

## Modeling the smart city performance, Croatian Case

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### Abstract

*A smart city term can be considered as a buzzword used in many areas such as science, industries or governments. Since the main vision of Smart Cities is to develop urban environment using Information and Communication Technology and Internet of Things it is not important if it is a subject, an object, a goal or a tool. Everything is correct – it is a kind of asocial and ICT topic at the same time. The Objectives of this research are: to use context analysis method – SWOT to identify the factors of strategic importance to the organization; in accordance with the strategy, to implement methodologies for a set of indicators which are used to govern, measure the performance and improve the quality of life using ISO 37120 Sustainable development of communities - Indicators for city services and quality of life (hereinafter: ISO 37120); and finally, to indicate the problems and issues which appeared in collecting data process. Approach: This paper presents the data sources for ISO 37120 Smart City indicators – Croatian case: data collection methods, intervals, publication forms, public or non-public sources and many other issues. Results presented in this paper: firstly, the joint methodology of SWOT and ISO 37120; secondly, the possibility of data integration, problems and issues which occurred during the survey; and finally, the model of collecting data indicators value used in measuring the compliance with the factors of strategic importance to the company. Implications of research results for the practice to be implemented in Croatian small Smart City, at least one. Value The key contribution of this paper is the systematic research of every data source needed, the procedure of receiving data, intervals, reporting the issues discovered, raising the awareness of the need to have publicly available data, and, of course, combining SWOT with ISO 37120 methodology.*

**Keywords:** Smart City indicators, Benchmarking on indicators, Data sources for ISO 37120 indicators, Sustainable development of communities, Indicators for city services, Quality of life.

## **1. Introduction**

A Strategic approach to planning and manage the public government is more reliable if it is based on general accepted methodology (Kaplan, R. S., 2001) (Kaplan, R. S., Norton, D. P., 2000.). During the decision making process of joining the ISO 37120 family, the City government of Koprivnica has made an analysis of the current state. In the preparation for application process the City of Koprivnica as a candidate for being the first certificated small Smart City in Croatia and eighth with diamond ISO 37120 certificate in Europe, the ISO 37120:2014 gained the experience in implementing that methodology.

ISO 37120 standard sets the definitions and methodology for 100 indicators to steer and measure the delivery of city services and the quality of life. This set of standardized indicators provides a uniform approach to what is measured, and how that measurement is to be undertaken. The general character of methodology makes it applicable in small, middle or big cities as urban areas, as well as municipalities. In the future, the rural areas will be interested in implementing that methodology as well.

The indicators can be used to track and monitor a city's progress on city service performances and the quality of life and assist cities in setting targets and monitoring achievements. To achieve a sustainable development of the same community it is necessary to consider all indicators. In the process of planning for the future, the current use and efficiency of resources have to be taken into consideration in order to better plan for tomorrow.

The Analysis of the current state of cities indicators value divided in 17 areas set the basis to conduct a SWOT analysis and to make conclusions about measures and actions that have to be planned and undertaken to achieve the goals of sustainable development.

The modelling the Smart city performance was based on ISO 37120 methodology in Koprivnica City.

This paper consists of three main sections and the conclusion. The first section is divided in two parts and describes the methodology of the research explaining the extended SWOT analysis method and the ISO 37120 methodology in general. The second part is divided in two parts and it describes the implementation of the methods and the implementation results. The third part explains the research process, the impact of the ISO on the SWOT and the issues that arose during the research. Finally, the paper ends with the conclusion.

## **2. The methodology of the research**

The logical first step of the research is to establish the context to understand the organization and the environment. The SWOT Analysis Method is suggested to be performed prior to the implementation of the ISO 37120 methodology. This cycle should be performed continuously to improve the organizational performance.

### ***2.1. Extended SWOT analysis method***

The use of SWOT analysis method is suggested for context analysis. The SWOT framework was presented in 1969 and became popular among managers during 1970s because of the implemented thesis that the resources of the company could be harmonized with the environment (Autry, Bond, Harvey, Novicevic 2004). The SWOT analysis is a structured analysis matrix for categorizing the factors of organization's functioning (Dobrović & Penić 2008). In the matrix, strengths, weaknesses, opportunities and threats are analyzed, including both internal factors controlled by an organization (e.g., marketing, finances, etc.) and external factors (e.g., political and economic factors, competition, etc.) (Dobrović & Penić 2008). The environment of the company is comprised of the external factors (Threats and Opportunities) which are usually not under the short-term management control (Gonan Božac, 2008).

The way in which weaknesses and threats will be overcome and strengths and opportunities exploited depends on how effectively a particular environment is observed and appropriate solutions for perceived situations created (Dobrović & Penić 2008). The SWOT analysis represents a diagnosis of the organization's current state as well as that of the environment that the organization acts in, which explains why it is vital to recognize as many strategic factors as possible to ensure that at any given moment the organization can respond appropriately (Dobrović & Penić 2008).

The value of the SWOT analysis mainly lies in the fact that it represents self-assessment for the management (Dobrović & Penić 2008). In this paper, the extended SWOT (eSWOT) analysis was used comprising the following four phases (Dobrović & Penić 2008): 1. Determining SWOT analysis elements (strengths, weaknesses, opportunities, threats) called initial elements; 2. Ranking within a group of elements, determining the strength of their impact on attaining goals; 3. In this phase it is necessary to provide answers to the question concerning what should be done in order to use internal strengths (S) and external opportunities (O) to eliminate the activity of internal weaknesses (W) and external threats (T); 4. The final stage comprises the following three steps: - for previously defined strategies specific activities for their execution are determined; - for each predefined activity it is necessary to establish a measurable goal for determining the activity scope; - impact of particular activities on the goals needs to be determined.

### ***2.2. The International Standard ISO 37120: 2014***

State-of-the-art issues of Smart Cities are oriented to technical solutions, to IoT solutions, to applications and digital platforms for Big Data but the most important detail that has to be considered is the methodology, which should be comparable and measured in the same way.

Nowadays accessible application and platform solutions for collecting Big Data that has to be analyzed and used for making decisions and governing are focused on city info, commerce, communities, city administration, government, lodging, gastronomy and accommodation, parking and wallet. The degree of the development and implementation

around the world is presented in scientific articles about e-government mostly, because the public institutions are interested in providing their services to citizens by information-communication technology (Ivanova, N.V., 2013). Other solutions are oriented to e-inclusion and engage the citizens into participating in the process of making decisions for the city development. All of them offer to collect, store and analyze different kind of data, recognized and defined as important to lead to an important public government decisions. But, is it possible to compare cities, and to make a benchmark on those data and information? The answer is negative, because the data collected and stored in these platforms are not comparable. In accordance with that fact, it is not possible to conduct the benchmarking between cities. **Why is the benchmarking important?** It is important from the citizens' point of view in order to choose and to make decision about the improvements in that area and, therefore, to achieve a higher standard of quality of life. From the investors point of view it is important to make decision where to invest and in which projects. The data is collected by defined methodology so they are comparable and they can assure the objective base for decision-making. *That's why ISO 37120 standard is so important. It is strongly connected to Development strategy of the City of Koprivnica 2015 – 2020.* (<http://koprivnica.hr/wp-content/uploads/2014/01/Strategija-razvoja-Grada-Koprivnice-2015.-2020..pdf>). Governing a City to develop Smart City means to achieve a development based on strategic planning in order to implement intelligent applications and agile systems.

The indicators of ISO 37120 are grouped in 17 areas, as follows: (1) Economy, (2) Education, (3) Energy, (4) Environment, (5) Finance, (6) Fire and Emergency, (7) Governance, (8) Health, (9) Recreation, (10) Safety, (11) Shelter, (12) Solid waste, (13) Telecommunication and Innovation, (14) Transportation, (15) Urban planning, (16) Wastewater and (17) Water and Sanitation. (ISO 37120:2014, 2014).

According to obligatory criteria, the indicators are divided in two groups. First group contains 46 obligatory and second 54 supportive indicators.

Performing benchmarking between cities using the best-achieved value for each indicator is the advantage for all the participants. The city with the best indicator value achieved as a measure is pointed out as the best practice city, and other cities can learn and apply the best-implemented solutions to improve indicator value. This is the most important in the area of environment, fire and emergency, health, safety shelter areas, because the improvements in any city bring benefits to all World citizens. The example values might be: reducing CO<sub>2</sub> emissions, the number of saved human lives, prevented diseases and so on.

Other indicators make local communities competitive, firstly for the investments, but also as a desirable community to live in, because of their labor markets for different kinds of experts and labor force. These facts lead to the need of making a **Cause and Effect Analysis** between the indicators. For example, if the local community has achieved a good environment for new investments, it might lead to growing population because of more new workplaces. That leads to the situation in which local government has to make a decision on what kind of public transport has to be introduced, in which area it will be

possible to build new flats and houses. The new work force has to use a vehicles to get to workplace but the indicator whose value can be jeopardized by implementing a public transport does not allow the increase of the CO2 emission. So, the possibility is to make an urban plan to createnew residential areas near new workplaces, or to implement an environmentally acceptable public transportation (e.g. electrical bus, bike etc.) to those who can use it.

Data collection is a big challenge for every government institution, whether on a local or a state level. Which data is important, from whom they have to be collected, when, why, how often, how to avoid redundancy, how to be sure about the authenticity, how can we ensure the security and impersonalizing data when it gets to processing and analyzing. There are so many challenges in this process. Nowadays we can collect a lot of data by sensors, mobile phones, and other digital devices and IoT solutions. This is an opportunity but also a risk if data is collected by machines – it can be dysfunctional, maybe tainted by a virus. If we take decisions based onthis data, it is very important to be sure about its quality. On the other hand,the challenge is a data collection produced by human decisions,like data about pupils and their skills during educational processes, like health recordsin hospital and other levels of health institutions. Maybe, the data collection is not a problem at all, but using information based on itand learning from it,as well as making decisions based on information. It still presents a challenge.

### 3. The Research Approach, Croatian Case

City Council of Koprivnica adopted the Strategy for Development of the City of Koprivnica 2015-2020 in May 2015 (hereinafter: Strategy). The Strategy identifies a vision and mission and development priorities, objectives and measures for the development of the City of Koprivnica in the five-year period from 2015 to 2020.

The Strategy of the City of Koprivnica set three priorities for development that are focused on the growth and development of the city as follows:

- Priority 1 - Smart growth
- Priority 2 - Sustainable growth
- Priority 3 - Inclusive growth

**Smart growth** aims to influence the growth of the economy, especially small and medium enterprises in the City of Koprivnica (in the text below: SME), which would improve technology and management types used in production and business. The strategic objectives of Smart Growth are creating an enabling business environment for the economic performance of SMEs, the launch of innovative entrepreneurship and the creation of an integrated tourist offer in the city.

**Sustainable growth** aims to affect the sustainable use of existing resources in Koprivnica by saving the benefit of all citizens. The strategic objectives of sustainable growth are increasing the efficiency of waste management, energy efficiency (EE), renewable energy sources and reduction of harmful emissions and reduce the impact of natural disasters.

**Inclusive growth** is based on the achievement of the targets in the long run to influence the educational structure of the citizens, and thus the educational structure of future entrepreneurs. The strategic objectives of inclusive growth are improving the educational structure of the population, the establishment of a unified cultural policy and cultural capital increase and improving the quality of existing and development of new services within the social welfare system.

As the target groups are defined: citizens (public) media, potential beneficiaries of development projects defined by strategy and institutions at the regional, national and international level (Koprivnica-Krizevci County, relevant ministries and institutions at the state level and cross-border partners and associates).

**3.1. A Modified SWOT Analysis for the City of Koprivnica**

Development of strategic goals was preceded by the analysis of external and internal environment that is based on a SWOT analysis that helped to determine which goals are to become strategic, and which operating. In doing so, it was taking into account external factors of City of Koprivnica and the possibility of internal capacities of the city. SWOT analysis took into account the strengths, weaknesses, opportunities and threats, which are related to the situation at the time of creating the development strategy of Koprivnica.

The Table 1 shows that the SWOT analysis identified a total of 52 factors that in some way affect the future growth and development of the City of Koprivnica, of which 30 are internal factors, and 22 are external factors.

The internal environment consists of strengths and weaknesses which management of City of Koprivnica can control and on which it has a controlling influence. There were identified 16 factors that affect the smart, sustainable and inclusive growth, and in which the powerful development is contained. Moreover, 14 factors that have influence on smart, sustainable and inclusive growth, but which contain weaknesses for the future development.

The external environment consists of the opportunities and threats over which management of City of Koprivnica has no short-term control Ten factors were identified that affect the smart, sustainable and inclusive growth, and which contain growth opportunities and 12 factors that affect the smart, sustainable and inclusive growth, and which contain threats to future growth.

Table 1: The SWOT analysis of City of Koprivnica

		POSITIVE		NEGATIVE	
		STRENGTHS		WEAKNESSES	
INTERNAL	SMART GROWTH	S1	County GDP higher than the national average	W1	reduction in entrepreneurs' income
		S2	stable number of entrepreneurs in the City	W2	lack of competitiveness of SMEs

		S3	current capacities and know-how in the manufacturing industry	W3	lack of investment and know-how in research and development and innovation		
	SUSTAINABLE GROWTH	S4	advantageous geographical position	W4	lack of specialization at SMEs		
		S5	well-designed energy development	W5	difficult access to affordable capital for SMEs		
		S6	possessing competencies in sustainable building	W6	lack of interest in entrepreneurship for SMEs		
		S7	existing integrated waste management system	W7	incoherence of support institutions in the SME sector		
		S8	good coverage of municipal infrastructure	W8	poor inter-sector cooperation (culture-tourism-nature-gastronomy)		
		S9	potential large capacity of existing sources of drinking water	W9	high unemployment rate (growth in the last 10 years to 4.3%)		
		S10	rich cultural heritage	W10	a high proportion of young people (20-25) and the contingent of unemployed		
		S11	cultural events	W11	lack of specific highly educated employees		
		S12	modern and innovative facilities and culture	W12	educational structure and the County's lagging behind the national average		
	S13	preserved natural heritage	W13	declining interest and verified programs			
	INCLUSIVE GROWTH	S14	establishment of CICC with services for the unemployed (information, education, counseling)	W14	high school graduates (62% of respondents) are not familiar with the possibilities of studying in Koprivnica		INCLUSIVE GROWTH
		S15	The existence of a comprehensive program of learning and Koprivnica				
		S16	the existence of network of formal, informal and informative education				
<b>OPPORTUNITIES</b>				<b>THREATS</b>			
EXTERNAL	SMART GROWTH	O1	MPS are using funds from the European Regional Development Fund (grants or soft loans)	T1	continued recession in Croatia	SMART GROWTH	
		O2	connectivity, enterprise and linking SMEs with large companies, cooperation with scientific sector	T2	lack of interest and knowledge of SMEs and R & D		
		O3	the development of R & D infrastructure (INNOTECH)	T3	unavailability of capital for entrepreneurial projects		
	SUSTAINABLE GROWTH	O4	the development of integrated tourism offer, which includes natural and cultural heritage	T4	insufficient investment and the establishment of an enabling business environment	SUSTAINABLE GROWTH	
	INCLUSIVE GROWTH	O5	further development of an integrated waste management system	T5	growing trend of natural disasters (floods and droughts)		
	O6	better linking with higher education institutions also with employers and CES	T6	project Piškornica - financial and environmental risk for the City of Koprivnica			

	O7	new programs of training for self-employment (EU funds)	T7	continuation of public funding and abundant supply	<b>INCLUSIVE GROWTH</b>
	O8	the existence and development of institutions of higher education (high school, POU)	T8	continuation of the economic crisis and the inability to create new jobs	
	O9	capacity building and activities for community wellbeing	T9	insufficient information about study opportunities in Koprivnica	
	O10	recognizing and encouraging the potential of young people in Koprivnica	T10	growth of population at risk of poverty	
			T11	Depopulation	
			T12	lack of an unified cultural strategy	

Source: The development strategy of Koprivnica ( "Gazette of Koprivnica" number 2/15), p. 7th

The table 2 shows the recapitulation of the factors that affect the future growth and development of the City of Koprivnica, which stems from the SWOT analysis.

Table 2: Recapitulation of the factors influencing the future development and growth of City of Koprivnica

		<b>POSITIVE</b>		<b>NEGATIVE</b>	
		<b>STRENGTHS – 16</b>		<b>WEAKNESSES – 14</b>	
<b>INTERNAL</b>	SMART GROWTH	3	SMART GROWTH	7	
	SUSTAINABLE GROWTH	10	SUSTAINABLE GROWTH	1	
	INCLUSIVE GROWTH	3	INCLUSIVE GROWTH	6	
<b>EXTERNAL</b>	<b>OPPORTUNITIES -10</b>		<b>THREATS – 12</b>		
	SMART GROWTH	3	SMART GROWTH	4	
	SUSTAINABLE GROWTH	1	SUSTAINABLE GROWTH	2	
	INCLUSIVE GROWTH	6	INCLUSIVE GROWTH	6	

The development strategy of Koprivnica 2015 to 2020 was not elaborated in detail the strategic alternatives of development of the city, neither the possible strategies of the combinations and the connections between the weaknesses, threats, opportunities and power of City of Koprivnica, and did not take into account the links between external and internal factors.

Comparing the SWOT analysis data, the links and impacts, particular strategic factors were identified in the external and internal environment of the City of Koprivnica, in order to formulate strategies based on the relationship between the opportunities and threats from the external environment and the strengths and weaknesses of the internal environment. And to improve the quality of service delivered to citizens and businesses, and to ensure that the development of City of Koprivnica will be based on the Smart city concept.

In several tables further in the text is showed the ranking of strengths, weaknesses, opportunities and threats based on data from the SWOT analysis. Empty fields without markings are indicating that there are some factors whose impact can not be interconnected.



Table 3: The Strengths Rank (S Rank)

STRENGTHS RANK – S RANK																	
	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	TOTAL
S1		S1	S1		S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	S1	14
S2			S2	S2	S2		S2	S2	S9	S2	S11	S12		S2	S2	S2	9
S3				S3	S3		S3	S3	S3				S13	S3	S15	S3	7
S4					S4				S9		S4	S4	S13			S4	4
S5							S5	S5	S5				S13		S5	S5	5
S6								S6							S6	S6	3
S7								S7	S7				S7		S7	S7	5
S8									S9					S8	S8	S8	3
S9													S9	S9		S9	6
S10											S10	S10			S10	S10	4
S11												S12				S16	1
S12														S12	S12	S12	5
S13																S16	3
S14															S14	S14	2
S15																S15	2
S16																	2

The comparison of strength factors shows that the greatest impact has the factor that is often entered, or has more impact on other factors in the group. Data in the table above shows that the GDP of Koprivnica-Križevci County has the greatest impact. It is higher than the Croatian average (S1), followed by a stable number of entrepreneurs in the City (S2), then the existing capacities and know-how in manufacturing (S3), followed by potential large capacity of existing sources of drinking water (S9) and modern and innovative facilities in culture (S12), then a well-designed energy development (S5), the existing integrated waste management system (S7) and others.

The comparison of Weaknesses factors found that the drop in entrepreneurs' income (W1) and the lack of competitiveness of SMEs (W2) have the greatest impact, followed by lack of investment and know-how in research and development and innovation (W3) and the lack of specialization in SMEs (W4), followed by difficulties in accessing affordable capital to SMEs, a lack of interest in entrepreneurship for SMEs (W5 and W6), followed by weak inter-sectoral cooperation (W8) and others.

Table 4: The WeaknessesRank (W rank)

		WEAKNESSES RANK - W RANK													
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	TOTAL
W1		W1	W1	W1	W1	W1	W7	W1	W1	W1	W1	W1	W1		11
W2			W2	W2	W2	W2	W2	W2	W2	W2	W2	W2	W2		11
W3				W3	W3	W3	W3		W3	W3	W3	W3	W3		9
W4					W4	W4	W4	W4	W4	W4	W4	W4	W4		9
W5						W5	W5	W5	W5	W5	W5	W5	W5		8
W6							W6	W6	W6	W6	W6	W6	W6	W6	8
W7								W7	W7	W7	W7	W7	W7	W7	8
W8									W8	W8	W8	W8	W8	W8	6
W9										W9	W9	W9	W9	W9	5
W10											W10	W10	W10	W10	4
W11												W11	W11	W11	3
W12													W12	W12	2
W13														W13	1
W14															-

Table 5: The Opportunities Rank (O Rank)

		OPPORTUNITIES RANK - O RANK										
	O1	O2	O3	O4	O5	O6	O7	O8	O9	O10	TOTAL	
O1		O1	O1	O1	O1	O1	O1	O1	O1	O1	9	
O2			O2	O2	O2	O2	O2	O2	O2	O2	8	
O3				O3	O3	O3		O3	O3	O3	6	
O4					O4	O4	O4	O4	O4	O4	6	
O5						O5		O8	O5	O5	3	
O6							O6	O6	O6	O6	4	
O7								O7	O7	O7	3	
O8									O8	O8	3	
O9										O9	1	
O10											-	

Results of ranking the Opportunities show that the largest external opportunities are based on the use of funds from the European Regional Development Fund by SMEs (O1), linking SMEs with large companies and cooperation with scientific sector (O2), the development of R&D infrastructure (O3), the development of integrated tourism offers (O4), better linking with higher education institutions and with employers and CES (O6) and others.

Table 6: The Threats Rank (T Rank)

		THREATS RANK - T RANK												
	T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	TOTAL	
T1		T1	T1	T1			T1	T1		T1	T1		7	
T2			T3	T2			T2		T2	T2			4	
T3				T3			T3	T3		T3	T3		6	
T4						T6	T4	T4		T4	T4		4	
T5								T5		T5	T5		3	
T6											T6		2	
T7								T7		T7	T7		3	
T8										T8	T8		2	
T9										T9	T9	T12	2	
T10											T10		1	
T11													-	
T12													1	

Ranking Threats show that, for further growth and development, the biggest threats are continued recession in Croatia (T1), lack of interest and knowledge of SMEs, R&D (T2), the unavailability of capital for entrepreneurial projects (T3) and insufficient investments in the establishment of an enabling business environment (T4), followed by a growing trend of natural disasters (T5) and the continuation of public funding in abundant supply (T7) and others.

### 3.2. The TOWS matrix of City of Koprivnica

The SWOT analysis is widely used as the sole basis for the development strategy of the organizations. With the development of economic science in the field of strategic management, the other models have been developed in an attempt to improve the basis for decision-making in strategic management.

So Heinz Wehrich (1982), when considering operational model for situational analysis found that the combination and systematization of factors arising from the SWOT analysis can get to the selection of different types of strategies which are important for the further development of the organization. Wehrich expanded the SWOT analysis and developed more realistic model for economic situational analysis – the TOWS matrix (Wehrich, 1982). The TOWSmatrix has given the strategic planning a new dimension by linking the external environment of the organization (threats and opportunities) with the internal environment of the organization (strengths and weaknesses) (Al Salmi, Hasnan 2015). In the TOWS matrix which Wehrich proposed, "T" stands for threats, "O" stands for options, "W" stands for weaknesses and "S" stands for forces of the organization. This model was accepted by many scientists which process it in their research papers

concerning strategic management (Ravanavar, Charantimath 2012, Vanek & Milolas & Chewing Gum 2012 and others).

Furthermore, a TOWS matrix is completed in this article and it is based on factors arising from the SWOT analysis of the Strategy of the City of Koprivnica. When creating the TOWS analysis the data from tables ranking factors are used and, primarily because of space limitations and for the sake of comprehensiveness and simplification, for each of the strengths, weaknesses, opportunities and threats 4 of the most influential factors are taken into consideration.

Table 6: The TOWS matrix for the City of Koprivnica

		<b>Strengths</b>		<b>WEAKNESSES</b>	
	S1	County GDP higher than the national average		W1	reduction of entrepreneurs' income
	S2	stable number of entrepreneurs in the City		W2	lack of SME'S competitiveness
	S3	current capacities and know-how in the manufacturing industry		W3	lack of investment and know-how in research and development and innovation
	S9	potential large capacity of existing sources of drinking water		W4	lack of specialization at SMEs
	S12	modern and innovative facilities in culture		W5	difficult access to affordable capital for SMEs
				W6	lack of interest in entrepreneurship for SMEs
				W7	incoherence of support institutions in the SME sector
				W8	poor inter-sector cooperation (culture-tourism-nature-gastronomy)
<b>OPPORTUNITIES</b>		<b>THE STRATEGIES (MAXI-MAXI)</b>		<b>WO STRATEGIES (MINI-MAXI)</b>	
O1	MPS are using funds from the European Regional Development Fund (grants or soft loans)	1.	connect SMEs with strong companies in the manufacturing industry in the City of Koprivnica, which will strengthen the business and SME development (S3, O2)	1.	connect SMEs with large manufacturing companies in the city and to increase the income of SMEs and their competitiveness (W1, W2, O2)
O2	connectivity, enterprise and linking SMEs with large companies, cooperation with scientific sector	2.	Using the EU funds to develop entrepreneurs' business, which will increase the number and power of the entrepreneur (SS, O1)	2.	connect SMEs with large manufacturing companies in the city that have developed know-how and are investing significant resources in R & D (W2, O3)
O3	the development of R & D infrastructure (INNOTECH)	3.	EU funds to use to enrich the content of culture and tourism and to include the natural and cultural heritage (S12, O1, O4)	3.	to assist SMEs in obtaining funds from the EU funds by investing in the development of SMEs (specialization, competitiveness, increase interest in entrepreneurship, better connections with educational institutions (W2, W4, W6, O1)

O4	the development of integrated tourism offer, which includes natural and cultural heritage	4.	connecting high educational institutions with strong companies in the manufacturing industry and SMEs to open new employment opportunities (S2, S3, O6)	4.	develop an integrated tourist offer of undertakings that will benefit and which will contribute to increasing the income of entrepreneurs (W1, O4)
O6	better linking with higher education institutions, with employers and CES	5.	take advantage of a larger GDP and develop R & D based on the smart city concept linking large companies and SMEs (S1, O2, O3)	5.	create more effective and more efficient city government, strengthen the support of city institutions and services and to take measures and activities that will provide assistance and training to entrepreneurs and increase their interest in entrepreneurship (W4, W6, W7, O2, O6)
<b>THREATS</b>		<b>ST STRATEGIES (MAXI-MINI)</b>		<b>WT STRATEGIES (MINI-MINI)</b>	
T1	continued recession in Croatia	1.	Take advantage and use increase of GDP to soothe and partially eliminate the impact of the current recession in Croatia on business entrepreneur and City Development (S1, T1, T3, T4, T7)	1.	in the Budget of the City to provide funds that will influence on the increasing competitiveness of SMEs, encourage the newly established businesses, stimulate job creation and enterprise development (W1, W2, W3, W7, T3, T4)
T3	unavailability of capital for entrepreneurial projects	2.	in cooperation with large companies in Koprivnica to increase the interest of SMEs in R & D (S3, T2)	2.	organize free training for entrepreneurs in order to inform and educate the research, development and innovation based on the Smart City concept in order to increase specialization in business operations and for the access to capital through EU funds (W3, T2, T3, T4)
T2	lack of interest and knowledge of SMEs and R & D	3.	Redirect the part of an investments in the prevention of the impact of natural disasters (mixed drainage system, etc.), (S1, T5)		
T4	insufficient investment and the establishment of an enabling business environment				
T5	growing trend of natural disasters (floods and droughts)				
T7	continuation of public funding and abundant supply				

By using TOWS matrix, four possible types of business strategies for further development of the City of Koprivnica (SO, WO, ST and WT) are composed and 4 of the most influential factors were taken into account. Comparing the data in the table above with the Strategy of the City of Koprivnica it has been observed that the Strategy was generally well-defined by the priorities, objectives and measures important for the further development of the City of Koprivnica in the period from 2015 to 2020. Further in-depth

analysis of development priorities, objectives and measures based on the data from the TOWS matrix, due to space limitations of this study will not be further examined.

#### 4. The research process and the ISO 37120

During 2016, the City of Koprivnica launched a process of data collection in order to obtain the international ISO 37120: 2014 certificate. Certification has been successful, and in October 2016 WCCD awarded the City of Koprivnica the platinum ISO 37120 certificate, which confirmed that in the certification process, city met the highest standards prescribed by this international organization.

##### 4.1. Obtaining the ISO 37120 certification for the City of Koprivnica

Based on data collected for the City of Koprivnica, out of 100 possible indicators, the results were calculated for 94 indicators in total (46 core and 48 supporting) ). Moreover, for the 6 supporting indicators, the data could not be established and no information was gathered from the competent authorities since there were no official data bases, at any level (local, regional, national). Review of the data collected to obtain ISO 37120 certification for the City of Koprivnica is presented in the Table 7.

Table 7: Recapitulation of data collected for obtaining the ISO 37120 certificate for the City of Koprivnica

ID	ABR.	AREA	CORE INDICATORS	SUPPORTING INDICATORS	NO RECORDS (SUPPORTING INDICATORS)	TOTAL
1	EC	Economy	3	4		7
2	ED	Education	4	3		7
3	EN	Energy	4	1	2	7
4	EV	Environment	3	3	2	8
5	FN	finance	1	3		4
6	FR	Fire and emergency response	3	3		6
7	GV	Governance	2	4		6
8	HL	Health	4	3		7
9	RE	Recreation		2		2
10	SF	Safety	2	3		5
11	SH	Shelter	1	2		3
12	SW	solid waste	3	7		10
13	TV	Telecommunication and Innovation	2	1		3
14	TR	Transportation	4	4	1	9
15	UP	Urban planning	1	2	1	4
16	WW	wastewater	5			5
17	WS	Water and sanitation	4	3		7
<b>TOTAL</b>			<b>46</b>	<b>48</b>	<b>6</b>	<b>100</b>

Source: <http://open.dataforcities.org/> - Accessed 11/24/2016.

Further analysis of data and individual indicators important to obtain ISO 37120 certification led to the conclusion that there are different impacts on the indicators. For some indicators the most affected is local community (City of Koprivnica), on some indicators, the greatest impact has the state, and on a smaller number of indicators affects Koprivnica-Krizevci County (regional).

The authors (Zdjelar & Kelemen & Dušak, 2016) have analyzed the data sources in the context of accessibility, publicity, ownership. In accordance with the Case of Croatia, the data sources are as presented in Table 5.

Table 8.: Number of indicators by areas and levels of administration that collect data

AREA	STATE	LOCAL	REGIONAL	TOTAL
Economy	6		1	7
Core indicator	2		1	3
Supporting indicator	4			4
Education	1	1	5	7
Core indicator		1	3	4
Supporting indicator	1		2	3
Energy	6		1	7
Core indicator	3		1	4
Supporting indicator	3			3
Environment		1	7	8
Core indicator			3	3
Supporting indicator		1	4	5
Finance		4		4
Core indicator		1		1
Supporting indicator		3		3
Fire and emergency response		6		6
Core indicator		3		3
Supporting indicator		3		3
Governance		6		6
Core indicator		2		2
Supporting indicator		4		4
Health	3		4	7
Core indicator	2		2	4
Supporting indicator	1		2	3
Recreation		2		2
Supporting indicator		2		2
Safety	5			5
Core indicator	2			2
Supporting indicator	3			3
Shelter	1		2	3

Core indicator	1			1
Supporting indicator			2	2
Solid waste		10		10
Core indicator		3		3
Supporting indicator		7		7
Telecommunication and innovation	3			3
Core indicator	2			2
Supporting indicator	1			1
Transportation	4	3	2	9
Core indicator	1	2	1	4
Supporting indicator	3	1	1	5
Urban planning		4		4
Core indicator		1		1
Supporting indicator		3		3
Wastewater		5		5
Core indicator		5		5
Water and sanitation		7		7
Core indicator		4		4
Supporting indicator		3		3
TOTAL	29	49	22	100

*Source: Zdjelar & Kelemen & Dušak, 2016*

The State level of data sources includes ministries, agencies, institutes, Croatian bureau of statistics. The regional level of data sources includes counties and the office of the state government in counties. Local level of data sources means city government and cities agencies and utility companies.

The authors have focused on indicators on which the decisive influence has the City of Koprivnica. Analysis of the impact of the City of Koprivnica was based on legislation that oblige cities in Croatia to taking operation and taking care in the areas of waste management, pre-school and primary education, firefighting, recreation, public water supply, drainage and wastewater treatment, urban planning and administration of the city, governance, economy (partially) and others.

The analysis shows that the City of Koprivnica significantly affects on 60 indicators in total (25 core indicators and 35 supporting indicators), as shown in the Table 9.

As pointed out above, the local impact and importance of prevailing is noticed in 13 of 17 areas of certification. The analysis shows that the City of Koprivnica has no significant impact on the score indicators in four areas (Energy, Health, Safety, Telecommunication and Innovation).



Table 9: Indicators for ISO 37120 certification which has a dominant influence by City of Koprivnica (local influence indicators)

ID	ABR.	AREA	NUMBER OF THE INDICATORS					
			CORE	SUPPORTING	TOTAL	LOCAL INFLUENCE - TOTAL	LOCAL INFLUENCE - CORE	LOCAL INFLUENCE - SUPPORTING
1	EC	Economy	3	4	7	6	3	3
2	ED	Education	4	3	7	3	2	1
3	EN	Energy	4	3	7	-	-	-
4	EV	Environment	3	5	8	7	3	4
5	FN	finance	1	3	4	2	-	2
6	FR	Fire and emergency response	3	3	6	3	1	2
7	GV	Governance	2	4	6	5	2	3
8	HL	Health	4	3	7	-	-	-
9	RE	Recreation		2	2	2	-	2
10	SF	Safety	2	3	5	-	-	-
11	SH	Shelter	1	2	3	1	-	1
12	SW	solid waste	3	7	10	10	3	7
13	TV	Telecommunication and Innovation	2	1	3	-	-	-
14	TR	Transportation	4	5	9	5	1	4
15	UP	Urban planning	1	3	4	4	1	3
16	WW	wastewater	5		5	5	5	-
17	WS	Water and sanitation	4	3	7	7	4	3
		<b>TOTAL</b>	<b>46</b>	<b>54</b>	<b>100</b>	<b>60</b>	<b>25</b>	<b>35</b>

The most significant impact the City of Koprivnica has on the indicators in the following areas of certification:

- Solid waste – the impact on all 10 indicators (3 core and 7 supporting)
- Environment - the impact of the 7 out of 8 indicators (3 core and 4 supporting)
- Water and sanitation – the impact on all seven indicators (4 core and 3 supporting)
- Economy – the impact on 6 of the 7 indicators (3 core and 3 supporting)
- Water and sanitation – the impact on the 5 indicators (5 core)
- Governance - the impact on the 5 out of 6 indicators (2 core and 3 supporting)
- Transportation – the impact on the 5 out of 9 indicators (1 core and 4 supporting)
- other areas of the city's impact - the impact on the total of 15 indicators (4 core and 11 supporting).

Comparing indicators from the City of Koprivnica with indicators from other world cities which obtained ISO 37120 certification, it is evident that Koprivnica has 6 of the best indicators in the areas of Environment, Transportation, Solid Waste and Wastewater, and that these are the indicators on which just the City of Koprivnica may affect (<http://open.dataforcities.org/>, Page visited 24/11/2016.). On the other hand, Koprivnica in comparison with other world cities has 4 of the worst indicators in the areas of Environment, Solid Waste, Wastewater and Water and sanitation and these are indicators that the City of Koprivnica can affect on too. Further on, the City of Koprivnica is responsible for the 6 indicators without data (Environment and Transportation areas), while in the areas of Energy and Urban planning, the city has no influence because the data are collected at national level.

Table 10. City of Koprivnica - Overview of the best and worst indicators and indicators for which there is no data

THE BEST OF		THE WORST OF		NO DATA	
AREA	INDICATORS	AREA	INDICATORS	AREA	INDICATORS
ENVIRONMENT	Greenhouse gas emissions	ENVIRONMENT	Ozone (O3) concentration	ENERGY	Electrical interruptions
ENVIRONMENT	Nitrogen dioxide (NO2) concentration	SOLID WASTE	City population with regular waste collection (residential)	ENERGY	Electrical interruptions length
SOLID WASTE	Total collected municipal solid waste per capita per year	WASTEWATER	City population served by wastewater collection	ENVIRONMENT	noise pollution
SOLID WASTE	City's hazardous waste that is recycled	WATER AND SANITATION	City population with access to improved sanitation	ENVIRONMENT	Change in native species
TRANSPORTATION	Kilometers of bicycle paths and lanes			TRANSPORTATION	Mode share
WASTEWATER	City's wastewater receiving tertiary treatment			URBAN PLANNING	Jobs / housing ratio

Source: <http://open.dataforcities.org/>, Page visited 24/11/2016.

Comparing the data in Table 8. (Number of indicators by areas and levels of administration which collects data) and Table 10. (City of Koprivnica - Overview of the best and worst indicators and indicators for which there is no data) a certain discrepancy in the number of indicators of local / municipal levels is visible.

As pointed out above, the City of Koprivnica has a dominant influence on the total of 60 indicators relevant to the ISO 37120 certification, but databases are maintained only for 49 indicators (data for 11 indicators, ie. 18.3% of indicators, are maintained in by regional or state institutions). The reason for this is non-compliance of obligation given by laws and regulations to the Croatian cities in certain areas and obligation given by another Croatian laws and by-laws which define the jurisdiction of keeping individual databases (for example, data on unemployed workers are kept at the state level).

When analyzing the data for this study, it was also found that there is a mismatch between the database maintained by the City of Koprivnica with the data required by the International Standard ISO 37120 (specific data required by the ISO standard is not maintained or are partially maintained), to which the expert service of Koprivnica and all the city's institutions should urgently work for the period. until the next certification.

#### ***4.2. The impact of ISO 37120 on the existing SWOT analysis of the City of Koprivnica***

Given the fact that the SWOT analysis for the Strategy of the City of Koprivnica has been made more than a year before the City of Koprivnica obtained ISO 37120 certification, and that the exceptional character of this international certificate for the further development of the City of Koprivnica, below the impact of ISO 37120 certificates, the indicators are compared with the existing SWOT analysis of Koprivnica from 2015.

As stated above, the City of Koprivnica has a dominant influence on 60% of indicators relevant for ISO 37120 certification, which means it has the authority and obligation to manage the development of certain areas and activities based on information provided by ISO indicators.

City of Koprivnica for several years is continuously working on projects directed at the development of smart city (so-called Smart city concept) and is constantly investing in improving the quality of life by developing sustainable urban transport and mobility, sustainable construction, availability of information and integrated management processes and assets. Acquisition of ISO 37120 certification is just one of the city's activities focused on the development of Smart city concept, which is, among other things, used to compare the City of Koprivnica to other cities using a unique methodology recognized worldwide.

Comparing ISO 37120 certification indicators for the City of Koprivnica in 2016 with the SWOT analysis of the City of Koprivnica it can be concluded that the SWOT analysis from 2015 well-identified strengths, weaknesses, opportunities and threats and that there is no need to be updated. Also, the development priorities and objectives given in the Strategy include all important factors that determine the future development of the City of Koprivnica-based on the Smart City concept, and there is no need for their amendment.

However, using the latest results from the 2016-related indicators of ISO 37120 certification, the City of Koprivnica would still need to work on updating the measures set out in the Strategy. So that to achieve that the development of priorities and objectives align with the Smart city concept, on which the City of Koprivnica decided to base its development in the five-year period from 2015 to 2020.

#### ***4.3. The issues that arose during the research***

During the process of the needed data collection, the team has made some conclusions important for further actions in the process of developing Big Data model for supporting the recording improvements for life quality indicators.

Referring to the fact that methodology of data collection needed to be certificated by ISO 37120 is clear and strictly defined in the process of data collection, the team was faced with the data ownership as a kind of problem. It makes the whole process more complicated, because most data was not published and accessible to the public. In some situations, the collected data was not strictly related to the city, but to the wider area (for example in the area of energy, water and wastewater, environment – measuring air quality).

As it is defined by methodology, there are rules which data shall be collected and how to calculate the data to be acceptable for ISO certification procedure.

During the data collection process, the certification preparation team made the research on all the data sources collected from all the institutions. Apart from the demographic data about population collected during the census in 2011 published on [www.dzs.hr](http://www.dzs.hr), just internal records were accessible for data usage. All other data had to be asked for by different kind of requests, for example by official letters, by collecting and sending a request in accordance with the procedure of using the right of access to information or by e-mails. There were no data sources available according to the Open Government data Principles.

World Council On City Data (WCCD) published open data on <http://open.dataforcities.org> so it is possible to compare cities using indicators. There is one more step to do for the benchmarking and that is to set up the right value of indicators, the best practice and results that are desirable to be achieved in the city that is compared to the others.

Joining the WCCD Global City Registry enables cities to (1) improve transparency and accountability with open data and foster sound decision-making; (2) identify common management issues and themes, and learn and share solutions and informed practices with cities internationally; (3) access data for reporting and more in-depth data monitoring, visualization and comparison capabilities, (4) participate in City summits, roundtables, webinars and other exclusive WCCD events and activities, (5) measure performance against other WCCD cities and showcase city strengths, (6) be informed about activities of the others.

The most important thing of applying Benchmark method to the model of sustainable development and governing cities is to lean the validity between social changes.

84% of indicators were accessible in an unstructured text and the form of a report. The 27 indicators are from the state level, 44 of them are from the local level, and 13 are from the regional level.

8% of indicators were accessible on web sites of institutions. One of them is from the regional level, 3 of them are from the local level, 4 of them are from the state level.

Four indicators were accessible as a report from the web, one from the state level, and three from the regional level.

It was impossible to access data for four indicators.

In general, regarding the criteria of frequency of creation data for documenting the ISO 37120 indicators, most data has been collected continuously but published annually, apart from demographic data that is collected in census every 10 years. The last census of Croatian citizens was made in 2011.

## 6. Conclusion

During the whole project of implementing ISO 37120 in the City of Koprivnica there are a few important remarks to be pointed out:

- The Smart City is achieved after the measures which improve the quality of life are created
- Governing necessary to achieve a Smart City concept has to be based on Strategy for developing a Smart City
- The Strategy for developing a Smart City has to be accomplished using its own strengths and possibilities from the environment and respecting its own weaknesses and treats from the environment. The challenge is to choose and use the best strategy to reach the goals.

The problems related to the accessibility of data could be avoided by creating an Open data services on the state level. There are a lot of social areas where that concept could help improve and accelerate the process of collecting data that have to be used for documenting the indicators value. Implementation of IoT solutions in the area of air quality will be introduced and published as Open Data on the local level.

This article presents the unique approach to developing Smart City concept in a small European city by implementing ISO 37120 as an internationally accepted methodology.

All the data that is not classified as confidential can be included in the Open Data service. The software intelligent agents could be developed to collect data automatically from different sources to reduce the manual collection to a minimal level.

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