Smart cities: the analysis of ICT use in improving the quality of urban living

Ljiljana Zekanović-Korona

Department of Tourism and Communication Sciences
University of Zadar
Franje Tuđmana 24i
ljkorona@unizd.hr

Jurica Grzunov

Department of Tourism and Communication Sciences
University of Zadar
Franje Tuđmana 24i
jgrzunov@unizd.hr

Abstract. *Due to a sloppy implementation of the development strategy Croatia is constantly falling behind the developed Western countries regarding the technology development. Namely, the ICT experts sorted out the problems and proposed the first e-strategy but the majority of the proposed objectives have not been achieved yet due to a profound economic crisis and numerous other social and political factors.*

Although the digital economy features seven times larger growth rate than the traditional economy, its full potential has remained unused thanks to unevenly structured European political framework. Generally, European countries are still lagging behind other developed countries when the related and reliable networks are implied that in turn support economies and consequently our business and private lives. In the year of 2010, EU commenced a strategy based on which high rates of employment and productivity shall have been achieved by 2020. Five long-term objectives have been set accordingly concerning employment, innovations, education, social engagement and climate/energy. The member countries adopted their own national interests but all actions taken at the national levels have to support the strategy so that the set objectives are achieved. The objectives should lead to the development of new technologic, organizational and logistical solutions aimed at enhancing the quality of life and satisfaction of citizens.

This paper analyses the use of the advanced ICT for the purpose of enhancing the quality of life and satisfaction of citizens. The basic idea of the whole strategy was to improve the quality of life in all of the cities (big and small) with minimal environmental costs, using ICT as a stronghold to all of the changes. The target group of the research comprises the citizens who are the users of e-business services and the ICT solutions of public companies controlled by their respective cities in the Republic of Croatia. The results of the research relate to an online research based on 20 closed type questions by means of which it is to be found out to which extent the citizens are familiar with the smart cities concept and whether the level of quality of life and satisfaction is higher when the citizens of smart cities are implied.

Keywords. ICT, E-business, satisfaction, quality, smart cities, smart solutions

1 Introduction

For the last 50 years or so, the trend of concentrating the world population in cities has been on a constant rise. There has been an increase from about 50% of urban population in the 1950s to 75% of EU population living in urban areas in 2010; moreover, in accordance with the UN estimations, the percentage will rise to 85% over the next 40 years (Fig. 1 shows the percentage of EU inhabitants living in cities and the urbanization forecast by the year of 2050). (Caragliu et al., 2011)
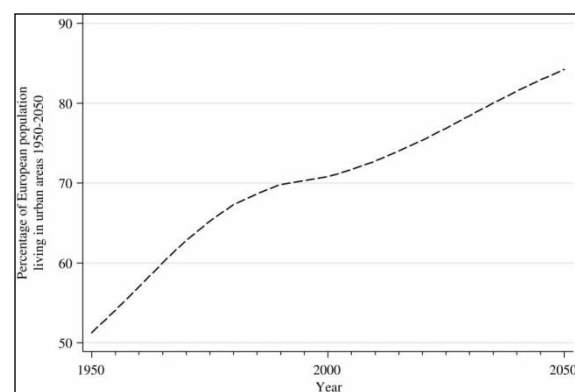

Figure 1. Percentage of EU population living in urban areas, 1950-2050 (forecast), Source: UN (2009)

The cities in which more than a half of the world population abides use over 80% of available natural resources (energy, water, food…). The increase in the number of cities and megacities and the people living in them has posed new problems. The problems of waste management, lack of resources, air pollution, traffic jams and inappropriate and outdated infrastructure have arisen as the basic technical, physical and material problems. Beside these

problems, there are as well the problems of social and organizational sorts (Chourabi et al., 2012). The importance of a prompt solving of these problems made many towns worldwide to look for "smarter" ways of managing the very cities and this requires the use of the contemporary technologic solutions.

Among the most important technologies are no doubt the Internet and the broadband network technologies that have become the pillars of the urban development (Schaffers et al., 2011).

Within this context, a smart city can be defined as a city in which the ICT is teamed with the traditional infrastructure, i.e. the towns that are managed with the help of the new digital technologies. The smart city concept has appeared in last decade as a fusion of ideas of enhancing the functioning of the cities by the use of ICT, increasing their efficiency and competitiveness, providing new solutions for the problems of poverty, social deprivation and bad life environment (Batty et al., 2012).

Generally, however, there is not a commonly-agreed definition of smart cities.

2 Smart cities in Europe

Due to various strategic reasons, numerous cities in the world have been continuously making efforts to increase their productivity in numerous fields. A special accent is therefore put on economy, living conditions, mobility, governing structures and human resources.
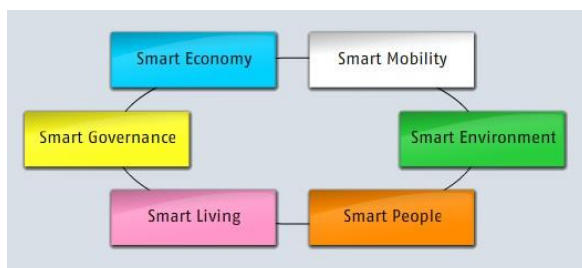

Figure 2. Characteristics of a smart city,
Source: http://www.smart-cities.eu/model.html

The development of "smart cities" is related to the use of ICT and all other conceivable technological improvements and it has to be specially opened to the social and emotional components of the life of an individual. The life in smart cities should be organized in a way that it, like a magnet, attracts the high-quality people, the best companies and the latest technological achievements. The quality of life in "smart cities" should make young people stay, especially young talented people. The objective of the management of a smart city should be to give a rise to the level of satisfaction of citizens and the quality of life providing at the same time for the safety of the collected data.

The pace of the development of "smart cities" in future strongly depends on the digital development. The concept of a "smart city" intertwines the human behavior with a large quantity of data and technology. Smart solutions based on ICT should not be imposed, they should rather gain upon the hearts of the citizens with their simplicity. The "smart city" issue falls into the domain of the mutual competitiveness of cities. The citizens want a good ratio of costs and quality of living in the cities of this kind (Medved, 2016).

Table 1. Top ten smart cities in Europe,
Source: http://www.smart-cities.eu/

Country	City	Economy	People	Governance	Mobility	Environment	Living	Total/Rank
LU	Luxembourg	1	2	13	6	25	6	**1**
DK	Aarhus	4	1	6	9	20	12	**2**
FI	Turku	16	8	2	21	11	9	**3**
DK	Aalborg	17	4	4	11	26	11	**4**
DK	Odense	15	3	5	5	50	17	**5**
FI	Tampere	29	7	1	27	12	8	**6**
FI	Oulu	25	6	3	28	14	19	**7**
NL	Eindhoven	6	13	18	2	39	18	**8**
AT	Linz	5	25	11	14	28	7	**9**
AT	Salzburg	27	30	8	15	29	1	**10**

The use of information and communication technologies is possible in several fields: traffic, health care, education, public health protection, city government, "smart building" projects and waste management. In "smart cities", the stress is on the development of and connection among the following elements: economy, people, management, mobility, environment and living. The main advantage of the modern cities is people featuring their knowledge and skills allied with the networked infrastructure. At the global level, various priorities in the development of smart cities have been set: in North America, it is smart networks; in Europe, it is regeneration and sustainability; in Asia it is more about urbanization issues and e-management whereas in Latin America the priority is upgrading the transportation (Burazer, 2013).

In Croatia, the ICT solutions have been used in the process of production and distribution of electricity and in upgrading the energy efficiency in buildings, industry and transport. The solutions of the kind bring both the economic profit and a significant reduction in environment pollution. The data model should be brought into conformity with the ICT network architecture in order to be able to provide for the requirements of various services. Broadband systems

should provide for the exchange of a large quantity of data among the producers and consumers and for their interactive communication. The city subsystems such as electricity and water supply systems, transportation management and city services depend to a large extent on the connection and communication provided by the ICT. Clever networks integrate these city subsystems and provide for them to be managed and monitored from a single location, which facilitates the works and reduces the costs of managing the subsystems.

All the city subsystems are optimally managed by means of the ICT. For example, smart meters monitor and record the current consumption of electricity, gas or water and send data on consumption from a certain source via a communication network, the terrestrial or the mobile one. The advantage that the citizens experience from clever meters are the precise bills for certain periods of time and that can lead to optimized consumption. With the help from the smart meters, the distributors of a certain energy source can offer special price rates to certain consumers and that will eventually end up in a rational consumption mode regarding certain energy source and this will in turn reduce the adverse effects on the environment and people's health. M2M (machine to machine) communication is applied for the purpose of increasing the effectiveness of some processes and systems. By means of the use of ICT, the process of communication among various objects within a system has been spreading rapidly through the global network. There are four processes in the root of any M2M communication application:

- Collecting data
- The transfer of data through the communication network
- Data processing
- The response to the appropriate information. (Burazer, 2013)

The intelligent wireless data modules are built into the monitored devices and the collected data is sent through the telephone lines, the terrestrial wireless system or the satellite communication network to a monitoring center in accordance with the schedule. The final objective is to provide the needed data at the right time for the users who make optimal decisions. What influences the change of the existing process of communication and production at all levels, ranging from local to global, is the "Internet of Things", i.e. the unique common intelligent network that connects M2M communications via the Internet (Zanella et al., 2014).

In big cities, transportation has become an ever-growing problem because the use of a huge number of cars and other vehicles that run on fossil fuels cause increased air pollution and greenhouse gasses emission. There are traffic jams as well that cause delays and make the time spent on travelling too long; consequently, there is a large rate of absence from work. If workers are late for work or if they are absent

from work, it affects the production processes and all other activities in big cities. The ICT used in the process of production of cars intended for advancing the communication among cars (V2V - Vehicle to Vehicle) and among cars and the infrastructural network (V2I - Vehicle to Infrastructure) provide for various solutions of compensation for the traffic jams consequences. One of the traffic solutions for big cities is the implementation of so-called intelligent transportation systems.

What the "smart cities" expect from the intelligent transportation systems in real time is:

- Redirecting the traffic by means of optimizing traffic routes
- Providing for a simple choice of various means of transportation
- In line with the transportation requirements in big cities, there will come changes in the production of vehicles in which new functions will be installed
- The flow capacity of persons and goods in transport will increase

In accordance with the 2014 data, there are about 6.5 million of inhabitants in Rio de Janeiro and the traffic bottlenecks have been reduced by 22% since an intelligent transportation system was utilized. Other big cities have become "smart towns" as well and utilize various ICT solutions to solve the problems generated from too high a concentration of people in one place. The ICT as the fastest-growing sector is in service of "smart cities" and applications have been developed for "smart cities" for variety of transport needs such as announcing the time of arrival of a bus, streetcar or other public means of transportation to the station, reservation of places in public garages, redirecting the traffic for jams to be avoided as well as monitoring the smart public lighting, waste management, energy sources consumptions, city guide etc. Applications have been developed as well for "smart tourism" as well and they collect data on the preferences and habits of guests (a hotel issues a card to a tourist and thus all activities and expenses are monitored). Dubrovnik is an example of a city that has envisaged a "smart city" strategy for the period up to 2020. A smart street was equipped a short time ago and it features a smart parking system, smart public lighting, weather sensors and a security street surveillance system (Medved, 2016). Besides a free wireless Internet connection for guests, there will be smart lights available and smart cards valid for one, two or seven days based on which discounts are offered at restaurants and museums. In the course of creating the strategy, the opinions and suggestions of citizens were taken into account and this was the way of creating the final solutions.

In our region, the idea of CityHub has been proposed where CityHub will integrate all systems (waste, energy sources, traffic problems etc.). CityHub mobile application is the product of a Croatian company and it was developed in cooperation with

the Town of Osijek and it thoroughly changes the way in which citizens communicate with city companies. The development took some seven months at the cost of more than 100 000 kn. The citizens of Osijek anonymously report the public utility problems via smart phones. If they want to get a response, they should sign in by means of any of social networks. When a problem is encountered, it is to be photographed and then the application records the data on the report and the service moreover records the geolocation, the time, the description of the problem and the photograph. This all is in turn forwarded to the administrator and then to the city service in charge. The citizen receives the response via their registered user account. (www.tzosijek.hr, 2015)

This application functions as a cloud solution and its advantages are the ability of a quick integration into any city by means of changing the settings, a low price of implementation, a simple and quick upgrading and its 24/7/365 availability.

The application:

- Enhances the communication among citizens and public services
- Increases the transparency of public services (on what is the tax payers' money spent)
- Optimizes the work of bobbies (up to 80 %)
- Enables the cooperation among the city companies
- Makes all communications situated at the same place.

The idea of CityHub application originated in 2012 and as of today, the application is utilized in 5 countries (Croatia, Hungary, Germany, Austria and Slovenia) in the total of 33 cities.

The research done among the CIGRA university-trained electrical engineers in the course of the 12th Conference in Šibenik shows that the outdated infrastructure and the outdated regulations are the biggest obstacles to a rapid development of the energy system in Croatia; moreover, there are as well difficulties arising from a shortage of knowledge on the part of employees (Tomić, 2016). The experts in the field of energy are not unanimous as to their assessment of what new technologies should be invested into. The majority of them would invest into smart networks and energy efficiency first and then into the storage of energy and the renewable energy sources. The results of the research are as expected and in line with the EU public bids and proposals that encourage the investments into the energy efficient refurbishment of buildings, the construction of energy-saving buildings and into the renewable energy sources.

The electrical engineers are highly skeptic as to the rapid pace of implementing the smart cities concept for which the smart networks are a prerequisite. Only 4% of the surveyed think that Zagreb could become a "smart city" until 2020 whereas 33% of the surveyed think it will happen over a 20 or 30-year period. In

Zagreb, a system has been implemented that manages the hot water supply and heating water supply from heating plants. Figure 3 shows benchmarking results for Zagreb whereas Figure 4 shows the results for Luxembourg which is the best-ranked "smart city"; Figure 5 shows the comparison of the results for some cities in EU.
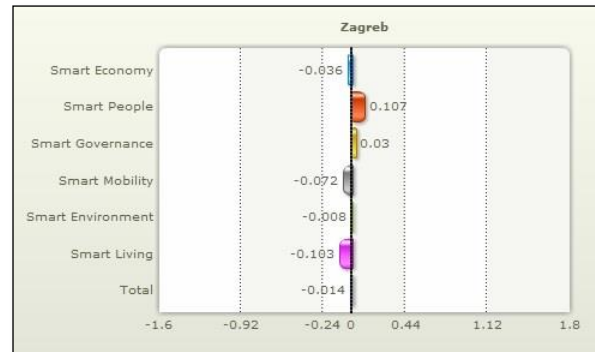

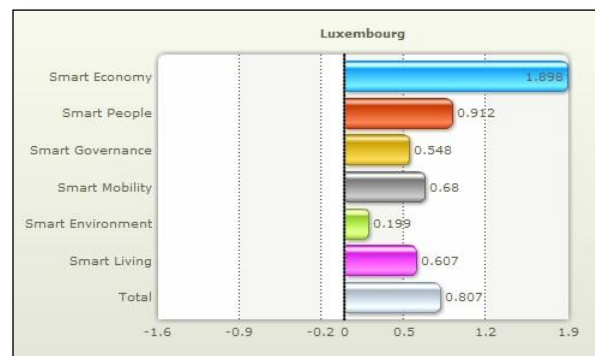**Figure3.**"Smart city" profile results for Zagreb; Source: http://www.smart-cities.eu/city.php?id=43

Figure4."Smart city" profile results for Luxembourg; Source: http://www.smart-cities.eu/city.php?id=15
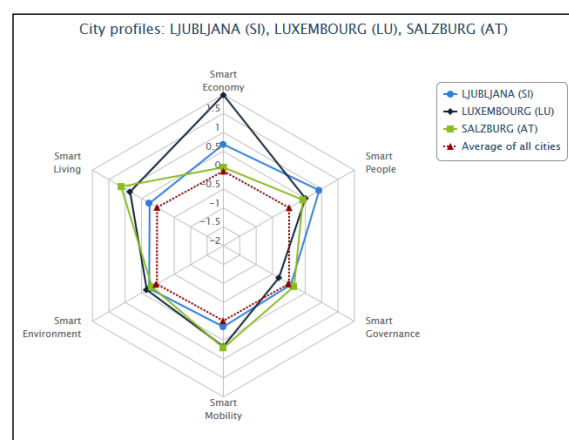
Figure5.A benchmarking example for some EU cities(European Smart Concept ties 3.0, 2014), Source: http://www.smart-cities.eu/

Among the citizens of Croatia, there is a rise in the trend of implementing smart solutions such as producing own electric energy and placing

solar/photovoltaic panels on roofs. The return of the invested money is possible in 3 to 5 years. Similarly, the infrastructure to support electric cars is as well being invested into and there are as well state subventions for the purchase of electric cars.

The implementation of smart solutions and shifting to the sustainable energy sources are long lasting processes and it is hard to assess when the investment will pay back as the use of renewable energy sources depends on the geographic position and weather conditions. In EU, there are positive examples of cities that have diminished the energy dependence and enhanced the city network and thus reduced the adverse effects on the environment. Barcelona is a "smart town" that smartly manages the traffic and parking by means of the Internet of Things technology (Žganec, 2014). Besides the energy management, water supply systems are important as unnecessary expenses could be cut in this realm as well. For example, smart sensors installed in the system could detect failures in the pipe system, i.e. the losses due to an uncontrolled leakage of water could be detected. The solutions of the kind improve the quality of the public utility company service system and the feeling of satisfaction of citizens. The modern systems, moreover, can provide safety for citizens by means of preventing the potential water pollutions (Hancke et al., 2013).

3 Questionnaire methodology

The objective of this research was to analyze the opinions of the citizens of the Republic of Croatia on the quality of living and the use of ICT and other advanced technologies in the function of improving the quality of life in Croatian cities.

The survey was conducted among a quasi-random sample of 212 respondents in Croatia (112 females, i.e. 52.83% of the sample and 100 male respondents, i.e. 47.17% of the sample). The questionnaire, which consisted of 20 questions (mostly closed type with multiple choice answers) examining the opinions of the citizens of Croatia regarding the quality of life in bigger cities in Croatia, was distributed online via social networks in period from February to April 2016. The results obtained by this research are not statistically relevant but serve mostly as a motivation for further research.

4 Results and discussion

The analysis of the results shows that the majority of subjects are aged 18-29 years (60.85%), followed by those of age 30-39 years (20.75%). More than one third of the subjects live in the Međimurje county (38.21%, mostly in Čakovec), followed by those from the Zadar county (33.49%, mostly in Zadar), and a smaller number of those who live in Zagreb (7.08%) and in Osijek (6.13%). Only a small number of citizens from other cities answered the questionnaire. Furthermore, 53.77% of the subjects are students, while only 37.26% percent have finished some form of higher education. Accordingly, only 40.57% of the subjects are employed or self-employed, while the rest of them are still in high school/college (54.72%) or unemployed (4.72%).

One of the more important questions was the one investigating the extent to which the citizens of Croatia are familiar with the term "smart city". Thus, the question was structured as a multiple choice type question and the answer options included the option of not being familiar with the term at all and it was chosen by almost 10% of the surveyed. The majority (over 60%) considers that a smart city should take care of the quality of life of its citizens, that it should be fully covered by a free Wi-Fi signal and that the system of providing information to citizens should be a quality and transparent one. Among the more frequent answers, there are ones dealing with the quality of being informed (55%), the infrastructural save of energy (54%) and water (44%) and the strategy of the development of the ICT systems at the city level. Almost a half of the surveyed think as well that a city should encourage the production of its own energy (50%) and, among other things, to do it by stimulating the use of photovoltaic panels (45%). Similarly, the majority of the surveyed think that a city, if dubbed "smart", should make considerable efforts in encouraging energy savings by means of stimulating the construction of energy-saving houses and flats (48%), using electric cars (32%) and energy-saving house appliances (37%) and by means of investing into energy-saving public lighting systems (32%). As to other answers to be pointed out, there are ones highlighting the necessity of implementing traffic problems-preventing systems (35%) and the intelligent systems for reserving parking spaces. Finally, almost a half of the surveyed (45%) think that web pages of smart cities should offer simple and functional templates for communication with citizens. The same question was analyzed in accordance with the cities in which the research was conducted, namely the cities from which at least ten people were surveyed. It is obvious from the results that the surveyed from Zagreb and Osijek are more familiar with the "smart city" term and its respective characteristics (from 50% to 90%) than the surveyed from Zadar and Čakovec (from 20% to 50%); the reason for that can partly lie in the assessment of the quality of being informed that in turn were subjected to a further set of questions. Namely, the quality of being informed was on average rated with 3.114 (st.dev. 0.98), where the surveyed from Zagreb (3.55) and Osijek (2.92) rated the quality of being informed higher than those from Zadar (2.66) and Čakovec (2.92).

Table 2. An excerpt from the results, Source: processed by authors

Descriptive components of a smart city	Number of answers	%
a) I am not familiar with the term.	22	10%
b) A city that takes care for the quality of life of citizens	129	61%
c) A city in which all citizens are well-informed	116	55%
d) A town featuring smart public lighting	68	32%
e) A town featuring a smart parking space reserving system	64	30%
f) A city which is fully covered with a free Wi-Fi signal.	132	62%
g) A city that provides for energy savings by means of infrastructure.	114	54%
h) A city that provides for saving water by means of infrastructure	93	44%
i) A city that stimulates the installation of photovoltaic panels on roofs.	95	45%
j) A city that encourages the production of its own energy	105	50%
k) A city that stimulates the use of energy-saving house appliances	79	37%
l) A city that stimulates the use of energy-saving electric cars	68	32%
m) A city whose companies install web newsstands for paying bills	75	35%
n) A city that has a strategy of developing information systems	109	51%
o) A city that stimulates the construction of energy-saving houses and flats	101	48%
p) A city that features a quality and a transparent system of informing the citizens	130	61%
r) A city whose web pages offer templates for communication with citizens.	96	45%
s) A city that features a developed system for avoiding traffic problems.	75	35%

The question related to the availability of information on the web pages of the city (i.e. the local management and public companies) resulted in very good marks mostly (avg. score of 3.41, st.dev. 0.99), whereas the possibility of communication with city management in their own city was rated considerably lower (avg. score of 2.75, st.dev. 1.19). Somewhat higher ratings for the availability of information on the city management web pages were given by the citizens of Zagreb (3.61) and Čakovec (3.64), whereas the ratings given by the citizens of Zadar (3.36) and Osijek (2.93) were somewhat lower. The surveyed in turn rated the care provided by the city and the quality of life of citizens (avg. score of 3.11, st.dev. 0.97) and the overall quality of life in their towns (avg. score of 3.61, st.dev. 0.94). The citizens of Čakovec gave the highest rates as the answers to these questions (3.44 and 3.81, respectively), whereas the lowest rates were given by the citizens of Osijek (2.8 and 3.26).
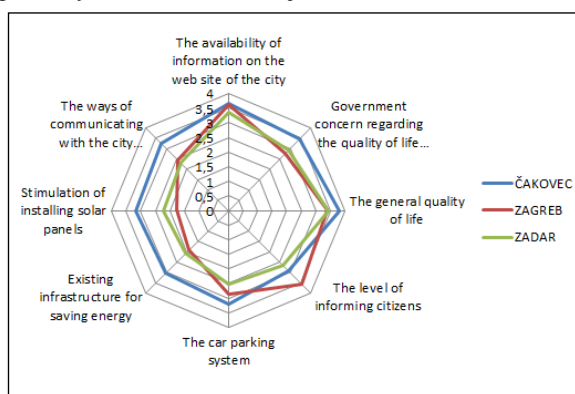

Figure6. Results for some of the bigger cities included in the research, Source: processed by authors

Regarding the various sizes of the samples of the surveyed from the afore mentioned cities, the spotted

differences in the average ratings of the care provided by the city management and the quality of life of citizens were as well confirmed by means of an F-test conducted on four series of ratings given by the surveyed in regards to the list. The result of the F-test F=5.7017, degrees of freedom=179, level of sign. 5%) confirmed that there are significant statistical differences between the ratings given to the city management as to the care for the quality of life of citizens in particular cities, i.e. the perception of citizens that is related to the extent to which city managements care for the quality of life of their citizens differs significantly from city to city. It is to be expected as well from the obtained results that there is a statistically significant relation between the ratings of the overall quality of life and the level of care for the quality of life provided by city managements. It was thus proved by means of a chi-square test (χ^2=83.74, 4 degrees of freedom – due to a relatively small sample some of the classes were joined in order to obtain better results, p=1%). In other words and based on the result of the chi-square test, it can be stated that the surveyed who give higher rates to the level of care provided by city government are generally more satisfied with the overall quality of life. Based on the answers collected from the online questionnaire, the correlation coefficients were calculated for the age, gender and education structures of the surveyed and the average ratings they gave to the smart city components based on the example of cities they live in. The obtained results do not indicate that there is a statistically significant relation between the age, gender and education of the surveyed and the particular ratings they gave for the given components. (All the coefficients calculated fall into the range from -0.25 to -0.05). Some of correlations can be seen in Table 3.

Table3. The correlation coefficients calculated for the answers to particular questions from the questionnaire, Source: processed by authors

Q1	Q2	Corr.
age	How do you rate the care your city provides for the quality of life of citizens	-0,08
age	How do you rate the overall quality of living in your city?	-0,12
Gender	How do you rate the quality of being informed in your city?	-0,11
Gender	How do you rate the parking system in your city?	-0,20
educ.	How do you rate the existing infrastructure regarding energy savings?	-0,11
educ.	How do you rate the stimulation for installing photovoltaic panels provided by your city?	-0,08
educ.	How do you rate the possibility of online communication between citizens and the city management?	-0,16

The next statistic processing followed for a set of questions related to the opinions on the existence of an information system in a city, the free Wi-Fi signal coverage, web newsstands where bills can be paid without a fee, coming across various other information and the level of development of the system for avoiding traffic problems. The results are shown in graphs in Figure 7.
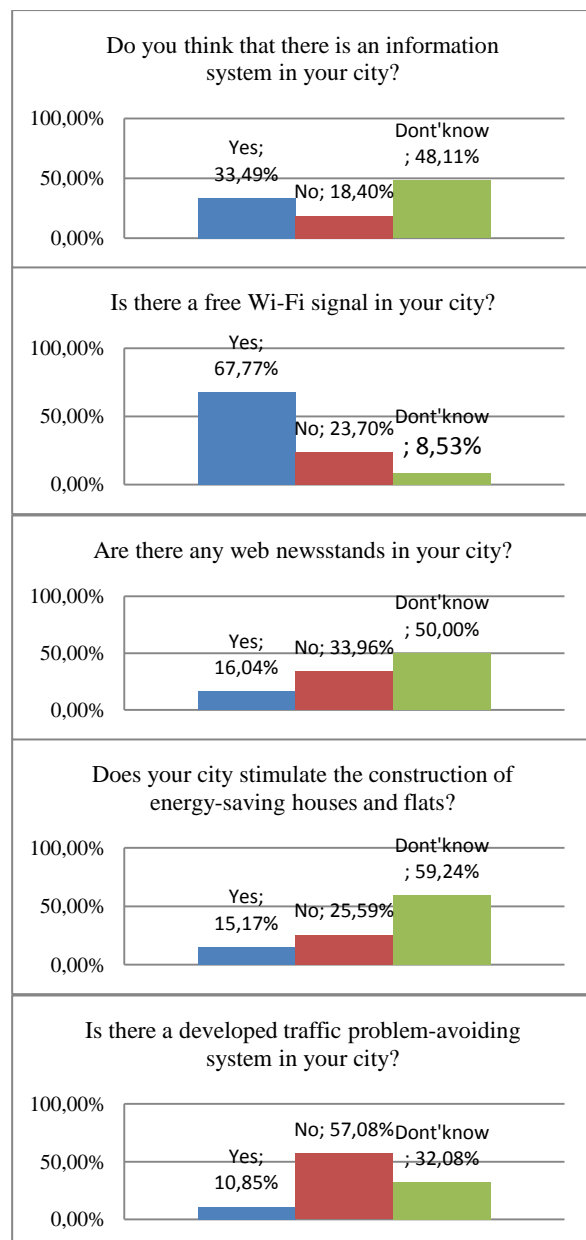

Do you think that there is an information system in your city?

Yes; 33,49%
No; 18,40%
Dont'know; 48,11%

Is there a free Wi-Fi signal in your city?

Yes; 67,77%
No; 23,70%
Dont'know; 8,53%

Are there any web newsstands in your city?

Yes; 16,04%
No; 33,96%
Dont'know; 50,00%

Does your city stimulate the construction of energy-saving houses and flats?

Yes; 15,17%
No; 25,59%
Dont'know; 59,24%

Is there a developed traffic problem-avoiding system in your city?

Yes; 10,85%
No; 57,08%
Dont'know; 32,08%

Figure7. Results of some of the questions processed during the research, Source: processed by authors

Finally, a set of questions was processed that rated the parking system (avg. score of 2.91, st.dev. 1.08), the existing infrastructure in terms of saving electricity and/or water (avg. score of 2.39, st.dev. 1.07), the stimulation of installing photovoltaic panels (avg. score of 2.41, st.dev. 1.28) as a measure for improving the energy efficiency and the sustainability of the city, and the possibility of communication with the city management (avg. score of 2.67, st.dev. 1.19). These ratings clearly show that the cities – not only these covered by this research but most likely all other cities in Croatia as well – do have opportunities for improvement and that city managements in all cities in Croatia have yet to make considerable efforts in order to improve the conditions of living in cities, which will in turn improve the satisfaction of citizens and converge Croatian cities toward smart cities. The implementation of all those improvements requires a great deal of time and quality human potentials without which the discussed advanced components are not possible.

5 Conclusion

Based on the results obtained in this research, it has been concluded that both the state and the local levels require efforts in informing citizens about the term "smart city". The citizens of Osijek and Zagreb, the cities in which, at the level of local managements, projects have been implemented that improve the quality of life of citizens by means of the use of modern ICT, are generally better informed on everything as well as on the "smart city" term. The obtained data were expected in a sense as Zagreb and Čakovec – observing on the state level – feature a higher standard of living. Zagreb as a big city has to use the latest technologies in order to solve the problems of pollution, parking schemes and traffic bottlenecks. In all cities, there are tendencies of reducing the costs of living by means of an ICT-supported control over the costs of energy sources. It is interesting that the citizens of Osijek are not satisfied yet with the quality of living in the city although the city management has been improving the communication with citizens by means of software and new technologies-based solutions. The testing has proved that there is a relation between ratings of the overall quality of life in a city and the care of the quality of life of citizens provided by the governing city structures. All the surveyed stipulate the use of ICT – to the maximal extent possible – for improving the quality of urban life. The components that constitute a smart city make the use of ICT inevitable (i.e. the construction of energy-saving houses and flats, the avoidance of traffic problems, solving the parking problems and energy savings systems). The research can serve as a roadmap to local governments if they want to turn their city into a "smart" one. Aimed at improving the quality of urban life, EU projects encourage all smart solutions as well. The results of the research show that the citizens stipulate the implementation of the smart solutions. City managements should be familiar with the needs and problems of citizens and create quality solutions supported by ICT.

References

Batty, M., Axhausen, K.W., Giannotti, F. et al. (2012)
Smart cities of the future, *The European Physical
Journal Special Topics 214, p. 481–518*

Burazer, B. (2013)
Normizacija u procesu kreiranja pametnih
gradova, *Hrvatski zavod za norme,* Retrieved from
*http://www.hzn.hr/UserDocsImages/pdf/Normizaci
ja%20u%20procesu%20kreiranja%20pametnih%
20gradova.pdf*

Caragliu, A., Del Bo, C. & Nijkamp, P.(2011).
Smart Cities in Europe. *Journal of Urban
Technology, Vol. 18, No. 2, April 2011, p.65–82*

Chourabi, H., Gil-Garcia, J.R., et al. (2012).
Understanding Smart Cities: An Integrative
Framework. *Proceedings of the 45th Hawaii
International Conference on System Sciences
(HICSS), ¸ p.2289-2297*

Hancke, G.P., de Carvalho, B. & Hancke, G.P. Jr.
(2013). The Role of Advanced Sensing in Smart
Cities, *Sensors 2013, 13, p.393-425*

Schaffers, H., Komninos, N., Pallot, M. et al. (2011)
Smart Cities and the Future Internet: Towards
Cooperation Frameworks for Open Innovation,
*Future Internet Assembly 2011: Achievements and
Technological Promises, p.431-446*

Tomić, D. (2016)
Koncept pametnih gradova i infrastrukture baziran
na IoT, *ICT Bussines,* Retrieved from
*http://www.ictbusiness.info/internet/koncept-
pametnih-gradova-i-infrastrukture-baziran-na-iot*
5.06.2016.

Zanella, A. & Vangelista, L. (2014).
Internet of Things for Smart Cities. *IEEE Internet
of Things journal, Vol. 1, No. 1, February 2014,
p.22–32*

European Smart Cities 3.0 (2014) Retrieved from
https://www.smart-cities.eu/ , 5.6.2016.

Žganec T.(2014) Igra prijestolja, Infotrend 195,p.14.

Medved,D.(2016) Kako opametiti svoj grad,
Infotrend 202,p.73