FRAMEWORK FOR DEVELOPMENT OF CITY'S INTELLIGENCE

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Abstract. The diversity of theories analysing intelligence of the city brings some misunderstandings as well as fragmented attempts to explain the background for development of this phenomenon. Therefore the *aim* of the article is to present an integrated framework for development of city's intelligence. The article discusses theoretical background for development of city's intelligence and provides an integrated model based on intelligence, productive knowledge creation, decision making and empowering infrastructure. The research *methods* used are critical analysis of scientific literature and modelling.

Keywords: social systems, urban development, city, intelligence, model.

JEL classification: O18, O30, R11, R58.

1. Introduction

Intelligence at social system's level is analyzed by a few authors; this category is more found in the context of intelligent (or any other successful) city, where it has different interpretations that concern mostly describing the characteristics of a particular city, but points a little interest to the development of these features in a particular social system. The problem also arises because the interpretation of intelligence as a separate category differs from the way it is interpreted in the context of the social system: if social scholars agree in part that intelligence of an organization, city, region or country are concerned with the development of knowledge, scholars analyzing intelligent cities highlight other key characteristics, such as the ability to use information communication technologies, innovation, etc. The question arises therefore: why in analyzing this category at the city's (or any other social system's) level there is such a big gap between its essence. Obviously, this brings confusion in interpreting intelligent cities and creating unified methodology for the development of intelligence at city's level.

Knowledge management theory offers enough knowledge creation and development mechanisms at the city level, but intelligence is not limited to internal knowledge creation. It is impossible to act with foresight, if there is no knowledge about how the others are acting, what they know, what technologies they use, etc. Therefore, the social system cannot create effective knowing, without comparison with other social systems because it does not exist in a vacuum, it is always surrounded by other social systems and it is a part of larger social systems. Thus without knowing what is happening in environment and acting only in accordance with what is known about itself, it is not possible to make effective decisions.

The *aim* of the article is to present an integrated framework for development of city's intelligence. The article discusses theoretical background for development of city's intelligence and provides an integrated model based on intelligence, productive knowledge creation, decision making and empowering infrastructure. The *methods* used to prepare the article are critical analysis of scientific literature and modelling.

2. Theoretical background for development of city's intelligence

The concept of intelligence has been broadly analysed in the scientific literature between the end of the 20th century and the beginning of the 21st century. Intelligence researches of that period have been distinguished by different approaches specific for different science directions. Many studies have been carried out in the field of psychology analysing *human intelligence* and its different forms (Chen and Chen 1988, Ackerman 1997, Flynn 1997, Hunt 1997, Romney and Pyryt 1999, etc.), in the field of *artificial intelligence* (Pienaar and Kruger 1999, Sunal, Karr and Sunal 2003, etc.), in the area of *business intelligence* (Craft, Fleisher and Schoenfeld 1990, Erdelez and Ware 2001, Makadok and Barney 2001, etc.). The recent

scientific literature seldom analyses intelligence as a separate category; today's scientific research is concerned about the expression of intelligence forms in various situations or analysing intelligence as the context of research object:

– various forms of human intelligence like spiritual intelligence (Satpathy and Mohapatra 2012), emotional intelligence (Iuscu, Neagu C. and Neagu L. 2012), multiple intelligence (Delgoshaei and Delavari 2012), etc.;

– in the field of computing and management sciences like creation and realisation of business intelligence tools (Chen, Chiang and Storey 2012, Bucur 2012, Airinei and Berta 2012, Giustozzi and Van der Veer Martens 2011);

– in the field of computing and education sciences like creation and employment of smart educational tools (Jin and Bouthillier 2012, Shum and Ferguson 2012, Chen et al. 2012, Dent 2007);

– in the field of artificial intelligence (Kaur 2012, Zhong 2008);

– in the field of defence where intelligence aims to be espionage (like military intelligence) (Ivanov 2011, Varnava 2012, Kramer 2011, Zegart 2012);

– in management research at the individual level like cultural intelligence (Ismail, Reza and Mahdi 2012, Rockstuhl et al. 2011); social intelligence (Harrysson, Metayer and Sarrazin 2012);

– in management research at the organization's level in the studies of business intelligence (Chau and Xu 2012, Agnihotri and Rapp 2011, Isik, Jones and Sidorova 2011);

– in management research at the social systems' level.

Any city can be seen as being a social system. If so, different aspects and features of social intelligence of individuals also could be applicable to such system. Social intelligence of an individual is the ability to be in harmony with own environment and getting them to co-operate. A social system like a city could hardly be considered as intelligent if the people or institutions do not feel well or feel themselves inadequate. This requires an awareness of the situation, trends and driving forces as well as interaction tools and styles that can involve other social actors in helping to achieve its objectives. However, the intelligence of any social system is much broader and complex issue than the one of an individual.

The concept of intelligence at social systems' level is mostly analysed in the terms of intelligent city (Lipman, Sugarman and Cushman 1986, Bruhns 1997, Droege 1997, Komninos 2002, 2006, 2011, Santinha and de Castro 2010). Various approaches existing in recent scientific literature point to different aspects of such a city, e. g. infrastructure of information communication technologies, knowledge management activities, learning, innovations, highly educated and talented citizens, etc. However, these approaches provide fragmented characteristics of being the intelligent city but no one of them provides an integrated background that is needed to become the intelligent city. The other side of the problem is that other concepts analysed in scientific literature like digital city, learning city, knowledge city, smart city, etc. (depending on the concept) are characterised by having the same qualities as mentioned above. Thus, an intelligent city as it is described in scientific literature has qualities of digital, learning, knowledge, smart, sustainable, informational and innovative cities. The essence of intelligence provides some essential aspects of intelligence: *knowledge, optimal usage of resources, effective interacting with environment* (Liugailaitė-Radzvickienė and Jucevičius 2012), it is about *having a skill of 'guessing right'* and possibilities as to *how* and *what kind of future might occur* (Jucevičius 2011). Therefore there remains a question: why is the understanding of the city as intelligent so far from the essence of the very intelligence itself?

The broader view of the main existing approaches to intelligent city is displayed in Table 1.

No doubt the concept of the intelligent city is broader than the concept of intelligence itself; however, the existing qualities of such a city (innovation, ICT, knowledge management activities, etc.) could be characteristics of any other city, and they do not express any unique aspects of being intelligent. Consequently, the most logical way to solve this problem is to distinguish the intelligent city from the other describing it in the terms of intelligence as the main quality of the intelligent city. This means that the intellectual potential, not the ability to employ information communication technologies, should be underlain.

Table 1. Main approaches to intelligent city

Author	Approach to intelligent city
Rodrigues and Tomé 2011	Intelligent cities are knowledge and digital cities together.
Komninos 2011: 174	'The concept of spatial intelligence refers to the ability of a community to use its intellectual capital, institutions and material infrastructure to deal with a range of problems and challenges'.
Intelligent Community Forum [1]	Five main indicators of an intelligent community: broadband connectivity (a clear vision of their broadband future, policies to encourage deployment and adoption), knowledge workforce (workforce qualified to perform knowledge work), innovation, digital inclusion, marketing and advocacy (communication of advantages and explanation of how they are maintaining or improving their position).
Santinha and de Castro 2010: 80	'At the internal level, the intelligent city must provide high-quality services and plan the territory in a way that its environment and urban design are attractive to citizens. It must promote a social and cultural milieu able to encourage creativity and efficiency among most its citizens. It must also develop, maintain, and attract qualified and talented human resources with diverse skills and cultural backgrounds. <…> At the external level, the intelligent city must have the capacity to, on the one hand, be part of thematic networks which may enhance its competitiveness and sustainability, and on the other hand collect the necessary information to sustain the production of knowledge useful to its development. <…> it must be able to disseminate information in a strategic way so that it can stand out in a globalized world'.
Komninos 2006: 1	'Intelligent cities and regions are territories with high capacity for learning and innovation, which is built in the creativity of their population, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge management'.

3. Model for development of city's intelligence

The background for development of city's intelligence as the main distinguishing quality of the intelligent city has been provided in the previous

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[1] https://www.intelligentcommunity.org/index.php?src=gendo cs&ref=Research_Intelligent_Community_Indicators&catego ry=Research

chapter. This chapter offers an integrated model for development of intelligence at the city's level.

It should be stated that in scientific literature there is a lack of attempts trying to provide models for development of city's intelligence. As mentioned above, the recent scientific literature is mostly concerned with providing characteristics of intelligent city and seldom discusses the background for becoming intelligent. Glynn (1996) conceptualised mechanisms relating individual and organizational intelligences:

– aggregation model: when organizational intelligence is measured as the sum, the mean or the maximum value of all its members' scores gathered from well-defined measures of individual intelligence, such as IQ tests;

– cross-level model: when diffusion and institutionalization processes convert and encode individual intelligence in the organization's memory, routines, rituals, standard operating procedures, and symbols and thus become organizational intelligence; socialization processes transmit intelligence from embedded systems to individual members;

– distributed model: when organizational intelligence emerges from the partnered interactions that constitute the organization. It is about the creation of meaning, the social construction of reality, and the development of organizational culture and symbolism; thus organizational intelligence is broader than individual and exists beyond individuals.

This conceptualization especially the last model is no doubt of high importance for explanation how the mechanisms relating individual and social system's intelligence are functioning. It provides an understanding that the roots of intelligence of the city lies in the human interactions. However, for quite a long time most studies considered intelligence mainly as a result of extensive use of ICT and new knowledge. This is especially true when intelligence is considered to be some kind of the synonym for smartness. It is not to deny that IT plays an important role and the city cannot be considered as an intelligent if it has underdeveloped IT infrastructure. In such a case it would be difficult to expect development of intelligent internal environment employing external competence networks and information databases. All intelligent cities are necessarily digital but not all digital cities could be called intelligent. Intelligence quality is needed for ability to solve problems based on knowledge, information and insight while the ability of digital cities is in provision of different services via digital communication.

Creation of collective knowing in a city is of crucial importance. However, this is not an easy task because different stakeholders and social groups in the city have different goals, different competence, knowledge base, resources and culture. Development of such knowing demands an adequate capability to absorb already existing knowledge and information from the external environment as well as a capability to develop new knowledge. Even if the productive knowledge that leads to creation of innovations is of primary importance losing a touch with generation of more fundamental knowledge is dangerous. In such a case risk of losing a knowledge platform for the development based on effective exploitation knowledge resources for the development increases.

The model for the development of city's intelligence consists of four dimentions (Fig. 1) presented further.
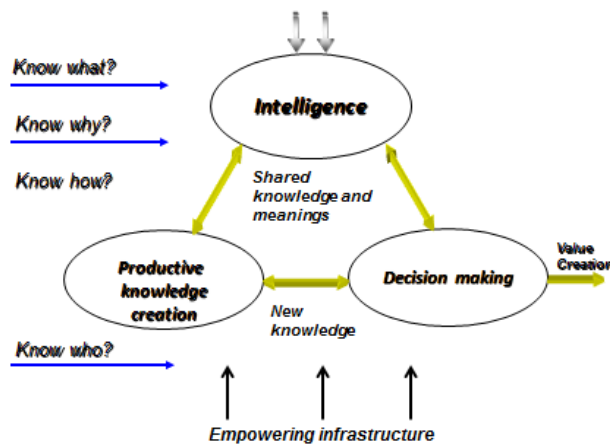

Fig. 1. The model for the development of city's intelligence (based on Jucevicius 2011)

The dimension of intelligence. Intelligence combines many of the most important features of many other concepts; this is a systemic and continuous process seeking to ensure developmental processes at strategic level. This process is concerned with the collection, interpretation, and management and sharing of social, political and economic information. It is about monitoring weak signals coming from the external environment which tell whether the social system is on the right track or not. This dimension has to ensure the adequate interpretation of both internal and external contexts and it is based on creation of mechanisms empowering the absorption of right information and knowledge and relating them with already existing knowledge. There is a big variety of information that could be a target for employing the intelligence function. First of all, it is important to understand the

strategic factors of success, key trends, driving forces and challenges. Deciding what information from the external sources needed is a prime and at the same time a difficult task because of big complexity of the city as a social – economic system with quite different internal interest groups. The intelligence function should not be performed by one single body – involvement of different social partners and interest groups into the process is important. It is hard to imagine that a city government or a single institution had sufficient financial and what is more important – intellectual resources and capabilities. Development of well-functioning intelligence system in the city requires cooperation and collaboration between most of interested parties. Collective and collaborative intelligence should be developed. Collaborative intelligence both as a process and the result could be understood as distributed system in the bigger social system where each actor is positioned in such way that it could contribute to the problem-solving network in most effective and efficient way while retaining its autonomy. The latter is important to understand because the intelligent city may be created only by the social actors who are autonomous in their decision making. Evolution of the whole ecosystem of the city is possible in that case.

Another important challenge is to learn where the needed information could be found. A variety of different networks comes to stake. Big knowledge networks consist of a range of sub-networks. Such sub-networks consist of smaller and more specialized communities using the same professional thesaurus. When such sub-networks are the part of a bigger or even global network, they contribute to the development of common knowledge by making their specific knowledge accessible to global community. At the same time they sustain their autonomy by protecting specific knowledge from the broader audience. The other important issue is a big diversity of cultures and embodied norms among sub-networks. All such issues should be counted when deciding to enter the knowledge network. Every member of the network has to understand that without becoming a source of knowledge for others it will be quite difficult to be a part of the community.

In principle there is not a big problem to get the valuable information if one knows what kind of information is needed and where to find it. Many specific tools are already known and could be employed. More challenging is making use from the information acquired. Intelligence needs creative approaches, ability to see between 'the lines'. It is less about analysis and more about synthesis, ability to see the whole picture even if

there are just small pieces of it and to recognise small signals.

The dimension of productive knowledge creation. The productive knowledge is the main source for successful development and social wellbeing. They are created by providing research and applying new knowledge in practice. It is also about educating competent knowledge workers able to perceive the meanings and apply them in their activities. Thus that dimension includes the creation of knowledge and competencies which are the tool for creation of innovations and sharing of innovation culture. On the other hand, the newly created knowledge is the basis for further knowledge creation. As it has already been mentioned, there is a difference between creation of new fundamental knowledge and the productive knowledge that could be transformed into innovations. However, that difference is not of antagonistic character: without fundamental, conceptual knowledge it may happen that there will be lack of competence even to recognise the value of already existing knowledge. Of course, there is a difference in importance of such fundamental knowledge for different cities. This is like the difference between knowledge city and the intelligent city. Does being a knowledge city automatically mean being intelligent? It is clear that without possessing and employing a certain level of specialised knowledge city or other social system can hardly become an intelligent. However, the ability to use already existing both external and internal knowledge in a creative, innovative way is more important than the ability to create new knowledge. It means entrepreneurship and innovativeness are of upmost importance. This is the main reason why emphasis on productive knowledge creation is given in the model (Fig.1). Such approach suggests the concept of open innovations to be employed as a driving force for creating a collective productive knowing in the city. That concept is usually used in business. However, it could easily be applied in finding innovative ways how government, municipalities could collaborate with the society.

It is important to point out one more aspect related to the dimension of productive knowledge creation in the proposed model of the intelligent city. Technology-driven approach in the concept of the intelligent city still prevails. However, such aspects like urban development, civil security, cultural life and many other aspects are not less but even more important. All those aspects are also knowledge-dependent. But such type of knowledge is of different nature; it is soft and to big extent – tacit. The boundary between tacit and explicit knowledge is often flexible even if most knowledge remains tacit. Understanding how such knowledge could be caught and transferred is still a big question not only to the practice but to theory as well. Because the tacit knowledge resides in people's beliefs, values, experiences, other intangible elements of organization like routines, structures, institutions (Inkpen 1998), it makes it complicated to formalize, purchase and share such knowledge. Applying less formal networks such as communities of practice, 'best practice groups' has a perspective. Knowledge networks facilitate sharing of tacit knowledge and creation of innovations based on interaction of knowledge from different sources. Knowledge networks for innovations consist of individual experts, researchers, business organizations, research institutions and are a vital part of well-functioning innovation system.

The dimension of empowering infrastructure includes the spatial design of the city, preparation, intention and arrangement to use information communication technologies as the integral tool for development (e-readiness) and networking as one of the most effective forms of social interaction. The digital dimension of the intelligent city has received probably most attention in the scientific literature and does not require deeper analysis. However, other dimensions of infrastructure are less discussed. The aim of the article is to present an integrated framework for development of city's intelligence with bigger emphasis on the intelligence function. It has been done earlier when two most important dimensions of the intelligent city model were discussed. Some other important dimensions of intelligent city infrastructure could be mentioned:

 – Availability of ICT infrastructure;
 – Local and international accessibility;
 – Sustainable and innovative transport system;
 – Local and global interconnectedness;
 – Green urban planning, buildings, energy;
 – Cultural, educational facilities, etc.

The dimension of decision making reflects how effective the dimensions of intelligence, knowledge creation and empowering infrastructure are. At this level the process of productive knowledge creation and the process of intelligence are monitored as well as the ability to empower existing infrastructure is evaluated. The effective interaction among those three dimensions should lead to social, economic and ecologic sustainability as the result.

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4. Conclusions

Intelligence of the city can be described as the organised intellectual ability of the city to perceive emerging changes in the environment, as well as the reasons and effects for its development.

Intelligent city possesses effective mechanisms for creating new knowing and competence by integrating new knowledge with the intellectual capital of individuals, organizations and institutions. Finally, it is capable of making and implementing decisions to achieve its goals by exploiting resources of all kinds in the most efficient way.

The conceptual model of the development of city's intelligence has four dimensions: intelligence that is responsible for the function of absorption of external information and knowledge; productive knowledge creation responsible for assuring the intellectual platform for the knowledge-based development and knowledge absorption capacity; decision making dimension responsible for making intelligent decisions; supporting infrastructure that is based on but not limited to ICT.

Intelligent cities have high capacity for learning and innovation, they are characterised by the culture supportive to creativity of individuals and institutions, and they have strong digital infrastructure and connectivity to the region and globally.

Acknowledgement

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