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The role of infrastructure in the future city: theoretical perspective

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Abstract

Academic scholars agree that increasing urbanization and intensive technological progress raises new issues in urban development trends. This paper defines the characteristics of future city and analyses the specifics and role of infrastructure in it. Future city development is based no more on infrastructure growth but on its effectiveness and quality which may be achieved only by installing newest technologies and implementing strategic management.

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Keywords: Future city; city infrastructure; city competitiveness; sustainable development.

1. Introduction

Scientists highlight that the importance of cities is increasing in regional, national or global economy. Scholars also forecast that the influence will only be stronger in the nearest future. Since urbanization reached the level that almost half of the world's population lives in cities, city infrastructure faces real challenges how to deal with enlarged density of citizens. Even though scientists (Barrionuevo et al. 2012, Bruneckiene et. al. 2012) agree that urbanization process positively correlates with urban economic development indicators, increased use of electricity, big amounts of sewerage, lack of food, produced waste and pollution are real issues for government and local authorities. Technological progress allows improving production trends but it also plays important role in urban development. Barrionuevo et al. (2012) conclude that „failure to adapt to the new urban reality could be disastrous for cities facing unprecedented demographic, economic, social and environmental pressures”. For this reason academic scholars started discussing about the future city which is innovating, knowledge-based and modern. Even

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though there are many researches about the impact of infrastructure on urban development, but scientific works still lack analysis on the specifics of future city infrastructure and its role for future city development. This justifies the actuality, timeliness and novelty of the problem analyzed in this paper.

The purpose of the paper is to distinguish the specifics of future city infrastructure and to present the critical aspects of the role of infrastructure for future city.

The methodology of the paper: systemic, comparative and logical analysis of scientific economic literature, the method of theoretical modeling.

Scientists started using different terms describing cities: digital, intelligent, ubiquitous, and smart or treat them generally as future cities. Digital city in scientific literature is understood as a city where newest computing technologies are used for critical services and infrastructure of a city: city management, work, housing, transportation, environment, leisure, health care, education, public safety. Authors (Komminos 2002, Kriščiūnas, Daugėlienė 2006) analyzing intelligent cities usually conclude that this type of city involves features of creative, learning and knowledge based city which focuses on creation of high skilled professionals, promotes research and innovation implementation in business, assures network building between education and business institutions. Nam and Pardo (2011) state that ubiquitous city with the help of newest computing technologies provides ubiquitous accessibility and infrastructure. Authors stress that the aim of ubiquitous city is „to create a built environment where any citizen can get any services anywhere and anytime through any devices”. A team of researchers jointly leading the European Smart Cities project (www.smart-cities.eu), suggests that smart city implies innovative industries, has high educated, skilled and creative inhabitants, the relation between the city government and citizens is based through the usage of new channels of communication for the citizens, e. g. „e-governance” or „e-democracy”. Smart city is also known for the use of modern technology in everyday urban life: ICT, modern transport technologies, e. g. logistics and new transport systems.

Even though academic scholars use different terms for cities (smart, intelligent, etc.) they treat these cities as future cities. Authors of the paper chose the term „future city“ on purpose in order to capture all possible features of a city not only for example digitality, ecology or economic prosperity. Compared with the concept of digital city or intelligent city, in future city the focus is not limited to the role of ICT infrastructure but mainly on the role of human capital/education, social and relational capital, and environmental issues. These are considered important drivers of urban growth (Lombardi et al 2011). Future city is also based on sustainable urban development principles which means that city aims for economic prosperity, social equity and environmental quality (Hasna 2012). The term „future city“ evolves all spheres of city functioning: economic (regional, national competitiveness, international transactions, foreign investment), social (traditions, religions, culture, society), environmental (green energy, land use policy, pollution), institutional (administrative authority, transparency, e-government), human capital (talent, innovation, creativity, education). Technological and business oriented philosophy together with humane and ecologic elements allow future city develop as comfortable, safe, delightful, cultural, prosperous and friendly.

2. Results

The understanding of future city infrastructure becomes wide as it embodies not only physical urban infrastructure but also human capital, information and newest computing technologies (software, server and network infrastructures, devices of citizens or city visitors). The specific of future city infrastructure is that all city infrastructures are interconnected in order to provide high quality services. Barrionuevo et al (2012) state that urban development is possible only under these conditions: innovation (creative activities, participation of private sector, talent, technology), social cohesion (democratic values, health and safety, community spirit, diversity), sustainability (appropriate density, compact growth, energy efficiency, public spaces) and connectivity (efficient mobility, pedestrian friendly, communications, international connections). As one of the targets of future city is to create quality of living, social infrastructure plays important role too as it assures education process, health and security service provision, and formation of recreation and leisure zones in a city.

Washburn and Singhu (2010) distinguish seven critical contemporary city infrastructure components and services: city administration, education, healthcare, public safety, real estate, transportation, and utilities. Future city uses newest technologies in order to transform these infrastructure components for effective and quality service

provision in both public and private sectors. The specifics of future city infrastructure can be described using the proposed classification:

- Future city administration: it must be efficient, transparent and involving citizens. Technologies provide opportunities for citizens to participate in the process of city administration as e-government system ensures easy access. Technological progress also allows implementing technologies for administration functions: sustainable use of buildings, transportation, etc. City administration must follow the principles of sustainable development and to assure sustainable urban development by balancing covered and green spaces.

- Education. In order to transfer knowledge creation into economic profit, integrating education, research and innovation became a necessity. Using knowledge for economic and social progress brings changes to educational system as long life learning becomes inevitable. Information and communication technologies make education more accessible as remote learning reduces costs and is as much effective as full-time studies.

- Healthcare in future is more rapid and effective as there is possibility to react quickly to emergency calls; the information about patient is easily transferred in electronic form which is also useful for future researches.

- Increased public safety in future city. Public video surveillance systems are very useful for public safety which together with location-based services allows receiving fast rescue help and works as means of prevention. Geographical information system helps to reach the accident place faster. Anttiroiko (2013) also stresses the need of early warning systems for meteorology and earthquake monitoring services in order to avoid disasters and the need of ICT to monitor the condition of physical infrastructure (f. e. roads, bridges, tunnels which is very important as condition of present infrastructure is not adequate to rapidly growing demand).

- Real estate in future city will be better occupied for lower prices. Another issue: the empty buildings will be used to fulfill existing needs of local government, initiatives or business.

- Transportation. Anttiroiko (2013) presents examples of South Korea how ubiquitous infrastructure was built: ICT was applied in transportation in order to assure real-time communication and to avoid traffic congestions. Future city transportation is also oriented to use more alternative vehicles as bicycles, electric cars, etc. in order to reduce pollution. Researchers also note that transportation system is very important in cities image formation because it determines accessibility of a city which is significant for city economy in terms of trade and tourism.

- Future city utility infrastructure will be improved to work efficiently. The main purpose of system development is to produce electricity from alternative resources (smart grids, gas and water distribution systems), reduce amounts of waste and effectively manage water and energy losses.

Future city infrastructure components mentioned above create attractive environment for business development. But future city is inconceivable without effective infrastructure for business centers and networks, knowledge and innovation implementation in manufacturing process. As it is not physical infrastructure it is to do with social capital forming and innovation implementation which depends on business support system and local economic policy. Performed analysis showed, that modern infrastructure is essential for future city to be economically successful, provide quality and reliable living conditions in parallel with care to natural environment.

Scientific literature emphasizes that neither contemporary nor future city can not function without infrastructure. As cities in global market are facing increasing rivalry in order to attract resources, investors and visitors, the key factors of city competitiveness and exclusivity play crucial role. According to classical economic theory and macroeconomic fundamentals, city is understood as a working system (Sinkiene 2008) which creates economic value: city uses its resources (geographical, physical and human) as inputs in production process and with the help of technological and intellectual assets produces specific products or services. Authors of scientific literature stress that the development of future city is no longer dedicated to only urban growth. Effective and quality (instead of growing) urban development in future city will provide infrastructure to individuals and business units to create economic value. Infrastructure assets together with other resources and assets of future city form certain characteristics of future city:

- Internationally accessible (mixed-modal access of the city).
- Economically vital (competitive business sector).
- Innovative (modern technologies implemented in infrastructure, business and social sectors).
- Safe (increased public and information safety in the city).

- Healthy (residents of the city live in ecologic environment promoting healthy lifestyle).
- Attractive (natural conditions and tourism objects are desirable for city visitors).
- Comfortable (public services assure comfortable living conditions).
- Inhabited with responsible society (residents are initiative in all city activities).

In order to justify the importance of infrastructure, the method of theoretical modeling was implemented. As transport infrastructure is believed to play the dominant role on city openness and livability, the case of cities central street renovation was chosen for modeling. The city „A” and its infrastructure were analyzed and the option to renovate its central street was evaluated. Due to limited extent of the paper, the main conclusions are presented in Table 1.

Table 1. The effect of future city infrastructure

Present situation in city „A“ – the central street and its sidewalks are in poor condition, there are no cycling path		Future situation – renovated central street and its sidewalks, built cycling path.	
Indicator	Effect	Indicator	Characteristics of future city
<ul style="list-style-type: none"> - Increased threat of road accidents for pedestrians and cyclists. - Limited accessibility of local government institutions located in the city center. - Restricted access of city center and tourism objects located there. - Poor condition of street causes damage for local transportation means 	<ul style="list-style-type: none"> - Road accidents cause injures and deaths in this street. - Each trip to city center will cost extra expenses. - Disabled people can not visit city center on their own. - Decreased tourism due to affected city image. - Increased expenditures of residents for car maintenance. 	<ul style="list-style-type: none"> - Increased safety for pedestrians and cyclists, diminished risk of road accidents. - Handle reach of local government institutions located in the city center. - Easy accessible tourism objects will increase the number of city visitors. - New cycling path will promote use of bicycles in everyday life and healthier lifestyle. - Convenient connection with other part of the city and comfortable way to national highway. 	<ul style="list-style-type: none"> - SAFE - COMFORTABLE - ATTRACTIVE - ATTRACTIVE - HEALTHY - INHABITED WITH RESPONSIBLE SOCIETY - INTERNATIONALLY ACCESSIBLE. - ECONOMICALLY VITAL.

The conclusions presented affirm that effective management of even small part of city infrastructure to big extent influences characteristics of future city. Authors also conclude that this causality is mutual: infrastructure must fit the demand of future city in order to fulfill changing needs of citizens and business sector.

3. Conclusions

Analysis of scientific literature showed that becoming future city is inevitable in order to maintain position in global market. Infrastructure both in contemporary and future cities forms the foundation for city functioning and plays crucial role in forming the characteristics of future city. Scientific literature lacks researches on future city infrastructure specifics which are significant analysing the transformation from present city to future. Performed research concluded that future city embodies well developed and quality infrastructure which forms the main characteristics of future city: international accessibility, economic vitality, innovativeness, safety, attractiveness, healthy environment and residents, responsible society. Authors also proved that future city is based no more on infrastructure growth but on its effectiveness which may be achieved only by installing newest information technologies and implementing strategic management. The specifics of future city oblige timely maintenance of city infrastructure in order to fit changing needs of citizens and business sector. Flexible and sustainable strategy of urban development will ensure viable economics, good living conditions and attractiveness of future cities.

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