

Management Solutions for Smart Logistics in Smart Cities

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Abstract:

Urban development increasingly requires the use of advanced technologies, with a particular focus on the range of tasks to be solved. In developing countries, the problems identified by the rapidly growing population are dominant, while in developed countries, whose populations are mostly aging, they are more focused on improving quality of life, reducing social inequalities and developing sustainable structures. These problems can be solved by applying the smart city concept in cities, as the rapid development of technology offers new development paths for cities that can handle the problems, the challenges of competitive and sustainable cities at the same time. Smart solutions affect for the supply chain, because of this smart supply chain tools are developed. In this paper, we would like to give a brief overview of what we mean by smart city, smart logistics – including the smart supply chains – and the relationship between them. Examples are demonstrated by the paper and we suggest some directions of development.

Keywords: Smart Cities, Smart Logistics, Industry 4.0, Logistics 4.0

JEL Codes: L91, M10, O18, O33, R11

LITERATURE REVIEW - Smart City concept

Since the development of the industrial revolution, specialists of development of cities have been envisioning the most advanced technologies in their ideas. Centuries earlier, the innovative solutions were driven primarily by the development of mechanical machines, but in recent decades, the development of electronics has been the most important driving force (Baji P. 2017).

After the Second World War, the futuristic ideas were replaced by the aspirations to improve the quality of life and human life. Thanks to the development of telecommunications in the 1960s the first similar concept which was developed 'electronic urbanization' (Zenetos 1969). Subsequently, the terms 'cybercity', 'information city' or 'digital city' were introduced in the literature of town development (Batty M. 2012).

Clearly one of the most important urban's phenomenon is the integration of settlements and digital technologies in the 21st century (Rab et al., 2015). The growth of smart city initiatives is continuous, cities are trying to solve complex problems, while increasingly elaborated processes need to be treated simultaneously (Nagy Z. et al., 2016).

The spread of smart technologies improves the quality of life, can contribute to reducing territorial differences within settlements, improves accessibility of urban services, reduces the burden on environment, and contributes to improving the situation of disadvantaged groups.

Smart city is a relatively new topic in science, the first such terms were used only in the 80s and 90s in the literature. Although the expression 'smart city' is becoming more widely known - thanks to the rapid development of ICT - there is no commonly agreed definition or concept of its content. In the last few years, more and more similar expressions have been spread about cities, for example: intelligent city, digital city, sustainable city, knowledge city ... etc., but the smart city term is still the most well-known. (Nagy Z. et al.-2016)

People in smart cities are basically coming from three areas (developers of technology infrastructures, environmentalists, and social scientists), while the smart city concept has developed primarily on four levels (academic, corporate, government and media) (Péter Baji, 2017).

Many definitions of smart cities exist. A range of conceptual variants is often obtained by replacing "smart" with alternative adjectives, for example, "intelligent" or "digital". The label "smart city" is a fuzzy concept and is used in ways that are not always consistent. There is neither a single template of framing a smart city, nor a one-size-fits-all definition of it (O'Grady and O'Hare, 2012).

Table 1, Frequency of mentioning 'Smart City' and similar expression in English and Hungarian

HU	google HU	%	google tudós	%	EN	google EN (thousand)	%	google scholar	%
"okos város"	53 200	70,53	274	52,09	'smart city'	3 600 000	9,41	147 000	57,02
"intelligens város"	8 020	10,63	92	17,49	'intelligent city'	355 000	0,93	14 100	5,47
"tudás város"	1010	1,34	7	1,33	'knowledge city'	1 730 000	4,52	7 660	2,97
"fenntartható város"	6680	8,86	86	16,35	'sustainable city'	527 000	1,38	55 600	21,57
"tehetséges város"	137	0,18	5	0,95	'talented city'	388 000	1,01	1 333	0,52
"összekapcsolt város"	204	0,27	4	0,76	'wired city'	210 000	0,55	2 150	0,83
"digitális város"	5860	7,77	40	7,60	'digital city'	6 190 000	16,17	23 800	9,23
"információs város"	322	0,43	18	3,42	'information city'	25 270 000	66,03	6 140	2,38
összesen	75433	100,00	526	100,00	sum	38270000	100,00	257 783	100,00

Source: own compilation

We wondered if the smart city phrase was still the most widely used, so we did a search in Hungarian and English with google search engine and google scholar (Table 1). In the case of Hungarian search, it is still the most widely used, but in English the search engine has found more hits for new terms.

A wide variety of definitions has been established in recent years in connection with the smart city, and we would like to quote some of these.

- 'a Smart City is a city well performing built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens' (Giffinger et. al 2007),
- In the urban planning field, the term "smart city" is often treated as an ideological dimension according to which being smarter entails strategic directions. Governments and public agencies at all levels are embracing the notion of smartness to distinguish their policies and programs for targeting sustainable development, economic growth, better quality of life for their citizens, and creating happiness (Ballas, 2013).
- 'smart city is defined by IBM as the use of information and communication technology to sense, analyze and integrate the key information of core systems in running cities' (IBM, 2010),
- 'smart city' „smart city as a high-tech intensive and advanced city that connects people, information and city elements using new technologies in order to create a sustainable,

greener city, competitive and innovative commerce, and an increased life quality” (T. Bakici, E. Almiralli J. Wareham, 2013)

- ‘a city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance’ (Caragliu et al., 2011),
- ‘a smart community is a community that has made a conscious effort to use information technology to transform life and work within its region in significant and fundamental rather than incremental ways’ (California Institute, 2001),
- ‘Concept of a Smart City where citizens, objects, utilities, etc., connect in a seamless manner using ubiquitous technologies, so as to significantly enhance the living experience in 21st century urban environments’ (Northstream, 2010),
- ‘Smart City is the product of Digital City combined with the Internet of Things’ (Su et al., 2011),
- ‘a smart city is a well-defined geographical area, in which high technologies such as ICT, logistic, energy production, and so on, cooperate to create benefits for citizens in terms of well-being, inclusion and participation, environmental quality, intelligent development; it is governed by a well-defined pool of subjects, able to state the rules and policy for the city government and development’ (Dameri, 2013).

Table 2, Giffinger’s Smart City model

<p>SMART ECONOMY (Competitiveness)</p> <ul style="list-style-type: none"> ▪ Innovative spirit ▪ Entrepreneurship ▪ Economic image & trademarks ▪ Productivity ▪ Flexibility of labour market ▪ International embeddedness ▪ <i>Ability to transform</i> 	<p>SMART PEOPLE (Social and Human Capital)</p> <ul style="list-style-type: none"> ▪ Level of qualification ▪ Affinity to life long learning ▪ Social and ethnic plurality ▪ Flexibility ▪ Creativity ▪ Cosmopolitanism/Open-mindedness ▪ Participation in public life
<p>SMART GOVERNANCE (Participation)</p> <ul style="list-style-type: none"> ▪ Participation in decision-making ▪ Public and social services ▪ Transparent governance ▪ <i>Political strategies & perspectives</i> 	<p>SMART MOBILITY (Transport and ICT)</p> <ul style="list-style-type: none"> ▪ Local accessibility ▪ (Inter-)national accessibility ▪ Availability of ICT-infrastructure ▪ Sustainable, innovative and safe transport systems
<p>SMART ENVIRONMENT (Natural resources)</p> <ul style="list-style-type: none"> ▪ Attractivity of natural conditions ▪ Pollution ▪ Environmental protection ▪ Sustainable resource management 	<p>SMART LIVING (Quality of life)</p> <ul style="list-style-type: none"> ▪ Cultural facilities ▪ Health conditions ▪ Individual safety ▪ Housing quality ▪ Education facilities ▪ Touristic attractivity ▪ Social cohesion

Source: Giffinger et. al 2007

As noticed above, the first operational definition of a Smart city has been given by Giffinger et al. (2007): “a smart city is a city well performing in six characteristics, built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens”(Table 2). This description extends previous literature results by identifying six dimensions (economics, people, governance, mobility, environment and quality of life), in turn broken down into 31 major factors and 74 indicators in total. As we can see above, smart mobility is one of the important factors for smart cities. In the literature, smart logistics is often described as the basis for the process of becoming a smart city.

Effects of the industry 4.0 – the logistics 4.0 and the supply chain planning 4.0

Industry 4.0 is the age when the human factor is getting to be overshadowed, and the automatization, the IT technology need more space. Another name of the industry 4.0 is the fourth industrial revolution. To adapt to the changed business environment is the key to companies could be competitive. This development gives more chances to the optimalization of the internal and the external processes as well.

An effect of the industry 4.0 is the e-commerce. Customers have a comfortable way to purchase, they can use the internet, there is no need to go to the shop, they can buy what they want from home. It indicates that the customers’ needs are increasing and they have become much more varied. So the need of goods and items are also increasing which influence the logistical system of the company, the distribution processes (Karmazin & Ulechla 2015). Home deliveries systems are getting to be more important, so the road transportation is getting under more pressure. It has become difficult for the companies to deal with the increasing demand.

For this problem Bock and Siepen (2018) introduced the supply chain planning 4.0 in their publication. The authors defined three steps to adapt to the changing environment:

- environmental analysis – determine deficiencies;
- vision – new digitalized processes;
- development and integration – develop the processes to come the vision true.

According to the research of Bock and Siepen (2018) companies are not prepared to the digitalization because they don’t have the appropriate tools, such as software or computers. The authors focused on especially the supply chain planning but it also contains the processes of

logistics. So if companies will be able to integrate the IT tools which help the demand planning, the efficiency of the companies will be also increased.

This is the reason why logistics 4.0 is a very important part of the supply chain planning and supply chain management. It is defined as a modern logistics which use the cloud computing, the digitalization and the networking. It means that the new direction of logistics is not focused only the transportation and the internal processes. But it is still necessary to integrate this modern logistics into the supply chain (Timocom, 2020).

Korczak and Kijewska (2018) summarized the definitions of the logistics 4.0. According the authors' research there are many kind of definitions from 2007 to 2017. What they have in common is the new name of logistics 4.0 – most of the authors name as smart logistics.

Smart solutions provided by smart logistics – Good Examples

Literature recommends many things which help the companies to be smart. Automatic tracking of goods, vendor managed inventory system, zero-emission transport, integrate the reverse logistics into the supply chain. The aim of paper is to introduce some examples which are used in the real business sphere.

Huawei uses the NB-IoT Enables Transformation of Smart Logistics. Their smart logistics is based on the real-time monitoring of valuable goods. The IoT platform gives data management, device management, connection management. With the help of GPS, they can positioning the delivered goods. So the partners would not focus on the useless information. The cargo has a goods trace terminal, and a handheld distribution terminal to make easier the logistics processes (Huawei, 2020).

Hitachi Transport System also offers “an intelligent and effective solutions” (Hitachi Transport System Brochure, 2020). They emphasize the greenness of their system. The system contains track & trace module (Hitachi, 2020).

There is some system which handles the whole supply chain with an IoT network. Sigfox's network allow to visualize locations in real time. Real-time reactions are reducing the delays and the costs in the same time (Sigfox, 2020).

Due to its size, the transport situation in and around Amsterdam is of national importance. There was a need for a traffic management system that could be linked to and compatible with national and regional monitoring systems. As a result, both control centers see the real-time situation and the authorities can work together to solve a problem that may even have a national impact. Since its introduction, the time spent in traffic has decreased by 10%. The system can be easily connected to various car navigation systems, which will allow Amsterdam to build a stand-

alone digital road management, thus facilitating the optimization of traffic in the area in the future (www.amsterdam.nl).

CONCLUSION

More and more urban agglomerations are heading to be smart. Smart logistics developments are essential in the process of becoming a smart city. In metropolitan agglomerations, the efficient transport of people, the reduction of travel time, the reduction of pollutants, the more efficient transport, the development of transport infrastructure all belong to this topic. In our article, we presented the evolution of logistics and the smart city concept, the impact of industry 4.0 on supply chains, and some good practices for smart logistics.

The town of our university, Miskolc a potentially smart city, but it is necessary to develop this. Its public transport has a track & trace system, so the passengers can check the real departure and arrival time most of the stations. It would be a great achievement if the companies of Miskolc could adapt this system into their road transport. It is strongly recommended for the couriers. When the cargo is arrived from the start station, the track & trace system will be activated, and both parties – the sender and the destination company – see the route, they can calculate the possible delays, which are derived from for example the road conditions or the traffic jam, and the destination company could prepared for receiving the goods.

If our recommendation will be implemented the theory of Korczak & Kijewska (2018) is getting to be true – to be a city smart it is necessary that the logistics is also smart.

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