ULAGANJE U STANOVNIŠTVO, TEHNOLOGIJU I INSTITUCIJE KAO KLJUČNE DIMENZIJE NUŽNE ZA UČINKOVIT RAZVOJ PAMETNIH GRADOVA S OSVRTOM NA SITAUCIJU U HRVATSKOJ

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Sažetak: Svjetski trendovi pokazuju kontinuirani porast broja stanovnika koji žive u gradovima. Očekuje se da će do 2050. godine u svijetu ok 70 %, a u Europi, oko 80 % ukupnog stanovništva živjeti u gradovima. Porastom broja stanovnika, rastu i izazovi upravljanja gradom te se s ciljem postizanja maksimalnog životnog standarda i kvalitete življenja njihovih stanovnika, uvođenje modela pametnog grada pokazalo kao nužnost. Republika Hrvatska kao članica Europske unije, dužna je slijediti preporuke koje su sadržane u nizu dokumenata i zaključaka, kao i izvora financiranja dostupnim državama članicama. Rad daje okvir za razumijevanje koncepta pametnih gradova kroz pregled znanstvene literature, primjere dobre prakse iz Europe i svijeta te detaljnu analizu o stanju i stupnju razvoja pametnih gradova u Republici Hrvatskoj, s fokusom na ključne dimenzije razvoja pametnog grada. Dokazano je da ulaganje u ključne dimenzije pametnog grada: stanovništvo, tehnologija i institucije generira povećanje prihoda, gospodarski razvoj i kvalitete života stanovnika. Metodologija istraživanja za ovaj rad temelji se na mješovitoj metodi koja uključuje prikupljanje, analizu i integriranje kvantitativnih i kvalitativnih istraživanja Cilj rada jest ponuditi okvir za razumijevanje koncepta pametnog grada, ukazati na prednosti ovakvog načina upravljanja i ključne dimenzije u koje je potrebno ulagati kako bi se povećao gospodarski razvoj i kvaliteta života dominantne, gradske populacije.
Ključne riječi: pametni gradovi, dimenzije za razvoj pametnih gradova, pametni gradovi u Hrvatskoj

INVESTMENTS IN POPULATION, TECHNOLOGY AND INSTITUTIONS AS A KEY DIMENSION REQUIRED FOR EFFECTIVE DEVELOPMENT OF SMART CITIES WITH A REVIEW AT THE SITUATION IN CROATIA

Abstract: World trends are showing a continuous increase in the number of inhabitants living in cities. It is expected that the 70% of the total world, and 80% of total European population will live in cities by 2050. By increasing the number of inhabitants, the challenges of city's management is growing as well, and with the aim of achieving maximum living standards and the quality of life of their inhabitants, the implementation of a smart city model was proved to be a necessity. The Republic of Croatia, as a member of the European Union is obliged to follow the recommendations contained in a series of documents and conclusions as well as sources of available funding available to the European member states. The paper provides a framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice from Europe and the world, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia with a focus on key dimensions of smart city development. It has been proven that investing in the key dimensions of a smart

city: population, technology and institutions generates revenue growth, economic development and the better quality of life of city population. The research methodology for this paper is based on a mixed method that involves the collection, analysis and integration of quantitative and qualitative research. The aim of the paper is to provide a framework for understanding the concept of a smart city, point out to the advantages of such management mode, as well as the key dimension to be invested in, to boost the economic development and quality of life of the dominant, city population.
Key words: smart cities, dimensions for the development of smart cities, smart cities in Croatia

1. INTRODUCTION

World trends are showing an continuous increase in the number of inhabitants living in cities. It is expected that the 70% of the total world's, and 80% of total European population will live in cities by 2050. By increasing the number of inhabitants, the challenges of city's management is growing as well, and, with an aim of achieving maximum living standards and the quality of life of their inhabitants, the implementation of a smart city model was proved to be a necessity. It is expected that 80% of the total carbon dioxide emissions by 2050, will originated from the urban areas (Wu, 2010).

The Republic of Croatia, as a member of the European Union is obliged to follow the recommendations contained in a series of documents and conclusions, as well as sources of available funding available to the European member states. There are several policies and initiatives in place at European union level that are promoting development of smart cities:

- "The energy union policy" sets out the targets and actions to transform the European energy system into the most sustainable in the world.
- "The European innovation partnership on smart cities and communities - (EIP-SCC)" is an initiative supported by the European Commission that brings together cities, industry, small business (SMEs), banks, research and others.
- "The Urban Agenda for the EU" promotes better laws, easier access to funding and more knowledge sharing on issues relevant for cities.
- "The smart cities policy context" aims to support the energy union and the Urban Agenda.
- "The Energy Performance of Buildings Directive - (EPBD)" promotes smart technologies in buildings to increase their energy efficiency.
- "The EU Covenant of Mayors for Climate & Energy" brings together thousands of local governments voluntarily committed to implementing EU climate and energy objectives in cities.
- "The Strategic Energy Technology Plane - (SET-Plan)" promotes research and innovation efforts across Europe by supporting the most impactful technologies in the EU's transformation to a low-carbon energy system.
- "The Smart Cities Information System - (SCIS)", which provides a lasting repository of information on smart city projects and serves as a knowledge platform to exchange data, experience and know-how (European Commission, 2019).

The European Commission defines smart city as a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business. They include not only the use of information and communication technologies for better resource use and less emissions, but also smarter urban transport networks, upgraded water supply and waste disposal facilities, more efficient ways to

light and heat buildings, a more interactive and responsive city administration and safer public spaces and meeting the needs of an ageing population (European Commisssion, 2019).

The paper provides a framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice from Europe and the world, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia, with a focus on key dimensions of smart city development. For the purpose of this analysis, there is the following hypothesis set:

HI Investing in the key dimensions of a smart city: population, technology and institutions generates revenue growth, economic development and the better quality of life of city population.

The research methodology for this paper is based on a mixed method that involves the collection, analysis and integration of quantitative and qualitative research. The aim of the paper is to provide a framework for understanding the concept of a smart city, point out to the advantages of such management mode, as well as the key dimension to be invested in, to boost the economic development and quality of life of the dominant, city population.

2. DEFINING THE SMART CITY

The term „smart city“ was first used by The California Institute for Smart Communities 1990s, related to the use of information and communication technology with regard to modern infrastructures within cities (Alawadhi et al., 2012). The concept was developing during the last thirty years, but it can be said that there is not a one-size-fits-all definition of it (O'Grady & O'Hare, 2012). To give the theoretical contribution, there are several definition of smart cities, listed, found in the existing literature. According to Komninos (2011), smart cities 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. The same author (Komninos, 2011)) is indicating that there are four dimensions that characterise smart cities:

***Table 1**. The four dimensions of smart cities*

DIMENSION	CHARACTERISTICS OF DIMENSION
1	Application of a wide range of electronic and digital technologies to create a cyber, digital, wired, informational or knowledge-based city
2	the use of information technology to transform life and work
3	The implementation of information and communication technology in the city infrastructure
4	Connecting the information and communication technology and people together to enhance innovation, learning, and know

Source: Komninos (2011)

Definition that is focused on the flows of information was given by other authors (Anavitarte and Tratz-Ryan, 2010), who stated that the smart city is based on intelligent exchanges of information that flow between its many different subsystem. Information are analysed and translated into citizen's and commercial services within the smart governance operating framework designed to make cities sustainable. Further, Hall (2000) consider a smart city as

the city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, as well as the city that can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.

A Smart City consists of not only components, but also of people. The European Union focuses at: "*Securing the participation of citizens and relevant stakeholders in the Smart City is therefore another success factor. There is a difference if the participation follows a top down or a bottom-up approach. A top-down approach promotes a high degree of coordination, whereas a bottom-up approach allows more opportunity for people to participate directly*." (Manville et al., 2017).

As stated before, there are many definitions of smart cities, while main elements are focused at two categories: input (activities) and outputs to implement a smart city, and objectives to reach implementing smart city solutions.

3. KEY DIMENSION REQUIRED FOR EFFECTIVE DEVELOPMENT OF SMART CITIES

Among the literature that is exploring smart cities, crucial dimensions are numerous. However, there are three dimensions that are standing out: technology, people and community. When referring to the technology dimension, there are different terms used: wired city, information city, ubiquitous city, digital city and intelligent city. An older term „wired cities", according to Duttton et al. (1987) were characterized as new sociotechnical systems, representing a complex and interdependent social and technological arrangements. However, Hollands (2008) argued that wired city is not necessary smart, but it means that it only contains cable and connectivity. Hollands (2008) warns at possibility that the smart city label can ideologically mask the nature of the underlying changes in cities, and it can represent an obstruction toward progressive urban change (Hollands, 2008). The term "information cities" is referred to "*an digital environments collecting official and unofficial information from local communities and delivering it to the public via web portals are called information cities*" (Anthopoulos & Fitsilis, 2010). The term „ubiquitous city" represents an extension of digital city concept and it refers to a city or region with ubiquitous information technology (Anthopoulos & Fitsilis, 2010). Digital city has social, cultural, political, ideological and theoretical dimension and it is as a comprehensive, web-based representation, or reproduction, of several aspects or functions of a specific real city, open to non-experts (Couclelis, 2004). According to Komninos (2011): "*Intelligent cities are territories with high capability 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*". It should be mentioned that there is a fundamental difference between intelligent and digital city. Intelligent city puts an emphasis on crossing of human and social capital, as the most valuable assets with digital city characteristic (Moser, 2001) that involves every function of the city such as work, housing, movement, recreation, and environment (Komninos & Sefertzi, 2009). So, while intelligent city characterizes a city that has the ability to support learning, technological development, and innovation procedures, it can be concluded that every digital city is not necessarily intelligent, but every intelligent city has digital components (Komninos & Sefertzi, 2009). Some authors (Odendaal, 2003), have a different view about benefits of use of information and

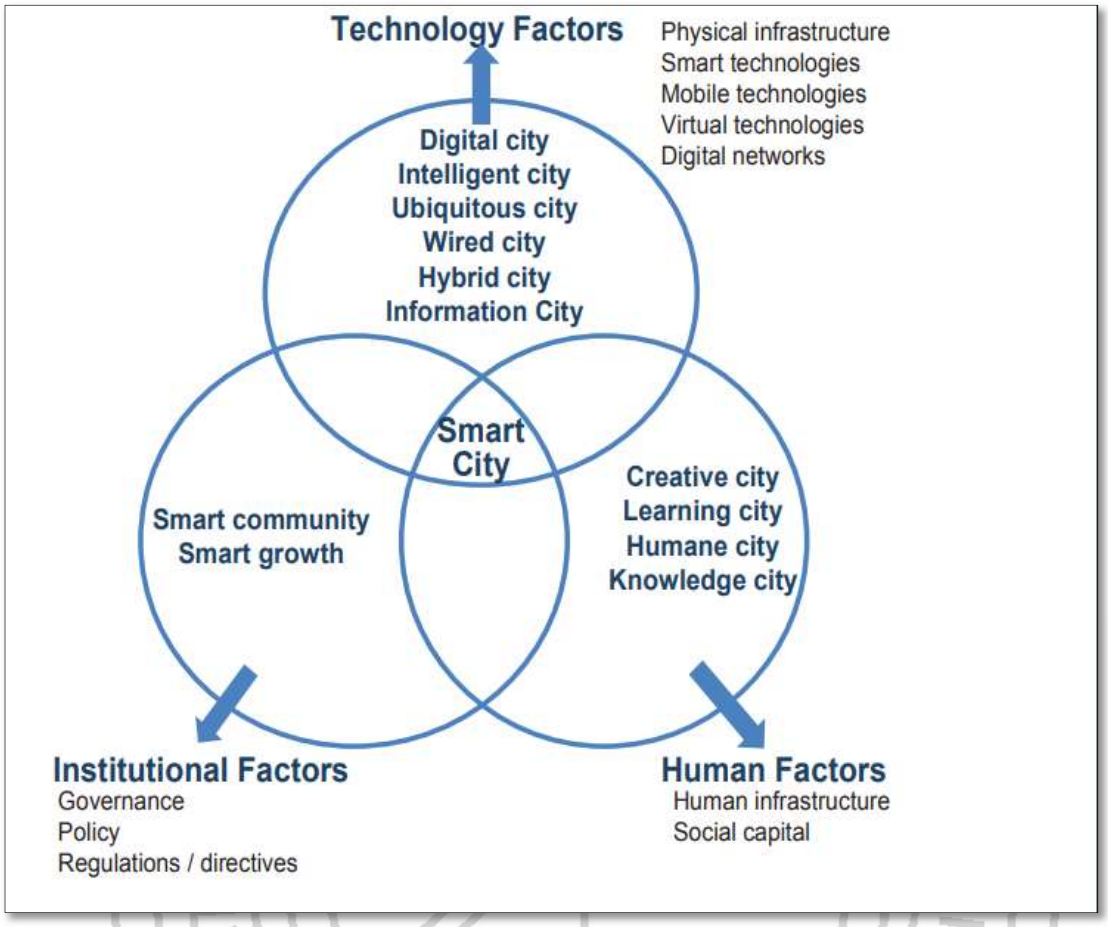
communication technology, stating that their impact is still unclear since it can increase inequalities and promote a digital divide. As possibly challenges of using technologies were outlined (Ebrahim & Irani, 2005) in the following: IT training programs, lack employees with integration skills and culture, lack of cross-sectoral cooperation, lack of inter-departmental coordination, unclear vision of IT management, politics and culture issues.

Dimension "people" refers to creativity, education, learning and knowledge, as key drivers that have central importance to smart city vision (Nam & Pardo, 2011). Creative occupations and workforce, knowledge networks, voluntary organizations, crime-free environments, after-dark entertainment economy are creativity elements for smart city development (Florida, 2003).

Smart city should be a center of higher education (Winters, 2011) and consequently it should have large number of skilled workforces (Alfred & Glaeser, 2005). Learning city is the factor that improves the competitiveness of city (Plumb et al., 2007) and is actively involved in building a skilled information economy workforce (Moser, 2001). Very similar to the term "learning city" is a "knowledge city" that implies "a city that was purposefully designed to encourage the nurturing of knowledge" (Edvinsson, 2006) and it is related to knowledge economy (IBM, 2010).

According to relevant literature, the institutional dimension refers to term "smart community". Smart community can be defined as a community broadly ranging from a small neighbourhood to a nation-wide community of common or shared interest, whose members, organizations and governing institutions are working in partnership to use IT to transform their circumstances in significant ways (Canada, 1998). The key role in smart community belongs to the governance (Chourabi et al., 2012), especially electronic governance (Paskaleva, 2009), since there are huge amount of data obtained from informational and communication infrastructure that need to be analysed and used for smart city benefits. However, some authors warned about possibility of misusing of these data and in the worst case scenario the emergence of technocratic governance (Kitchin, 2014). Related to this issue, Hoque (2012) suggested an algorithm-processed governance, as a protection against ethical claims of unclear decisions.

***Figure 1**. Main components of smart cities*



Source: Nam & Pardo (2011)

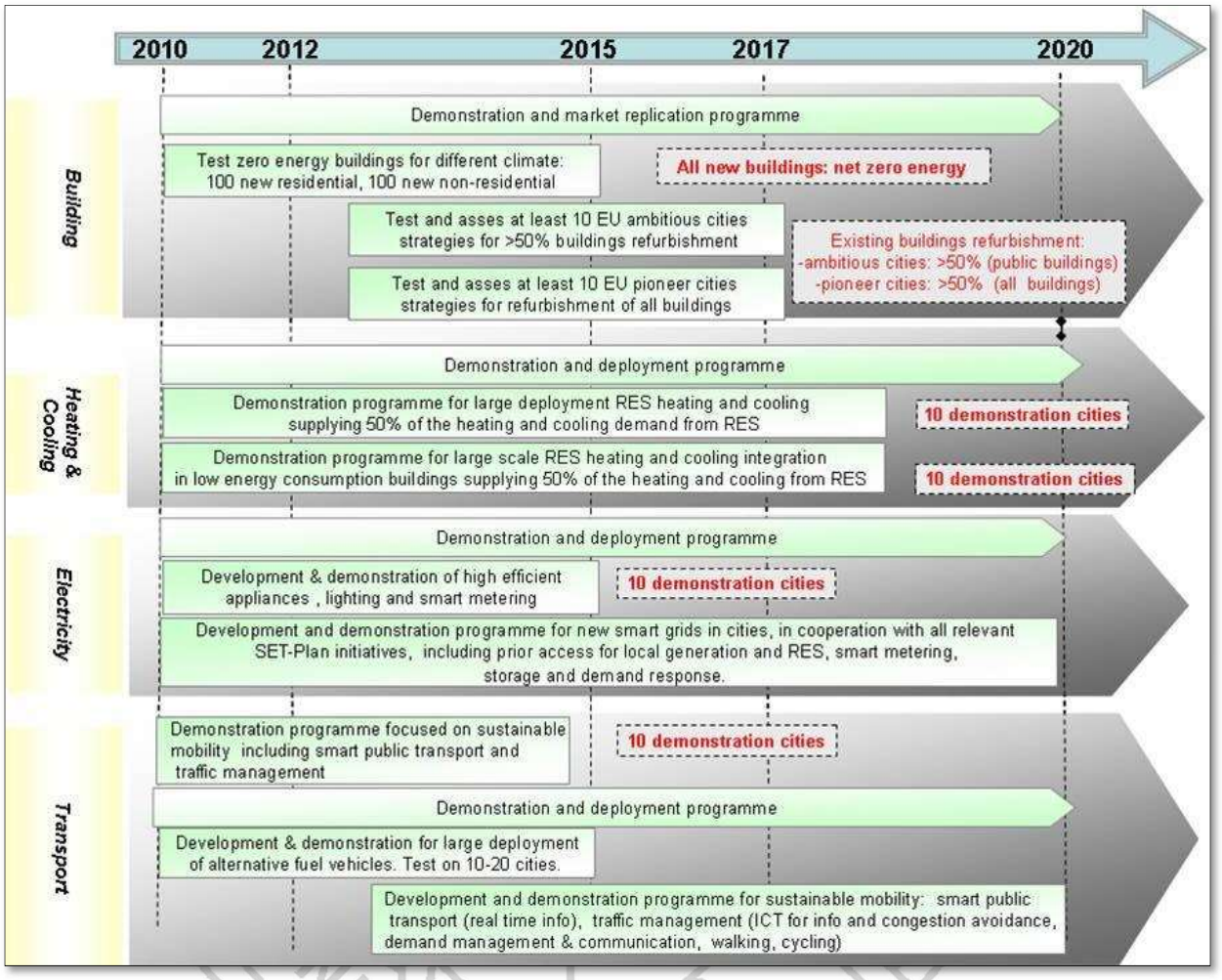
Based on previous analysis of literature, key components of smart cities can be simplified into three main factors (Figure 1): technology that includes infrastructures of hardware and software, human factor that comprises creativity, diversity, education and institution included in governance and policy. It can be seen that the smart city is placed at the intersection of investments in human and social capital, where IT infrastructure supports sustainable growth and improve a quality of life, through participatory governance (Caragliu, Del Bo, & Nijkamp, 2009). Finally, it is necessary that a smart community consciously decide on use of the technology as a mean for development and satisfaction of its social and business needs (Eger, 2009) by smart institutional preparation and community governance. Johnston and Hanssen (2011) think that smart governance depends on the implementation of a smart governance infrastructure that should be accountable, responsive and transparent (Mooij, 2003).

4. SMART CITY CONCEPT IN CROATIA

The Republic of Croatia, as a member of the European Union is obliged to follow the recommendations contained in a series of documents and conclusions as well as sources of available funding available to the European member states.

Figure 2 shows the 'technology roadmap', with the focus on buildings, heating and cooling, electricity and transport - technologies that aim to improve the environment and therefore does not include all aspects of the Europe 2020 targets.

***Figure 2**. European initiative on the Smart Cities technology roadmap*

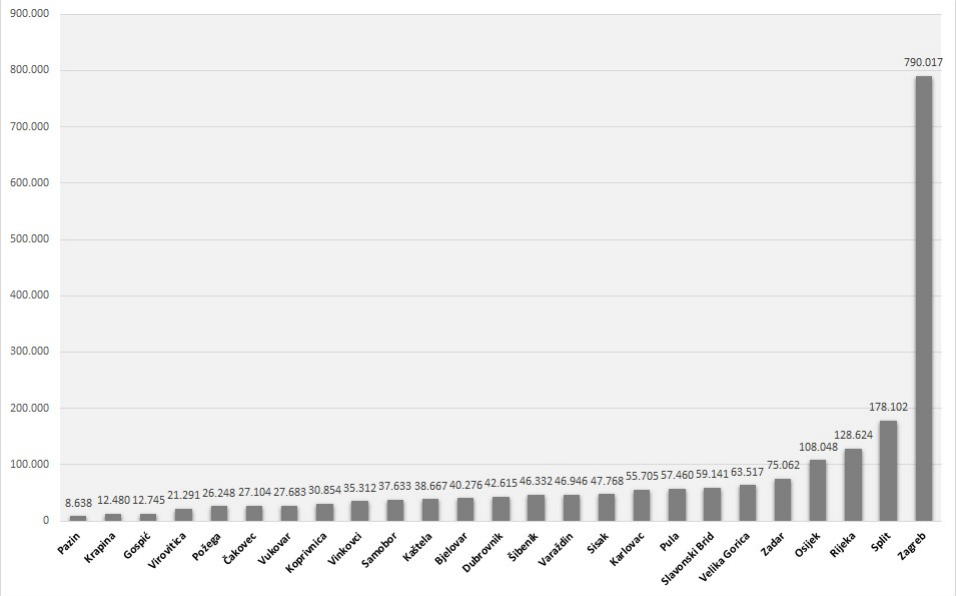


Source: Setis-EU (2012)

As can be seen (Figure 2), European initiative on the Smart Cities will support cities and regions in taking measures to progress towards a 40% reduction of greenhouse gas emissions, through sustainable use and production of energy by 2020. Systemic approaches and organisational innovation, encompassing energy efficiency, low carbon technologies and the smart management of supply and demand are required, with in particular, measures on buildings, local energy networks and transport, as the main components of the Initiative (Setis-EU, 2012).

There are 128 cities in Croatia and the latest data are showing that 59% of the Croatian population lives in urban areas. It is expected that 62.6 % of the population will be living in cities by 2025 (Croatian Bureau of Statistics, 2017). The next graph is showing number of people living in cities that are county centres in Croatia (Graph 1).

***Graph 1**. Number of people living in large cities, county centres in Croatia*



Source: authors based on Croatian Bureau of Statistics (2017)

Research covering smart city situation in Croatia are just a few. The most recent one is performed by scientists from The Institute of Economics Zagreb (Jurlina Alibegović, Kordej-De Villa, & Šagovac, 2018). It is based on the methodology developed under the European Smart Cities project (Giffinger et al., 2007). According to this methodology (Giffinger et al., 2007), there are six dimensions of the smart city concept:

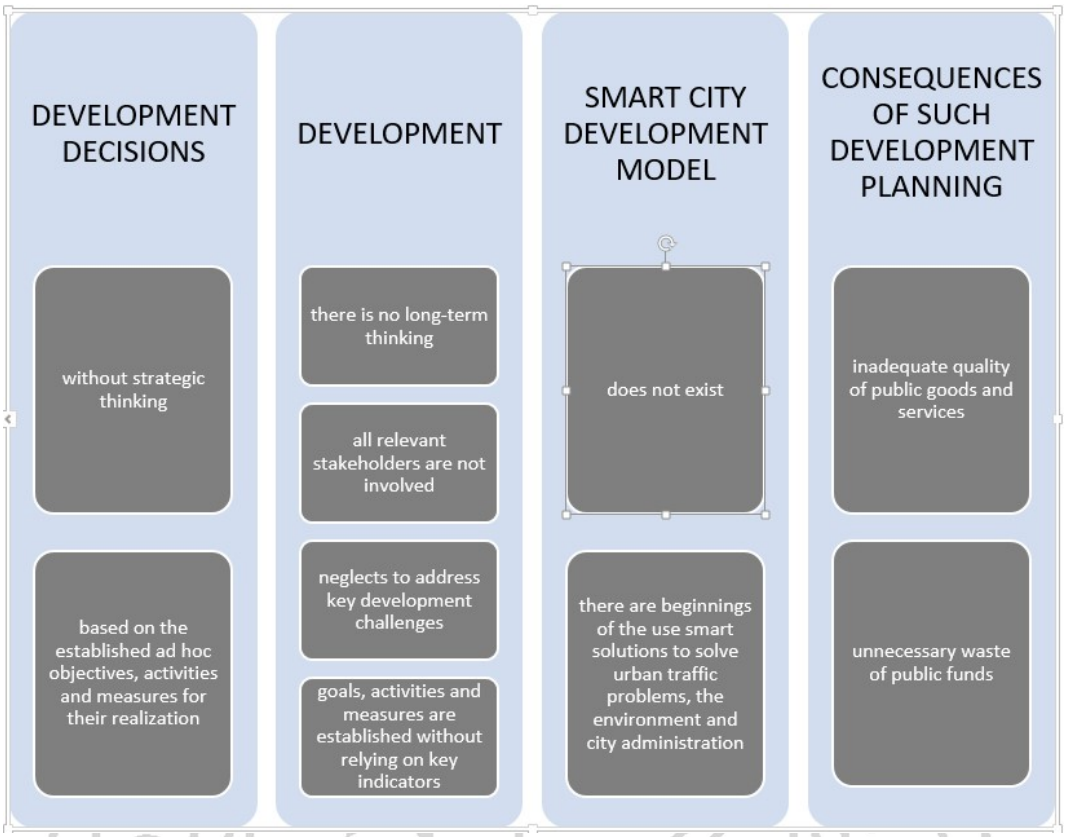
1. smart economy
2. smart people
3. smart governance
4. smart mobility
5. smart environment
6. smart living.

The smart economy is referring to innovation, entrepreneurship, trademarks, productivity and flexibility of the labour market and integration in the national and international market, while smart people dimension includes the level of education of citizens, the quality of social interactions regarding integration and public life and openness towards the world. Smart governance consists of political participation, services for citizens and functioning of city administration. Smart mobility involves local and international accessibility, the availability of information and communication technologies, modern and sustainable transport systems. Smart environment encompasses the natural conditions such as climate, green spaces, pollution, resource management and environmental protection, whereas smart living refers to the quality of life in different areas such as culture, health, safety, housing, tourism, etc. (Giffinger et al., 2007).

The City of Dubrovnik has developed The strategy of smart city called “The smart city – Dubrovnik”. It consists of several key smart city projects: “Smart parking” that ensures checking of availability of parking spaces covered with sensors, using Android, iOS and web

applications. Further, „Smart Sprinklers“ includes the first public park in Dubrovnik which incorporates the latest Internet of Things technology for smart irrigation. „Solar Bench“ project is enabling charging of smaller electrical devices like smartphones and tablets, while „Dubrovnik Card“ is an application that offers information about certain benefits on products and services within “Dubrovnik Card”, like free entrance to museums, galleries, bus rides, discounts at restaurants and so on. There is also a project called „Dubrovnik Eye“ that enables citizens to report communal issues that they spot in the city by using web and mobile applications (City of Dubrovnik Development Agency, 2015). The City of Zagreb has no smart city strategy but only “The Framework strategy of the smart city” that focuses on the following strategic areas (The City of Zagreb, 2018): digital infrastructure, efficient, transparent and smart city administration, smart energy management and communal services, education, economy and sustainable urban mobility. Regarding the other cities in Croatia, there are about thirty cities that has developed some smart projects. So, Gospić, Otočac, Karlobag, Senj, Osijek, Slavonski Brod, Koprivnica and Karlovac have “Traffic and Urban Mobility and Public Bicycles” project. Zagreb offers the possibility of car sharing or driving while the town of Krk and the municipalities on the island of Krk are managing island services as parking lot monitoring system, maintenance records of waste, electric car charger and LED lighting. City of Zagreb and town Osijek have solutions for monitoring of public transport and the City of Zagreb and towns Osijek, Rijeka, Velika Gorica, Koprivnica, Pula offer an overview of traffic and tourism trends. There are energy renewal and energy efficiency solutions in towns Sisak and Labin and solutions to support entrepreneurial climate with the proven transparent operation of city administration and openness to entrepreneurs in Pula and Ivanec. Town Umag has a project for an introduction of sustainable and ecological communal infrastructure that includes reduction of exhaust gases, use renewable energy sources, remediation of old waste dumps and construction of modern sorting ecological awareness of citizens (Jurlina Alibegović & Šagovac, 2015).

Figure 3. *Current obstacles in implementation of smart cities in Croatia*



Source: authors, based on Jurlina Alibegović & Šagovac, (2015)

According to Jurlina Alibegović and Šagovac (2015), there are several obstacles to the smart city development in Croatia, as shown in the above figure (Figure 3). It can be concluded that the main obstacle represent the absence of proper analysis of current situation and making decisions that are not based on strategic long-term thinking. Also, there is an urgent need to incorporate smart solutions at all municipal levels in Croatian cities.

CONCLUSION

World's, as well as trends in Croatia, are showing that the number of inhabitants living in cities is constantly growing. It is expected that the 70% of the total world's and 80% of total European's population will live in cities by 2050. This situation is placing significant challenges to the city's management institution. The obvious solution for achieving maximum living standards and the quality of life of the city population in the form of an implementation of a smart city model, was proved to be a necessity. At the European Union's level, there are several policies and initiatives in place that are promoting development of smart cities, and Croatia, as a member of the European Union is obliged to follow all these polices and initiatives. According to the European Commission, smart city should be a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business, including a better resource use and less emissions, smarter urban transport networks, upgraded water supply and waste disposal facilities, more efficient ways to light and heat buildings, more interactive and responsive city administration and safer public spaces and meeting the needs of an ageing population as well. The paper

provided a framework for understanding the concept of smart cities through an overview of scientific literature, examples of good practice, and a detailed analysis of the state and degree of development of smart cities in the Republic of Croatia, with a focus on key dimensions of smart city development. By using mixed method that involves the collection, analysis and integration of quantitative and qualitative research, it was proven that investing in the key dimensions of a smart city: population, technology and institutions generates revenue growth, economic development and the better quality of life of city population. It was shown that the situation in Croatia, regarding the implementation of smart cities, is not satisfactory, since Dubrovnik is an only town that has developed smart city strategy and the City of Zageb is still in the process of developing the framework for smart city. As the main obstacles in Croatia were noted the absence of proper analysis of current situation and making decisions that are not based on strategic long-term thinking.

The paper provided a framework for understanding the concept of a smart city, point out to the advantages of such management mode, as well as the key dimension to be invested in, to boost the economic development and quality of life of the dominant, city population and emphasized the urgency of incorporation of the smart solutions at all municipal levels in Croatian cities.

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