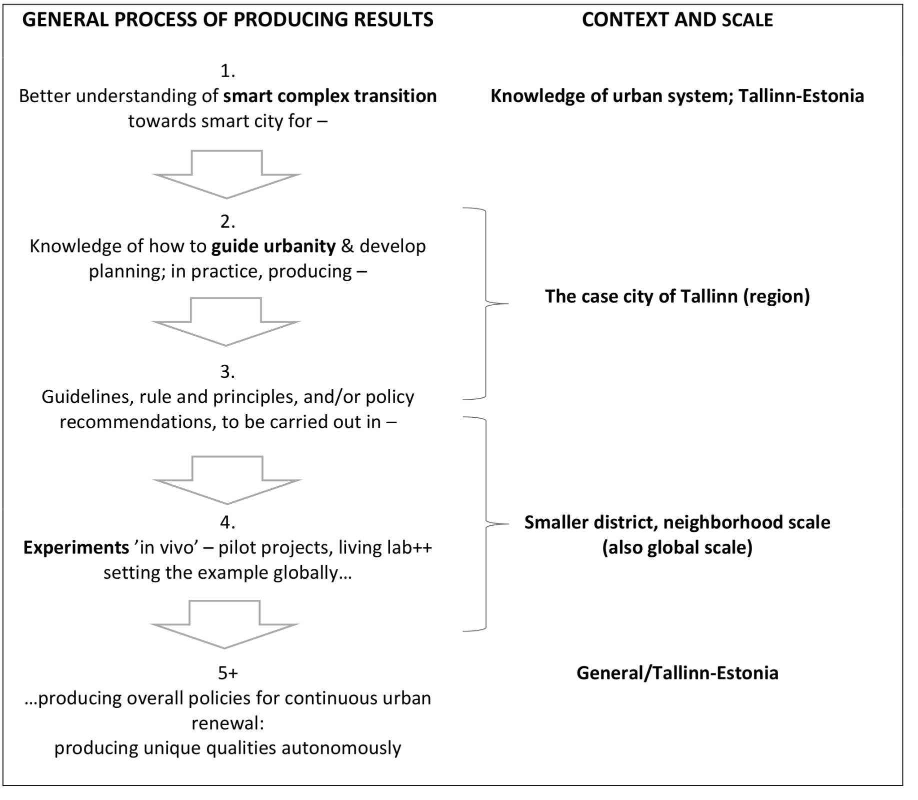

Figure 3: Results and spheres of influence. All sub-system studies would produce data for each (nested) scale.

NOTES

1. While the project builds on prior theories and knowledge of viable urban environment, however, technology (may) change how the good urban qualities are manifested and discovered.
2. It is noteworthy that the complexity thinking provides an apt frame for the relationship between micro- and macro-economics. Micro-economics reflect the bottom-up dynamics and emergent results of individual actors making dissipated decisions, while macro-economics represent the governing framework guiding local dynamics. Both feed back to each other. Due to its scope in urban studies, we will explore urban economic processes on the micro economic context, in a macro-level context.

3. For example, echoing theories of self-organization and principles in (evolutionary) economic geography (along with urban metabolism), space syntax is a theory that explores the overall structure of the traffic network as a general accessibility surface, in which certain (groups of) segments in the network have better overall accessibility (from every other segment) than others. Depending on the scale (i.e., how many segments away we are looking), different accessibility hot spots emerge. Potential for positive, self-organization generating urban activity is related to high accessibility on many scales (reflecting various modes of transport – walk, bike, car etc.). Changes in the network, such as highways, may be modeled and their impact evaluated. Regarding network theories, network topology has a great impact in flows in the network (e.g., few cars in a certain part of the network may cause congestion). Topological structure can reflect the different dynamics in traffic flow. In many systems complex networks (connected clusters, weak ties between the clusters) are associated with higher resilience of the system; the level of complexity may impact the behavior of the traffic flows in the overall system. Different types of networks – regular, random, small-world or scale-free networks – may reflect differing dynamics, e.g., sequenced jams (Li et al., 2007).

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