

Varazdin Development and Entrepreneurship Agency and University North, Croatia  
in cooperation with  
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Faculty of Economics and Business, University of Maribor, Slovenia  
Faculty of Management University of Warsaw, Poland  
Faculty of Law, Economics and Social Sciences Sale - Mohammed V University in Rabat, Morocco  
Ecole Nationale de Commerce et de Gestion de Tanger - Abdelmalek Essaadi University, Morocco  
Medimurje University of Applied Sciences in Cakovec, Croatia  
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**Book of Proceedings**  
Special Issue

# Modern Trends in Economic and Social Development

Editors:

**Nicholas Recker, Brian O'Hara, Petar Kurecic, Jernej Belak, Karin Sirec**

Selected Papers:

**116<sup>th</sup> esd Conference**

Hosted by: College of Letters, Arts, and Sciences, Metropolitan State University of Denver, USA

**117<sup>th</sup> esd Conference**

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*This book contains selected papers from two international scientific conferences: the 116th "esd" conference in Denver, USA, and the 117th "esd" conference in Maribor, Slovenia. Both conferences also served as the official introduction of our two new Partners: the College of Letters, Arts, and Sciences at Metropolitan State University of Denver, USA, and the Faculty of Economics and Business, University of Maribor, Slovenia. The main topic of the roundtable at the Denver conference was "Inclusive Development for Robust Organizations and Resilient Societies," while in Maribor it was "Contemporary Opportunities and Challenges for a Sustainable Global Economy." These were also the fourth and fifth "esd" conferences since early June 2024, when we suddenly lost "esd Conference" Founder and Scientific Committee President, Professor Marijan Cingula.*

*Domagoj Cingula, Organizing Committee President*

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# TWO DECADES OF BECOMING SUSTAINABLE - CITY OF KOPRIVNICA LONGITUDINAL CASE STUDY

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## **ABSTRACT**

*The concepts of smart, sustainable, and resilient cities are incorporated into strategic and planning documents periodically adopted and implemented by municipalities. This paper presents the application of ISO 37120 in the sustainable development process of the City of Koprivnica (Croatia). The research is focused on selection of measurement model for monitoring sustainability, developing the system of collecting data necessary for calculation of indicators and enhancing quality of data sources. There are two sets of hypotheses, and the research methodology that consists of nine phases: measurement model selection, recognizing the indicators and data relevant to calculate them, determination of data sources, and three measurement cycles. This paper also provides a longitudinal view of indicators, with the analysis of the achievements of goals, including challenges during pandemic years, as well as an analytical and critical review of the development priorities, strategic goals, and indicators from the new strategic development documents of the City of Koprivnica, as well as the envisaged measures. The challenge of becoming sustainable has been measured by using objective, generally applicable methodology established by ISO that assures the comparability and competitiveness to other cities.*

**Keywords:** *ISO 37120, Smart City, Sustainability, Sustainable Development, Quality of Life.*

## **1. INTRODUCTION**

Sustainable development is a global challenge that implies activities for progress focused on saving natural resources, the safety of people and property. Digital technologies and their applications support the transformation of community's actions towards sustainable, inclusive, and smart goals. Ahvenniemi et al. (2017) explored the distinction between sustainable and smart cities. By 2050, around 68% of the global population will live in urban areas, as estimated by the United Nations (2018). Urbanization leads to development but also brings carbonization pollution and climate-related impacts. To counter these, the European Union initiated the Smart City initiative, urging cities to adopt technological solutions for better urban management. Smart city principles are employed in domains like "sustainable urban mobility, districts, and the built environment, integrated energy infrastructures and processes, information and communication technologies, citizen focus, policy, integrated planning, knowledge sharing, performance metrics, open data governance, standards, business models, and funding" (EC, 2011).

In the past 30 years, organizations like ISO, OECD and EU bodies (European Commission, Parliament, and Council) have developed frameworks to promote sustainable development. The ISO 37120 standard provides indicators for city services and quality of life to help cities track sustainable development (ISO, 2014). OECD organized roundtables on smart city measurement (OECD, 2020). In 2019, the EU adopted the Taxonomy Regulation, classifying environmentally sustainable economic activities and investment impact. All three frameworks contribute to sustainability, but target different subjects. The ISO standard and OECD roundtables involve cities, while Environment-Social-Governance (ESG) approach to sustainability includes business entities. The ISO standard, being the oldest framework, offers a standardized methodology for measuring city performance. This framework is more comprehensive than OECD and ESG. The optimal approach for urban communities would be to adopt all three concepts, creating benefits for all sectors (administration, economy, and citizens).

The OECD continually communicates with the economic sector and local governments to establish a useful model for measuring smart city performance. The suggested indicators are aligned with the four smart city objectives: well-being, inclusion, sustainability, and resilience. In 2023, the focus is on achieving net-zero emission in smart cities.

ESG is based on three fundamental dimensions. The first is focused on the environment, considering the impact of the company on the environment. This includes greenhouse gas emissions, energy efficiency, pollution levels, biodiversity conservation, afforestation, wastewater management, and other environmental issues. The second dimension relates to the social dimension, such as employee satisfaction, their health and safety, diversity and inclusion of all members of society, conflict prevention and resolution, working conditions, customer relations and satisfaction, and other social issues. The third-dimension concerns governance, relating how the company is managed and governed. This involves bribery and corruption prevention, management and supervisory boards effectiveness, their diversity, privacy protection, cybersecurity, stakeholder participation in decision-making, and more.

This study focuses on the case study of the City of Koprivnica, which aims to establish a comprehensive sustainability monitoring system. Setting sustainable community objectives and improving quality of life (QoL) are central to Koprivnica's local policy. By implementing the ISO 37120 standard, Koprivnica can benefit from comparing itself with other certified cities and self-monitoring its progress and changes.

The following paragraph provides a brief overview of the strategic planning practices in the Republic of Croatia. It introduces how the City of Koprivnica planned its development from 2010 to 2030.

The first law for regional development was enacted in 2009. Over time, local self-government also became responsible for strategic plans (Article 15, Code of Civil Procedure). Following Article 14 of Croatia's Law on Regional Development (OG 147/14), the City of Koprivnica made a Development Strategy (2015-2020), highlighting sustainable, inclusive, and intelligent growth (Koprivnica, 2015). This strategy, rooted in situational and environmental analysis, significantly contributes to national and European global objectives. Following the 2015-2020 period, the City of Koprivnica launched a new strategic document, titled "Development Strategy of the City of Koprivnica until 2030" (Koprivnica, 2022). This strategy maintains the development momentum, aiming to continuously improve QoL through a "Green and Digital" approach.



The chapter dedicated to research methodology outlines the longitudinal research approach and the specific methods employed to ensure consistent data collection, data processing for indicator calculation, source verification, comparison, and presentation of developmental progress. A separate chapter details the longitudinally measured indicator sample, organized by topic.

## **2. RESEARCH MOTIVATION AND GOALS**

*“I often say that when you can measure what you are speaking about, and express it in numbers, you know something about it; but when you cannot measure it, when you cannot express it in numbers, your knowledge is of a meagre and unsatisfactory kind; it may be the beginning of knowledge, but you have scarcely, in your thoughts, advanced to the stage of science, whatever the matter may be.”* - Lord Kelvin, Lecture on "Electrical Units of Measurement" (3 May 1883), published in Popular Lectures Vol. I, p. 73

Local government and the local economy are closely intertwined in the regions under the jurisdiction of that local self-government. The economy, through production and sales, generates value for business owners and employees. The local government ensures methods to enhance living and economic conditions in its area. Therefore, there is a clear positive feedback loop between local government and the economy. With increased tax contributions from economic growth, the local government can enhance citizen services. Simultaneously, a growing economy can employ the local workforce, establishing and sustaining a presence in the region.

During the project's initial phase in 2010, the City of Koprivnica carried out numerous activities and development endeavours funded by the EU. These activities served as an incentive for initiating and executing projects aimed at enhancing sustainable urbanization and the QoL within the city. The examples worth to mention are in:

- biodegradable waste management (Komunalac, 2011),
- urban green mobility project Civitas Dyn@mo in 2013 (Komunalac, 2013),
- transport infrastructure and the establishment of bicycle for recreational pursuits in 2014 (Grad Koprivnica, 2014).

All of these activities required the prompt implementation of a measurement model and processes to monitor their impact on citizens' well-being, carbon emissions, and sustainable urbanization.

At that time, none of the accessible initiatives offered a suitable open methodology for direct adoption in Koprivnica without significant changes. The team concluded that a proprietary model wasn't feasible due to resource constraints for conducting comprehensive research. Proprietary models also lacked a possibility of city comparison. In 2012, ISO/TC 268 started developing an ISO standard for sustainable community development, working on methodologies for indicators measuring city service performance and QoL, later published as ISO 37120:2014. The team closely tracked the standard's development and started implementing it as soon as it was released in May 2014. The researchers have been motivated by the opportunity to establish a systematic measurement model for monitoring changes and tracking sustainable development (EC, 2011) for Koprivnica. The goal was to establish an objective, measurable, and comparable global indicator-based measurement model, monitoring Koprivnica's Smart City sustainable development and QoL from 2010 to 2030.

Based on expressed motivation and set research goal the researchers set the following research questions:

**RQ1:** Which measurement model shall be developed or adopted for monitoring of sustainable development in the City of Koprivnica?

**RQ2:** Which data must be collected?

**RQ3:** Which data sources for calculation of measurable indicators must be used to assure reliability and verifiability of data?

#### **Research Hypotheses:**

**H1:** Implementation of (developed/adapted) measurement model enables tracking development towards sustainable and inclusive smart city.

**H2:** Implementation of a standardized measurement model enables ranking of the city's results in comparison to other cities.

### **3. RESEARCH METHODOLOGY**

The research methodology has been designed and conducted through following phases:

**Phase 1:** Measurement model selection

**Phase 2:** Recognition, understanding and selection of indicators

**Phase 3:** Determination of data sources

**Phase 4:** Initial measurement and certification process conducted in 2016

**Phase 5:** Second measurement for tracking changes in the sustainable development in 2017

**Phase 6:** Analysing the results of second measurement conducted in 2017

**Phase 7:** Measurement for tracking changes in the sustainable development - third measurement in 2023

**Phase 8:** Analysing the results of third measurement in 2023, and comparison of three indicators values in three points of time

**Phase 9:** Making the conclusion and giving feedback to city authorities about the results of measurement to consider actual strategic goals and their potential achievement by 2030.

The research process and findings are presented in a separate chapter according to the defined research methodology.

#### **3.1. Research sample**

According to the timeline of the research project, all defined indicators were measured, contingent on accessibility to artefacts. Table 1 – column 3 - presents a sample of indicators that were measured three times during the research.

#### **3.2. Research findings**

##### **Phase 1: Measurement model selection**

The benefits of employing ISO 37120:2014 include the consistent and methodologically standardized measurement of indicators, ensuring result comparability and tracking changes within the same system, along with the system's comparability to others over the same timeframe (benchmarking). These application advantages serve as a central motivating factor for choosing to implement ISO 37120. The measurement model relies on the ISO 37120 methodology (ISO, 2014) (ISO, 2018), which was initiated in 2016, building upon development outcomes accomplished from 2010 to 2015. Subsequent measurements were conducted in 2017 and 2023. The subsequent measurement is scheduled for 2030 or a year following the expiration of the program period in 2030 or 2031.

The development process described earlier, founded on strategic planning and the vision of sustainable, smart, and inclusive growth, along with the motivation to quantify and continuously monitor the City of Koprivnica's progress, including indicators for assessing citizens' QoL, led to the adoption of the Conclusion on the implementation of ISO 37120:2014 by the mayor (CLASS: 402-08/16-01/0033, REG.NO.: 2137/01-05/01-16-01 of 14 March 2016). Regarding this, in 2016, the Mayor of Koprivnica initiated the certification project according to the ISO 37120 standard. The research methodology is grounded in the application of the ISO 37120 methodology, reflecting shifts in QoL over time through indicators. QoL is frequently emphasized by global organizations such as OECD, WHO, EUROSTAT, and the comparability of these approaches is outlined by Zdjelar in Table 4 - Comparison of frameworks of QoL (Zdjelar et al., 2021). Measuring QoL involves tracking 100 indicators with calculations mandated by the standard, ensuring benchmarking for all cities with ISO 37120 certification. From citizens' perspectives, benchmarking is crucial as it assists in decision-making for residential choices, while investors gain insights into where to invest and which projects to support, especially when combined with the Open Data (OD) approach (Kelemen et al., 2017).

### **Phase 2: Recognition, understanding and selection of indicators**

The ISO 37120 measurement methodology is established within the standard itself, outlining the necessary data to be collected. The researchers delved into this methodology, specifying the precise interpretation of the data. The determination involved identifying the required data and providing a precise and clear description to facilitate unambiguous communication and exchange of requested data between researchers and data providers. The researchers also defined the following aspects for all data:

- The period from which the data is sought and its accessibility.
- Establishing the data monitoring frequency at the source (e.g., annual, periods up to one year, multiannual).
- Indicating whether the data is publicly available and if so, in which format.
  - Publicly available in an online registry (searchable online database).
  - Publicly available in a published report (PDF).
  - Publicly available upon request (email, letter).
  - Kept as internal records.
  - Not available or does not exist.

### **Phase 3: Determination of data sources**

In that part of research, researchers revealed and recorded the competent institution responsible for monitoring each piece of data. The institutions responsible for monitoring the data necessary for calculating indicators in this survey are grouped at the national, regional, and local levels. It has been particularly useful to identify the data (and indicators) that reflect the results of local government policy activities. These indicators are potentially the best way to improve the final score. For the indicators sample, the data sources are specified in Table 1. Column 7.

### **Phase 4: Initial measurement and certification process conducted in 2016**

The research process of collecting data for calculating some indicators is demanding in the sense that the data for calculation are not directly available in the required format. Instead, they need to be generated by the relevant institutions to become usable (e.g., data on the duration of planned and unplanned electricity supply interruptions).

Furthermore, in the calculation of certain indicators, it is necessary to aggregate data from multiple institutions (e.g., the number of doctors per 100,000 inhabitants; the number of employees in emergency services). This is due to the hierarchical organization of certain activities in Croatia (e.g., healthcare, citizen protection, and safety) into different levels (e.g., primary, secondary, and tertiary healthcare, or fire service and police). All indicators are presented as relative numbers or percentages.

The initial measurement was conducted in 2016, based on the available data for all indicators that could be documented (94 out of 100). The situation observed in 2016 reflects the sustainable development measures that were implemented since the beginning of the millennium and carried out in the decade before the first measurement.

When the data were collected, the value of each indicator had been calculated (Table 1., column 4.). Once all indicators for which data had been obtained were calculated, references and data sources were systematically organized according to the indicator code numbers. The final verification of the calculations and the input of indicator values into the World Council on City Data (WCCD) information system were then performed. After an audit checks and confirms the sources, and possibly approves answers following clarifications, a certificate is issued based on the number of documented indicators. According to ISO 37120:2014, a set of 100 indicators is prescribed, out of which 46 are mandatory and 54 are optional. Depending on the number of optional indicators fulfilled, candidate cities can achieve certification ranging from bronze to platinum levels. The City of Koprivnica documented all 46 mandatory indicators and 48 additional indicators, totalling 94 indicators, thereby attaining the platinum certificate. These indicators, as per ISO 37120:2014, are grouped into 21 categories, each containing both mandatory and optional indicators. After the first measurement, the City of Koprivnica achieved the ISO 37120:2014 Platinum level certification (Grad Koprivnica, 2016). Simultaneously with the certificate issuance, all documented indicators and their values become publicly available to users worldwide with access rights on the WCCD portal ([dataforcities.org](http://dataforcities.org)). This allows for visibility, comparability, and stimulates public as well as investor interest. Subsequent measurements were significantly expedited due to the insights gained during the initial measurement, making the process more efficient.

#### **Phase 5:**

##### **Second measurement for tracking changes in the sustainable development in 2017**

One year after certification, the project team checked the revision of ISO 37120:2014 and found that the norm edition had not changed. To evaluate the model's performance, data collection and selection were carried out for the second measurement. During 2017, the data collection process was notably simpler due to the familiarity and effective organization of the collection system. The institutions from which data needed to be collected were already acquainted with the data requirements, the purpose of the collection, and the method of preparing and submitting the data upon request. Data that was publicly available, either through the website in a machine-readable format or as a report, was collected without the involvement of third parties. The results are presented in Table 1. column 5. Following the procedure previously outlined, the data collection was followed by indicator calculations. Certification was intended to be conducted annually, presenting a limitation to the chosen measurement model. The costs associated with certification constituted significant expenses, and the certificate itself in 2017, unlike today, held recognition at the level of financial sources (such as the EU, banks, etc.) as a factor that contributed to a certain prioritization when granting assistance.

This pertains to EU funds and other forms of financial aid required to promote sustainable development and implement projects aligned with that goal.

#### **Phase 6: Analysing the results of second measurement conducted in 2017**

When comparing the results of research, data collection, and of the process of measurement, multiple indicators significantly influence the sustainable urban development paradigm, assuming a highly pivotal role within said progression. Within the economic sphere, a notable reduction in unemployment rates is discernible within a year, shifting from 10.37% to 7.58%. Additionally, a significant decrease in unemployment figures among individuals under 24 years of age is observed, declining from 8.50% to 5.68%. Concurrently, a drastic surge in the number of entrepreneurs is evidenced, escalating from 1626.0689 to 3942.0834 per 100,000 inhabitants. This particular metric is normalized to a scale of 100,000 residents for the purpose of global comparability. Within the domain of safety, an increase in the count of professional firefighters is recorded, rising from 220.26 to 233.221 per 100,000 inhabitants. Simultaneously, a decline in the incidence of criminal offenses is noted, subsiding from 353.07 to 343.35 per 100,000 residents. During the year of measurement, local elections were conducted, resulting in an augmented voter turnout in comparison to the year 2016, manifesting as an escalation from 31.39% to 40.91%. In the same election year, which directly contributes to the measurement and its outcomes, the proportion of female participation decreased from 38.10% to 33.33%. Positive trends are identified in the healthcare sector, notwithstanding a consistent number of hospital beds; the count of physicians has risen from 816.27 to 991.19 per 100,000 inhabitants. While the majority of indicators, or rather, outcomes, have remained static or akin to those of the preceding year, it is paramount to highlight the surge in Internet connectivity rates, ascending from 50,628.40 to 53,849.19 per 100,000 residents within the span of one year. The same level of accessibility to public water supply has been sustained, accompanied by a slightly diminished water consumption per capita per day (110 to 107.78 liters). Nonetheless, there has been a reduction in the average annual number of hours of water supply disruptions for households, declining from 0.54 hours to 0.4372 hours per year per household.

#### **Phase 7: Measurement for tracking changes in the sustainable development - third measurement in 2023**

The current version of the norm is the ISO 37120:2018 series, which encompasses the "Sustainable Development of Communities" defined by City Services and QoL indicators. Furthermore, the norm comprises two subordinate standards: ISO 37122 – indicators for Smart Cities and ISO 37123 – indicators for Resilient Cities. The current version of ISO 37120:2018 standard is categorized into 19 topics, each measured by 104 indicators. Comparability between the measurements conducted in 2016, 2017, and 2023 is ensured because the authors of this research have focused on indicators that have not undergone changes in their structure and purpose. The results are presented in Table 1. column 6.

#### **Phase 8: Analysing the results of third measurement in 2023, and comparison of three indicators values in three points of time**

Consequently, it is evident that, in terms of the Environment, the percentage of the population connected to the public electricity grid increased from 96.58% in 2016 to 97.00% in 2022. In field of waste management, the total mass of collected municipal waste decreased from 0.30 tons to 0.14 tons per capita, while the percentage of recycled waste simultaneously increased from 26.29% to 63.00%.

During the comparative period, the same percentage of the population had access to the public sewerage system and improved sanitation, standing at 95% of the city of Koprivnica's population. The consumption of water from the public water supply increased from 110 liters to 121.13 liters per capita per day. Additionally, the number of hours of disruption in the public water supply system decreased from 0.54 hours to 0.27 hours per household per year. Regarding air quality and climate changes, the percentage of suspended particles PM<sub>2.5</sub> increased from 15.5 µg/m<sup>3</sup> in 2016 to 22.71 µg/m<sup>3</sup> in 2022. However, the percentage of nitrogen dioxide decreased from 13.6 to 11.8 µg/m<sup>3</sup>, as well as the percentage of sulphur dioxide from 4.6 to 4 µg/m<sup>3</sup>. Indicators classified within the social sphere reveal that the number of students in primary education has increased from 97.32% to 99.42%, and the percentage of students completing secondary education has risen from 87.34% to 99.81%. In the field of education, the student-to-teacher ratio has decreased from 13 to 12.25 students per teacher. The percentage of the population without adequate housing has remained at 0.03%, as well as the percentage of the population living below the international poverty line at 14.77%. Regarding healthcare, the number of hospital beds has increased from 997.66 to 1,077.67 beds per 100,000 inhabitants, while the number of medical personnel has decreased from 816.27 to 591.32 per 100,000 inhabitants. Sports and recreation have shown growth in the area of outdoor and indoor sports facilities. The surface area of closed recreational spaces per capita has increased from 3.58 to 3.87 m<sup>2</sup>, and open spaces from 0.11 to 0.23 m<sup>2</sup> per capita. The final section pertains to indicators describing the economic situation. The unemployment rate has decreased from 10.37% to 3.44%, and simultaneously, the percentage of young unemployed individuals has dropped from 8.50% to 5.70%. A significant data point is that the number of business entities has increased from 1626.06 to 2774.66 per 100,000 inhabitants. In the realm of finances, the percentage of taxes collected has risen from 78.50% to 95%, while the share of own revenues in total income has declined from 70.58% to 48.27%. The number of professional firefighters, directly related to public safety, has increased from 220.26 to 262.42 per 100,000 inhabitants. The number of property-related criminal offenses has increased from 353.07 to 370.88 per 100,000 inhabitants. Regarding local elections, the number of voters who participated in the elections has risen from 31.39% to 38.85%, while the percentage of women on local electoral lists has decreased from 38.10% to 33.33%. Managing the local community also includes transportation, where there is a noticeable increase in public transport usage from 0.0061 to 0.2 trips per capita per year. The data on traffic-related fatalities shows an increase from 0 to 7 casualties per 100,000 inhabitants.

### **Phase 9: Making the conclusion and giving feedback to city authorities about the results of measurement to consider actual strategic goals and their potential achievement by 2030**

After comparing the measurement results based on indicators, it is possible to draw conclusions from the trends in these outcomes. In addition to drawing conclusions from results over a time period, it is also possible to compare with other units of local government. Conclusions can lead to recommendations for local policy makers to improve decisions that directly impact QoL, environmental preservation, or entrepreneurship stimulation. In the provided example, it's significant to realize that an increase in the number of businesses very likely contributes to a decrease in unemployment. This is an indicator for the local government to develop programs and measures to promote entrepreneurship, such as through the establishment of entrepreneurial zones, incentivized leasing or purchasing prices for land in business zones, measures for start-ups, micro and small entrepreneurs, and so on.

It can be assumed that increased economic activity resulted in higher levels of fine particulate matter (PM2.5), hence it's necessary to pay attention to environmental protection by implementing measures to mitigate this impact. Greater economic activity led to reduced municipal administration debt and there's also noticeable improvement in local tax collection efficiency. A recommendation is to direct the increased inflow of tax revenue towards promoting entrepreneurship and investing in citizens' QoL.

Each of the monitored indicators serves as a direct input parameter for decision-making, planning, and strategies for every future period. Since measurements can be done on an annual basis, some decisions can be made swiftly to influence outcomes in the short term, with the longest effect lasting until the end of the observed period, i.e., until 2030.

Measured values of indicators (research sample) according the time is presented in Table 1., as well as the data sources. Based on the results of the research presented in Table 1 columns 2016, 2017 and 2023, the hypothesis H1 can be confirmed.

To document the facts on assuring the comparability on international level it should be used the indicators values recorded in WCCD portal (<https://dashboard.dataforcities.org/login>). According to the sample of indicators in this research some comparation are selected from the total of indicators and presented in Table 2. By presenting comparability on objective and measurable way between cities that implement ISO 37120 the hypothesis H2 is confirmed.

*Table 1: Measurement results in period 2015-2023 and data sources  
(Source: Zdjelar Robertina and Dario Jembrek, authors)*

Ord. Num.	INDICATOR (research sample)	CALCULATION – RQ2	RESULT 2016.	RESULT 2017.	RESULT 2023.	Source (RQ3)
1	2	3	4	5	6	7
ECONOMY						
1.	<b>City's unemployment rate</b>	The number of working-age city residents who are not in paid employment or self-employment, but available for work and seeking work in the past 4 weeks divided by the total labor force and by 100 and expressed as a percentage.	10,37%	7,58%	<b>3,44%</b>	National level - Croatian Employment Institute
2.	<b>Youth unemployment rate</b>	The total number of unemployed youth (youth under 24 who are actively seeking work in the past four weeks) divided by the youth labor force	8,50%	5,68%	<b>5,70%</b>	National level - Croatian Employment Institute
3.	<b>Number of businesses per 100 000 population</b>	The total number of businesses in a city divided by one 100 000th of the city's total population	1.626,06/100000	3942,0834	<b>2.774,66/100.000</b>	National level - Central Bureau of Statistics, Croatian Chamber of Commerce
EDUCATION						
4.	<b>% of students completing primary education: survival rate</b>	The total number of students belonging to a school who completed the first grade of primary education divided by the total number of students who reached the final grade of primary education; result multiplied by 100 and expressed as a percentage.	97,32%	97,32%	<b>99,42%</b>	Local level – City of Koprivnica; Regional level – Koprivnica-Križevci county
5.	<b>% of students completing secondary education: survival rate</b>	The total number of students belonging to a school who completed the first grade of secondary education divided by the total number of students who reached the final grade of secondary education; result multiplied by 100 and expressed as a percentage.	87,34%	100,00%	<b>99,81%</b>	Regional level – Koprivnica-Križevci county

6.	<b>Primary education student/teacher ratio</b>	The number of enrolled primary school students divided by the number of full-time equivalent primary school classroom teachers	13	12,25	<b>12,25</b>	Local level – City of Koprivnica
ENERGY						
7.	<b>% of city population with authorized electrical service</b>	The number of persons in the city with lawful connections to the electrical supply system divided by the total population of the city; the result multiplied by 100 and expressed as a percentage.	96,58%	96,58%	<b>97,00%</b>	National level - Central Bureau of Statistics
ENVIRONMENT AND CLIMATE CHANGE						
8.	<b>Fine particulate matter (PM2.5) concentration</b>	The concentration of PM 2.5 in micrograms per standard cubic meter; annual average	15,5 µg/m3	15,5 µg/m3	22,71 µg/m3	National level - Croatian Environment Agency Local level – City of Koprivnica
9.	<b>Nitrogen dioxide (NO2) concentration</b>	The sum of NO2 concentration in micrograms per m3 for the whole year divided by 365 days; annual average for daily NO2 concentration	13,6 µg/m3	13,6 µg/m3	<b>11,8 µg/m3</b>	Regional level – Koprivnica-Križevci county
10.	<b>Sulphur dioxide (SO2) concentration</b>	The sum of SO2 concentration in micrograms per m3 for the whole year divided by 365 days; annual average for daily SO2 concentration	4,6 µg/m3	4,6 µg/m3	<b>4 µg/m3</b>	Regional level – Koprivnica-Križevci county
FINANCE						
11.	<b>Own-source revenue as a percentage of total revenues</b>	The total amount of funds obtained through permit fees, user charges for city services, and taxes collected for city purposes only, divided by all revenues; the result multiplied by 100 and expressed as a percentage.	70,58%	70,58%	48,27%	Local level – City of Koprivnica
12.	<b>Tax collected as a percentage of tax billed</b>	The total revenues generated by tax collection divided by the amount of taxes billed; the result multiplied by 100 and expressed as a percentage.	78,50%	78,51%	<b>95%</b>	Local level – City of Koprivnica
SAFETY						
13.	<b>Number of firefighters per 100 000 population</b>	The total number of paid full-time firefighters divided by on 100 000th of the city population.	220,26/ 100.000	233,221/ 100.000	<b>262,42/ 100.000</b>	Local level - Public fire-department
14.	<b>Crimes against property per 100 000</b>	The total number of all property crimes (burglary, larceny-theft, motor vehicle theft, arson) reported divided by one 100 000th of the total city population	353,0707/ 100.000/yr	343,35/ 100.000/yr	370,88/ 100.000/yr	Local level - City police station
GOVERNANCE						
15.	<b>Voter participation in last municipal election (as % of eligible voters)</b>	The number of persons that voted in the last municipal election divided by the city population eligible to vote; the result multiplied by 100 and expressed as a percentage.	31,39%	40,91%	<b>38,85%</b>	Local level – City of Koprivnica
16.	<b>Women as a % of total elected to city-level office</b>	The total number of elected city-level positions held by women divided by the total number of elected city-level positions; the result multiplied by 100 and expressed as a percent.	38,10%	33,33%	33,33%	Local level – City of Koprivnica
HEALTH						
17.	<b>Number of in-patient hospital beds per 100 000 population</b>	The total number of in-patient public and private hospital beds divided by one 100 000th of the city's total population	997,66 / 100000	997,67/ 100.000	<b>1.077,67/ 100000</b>	Regional level – Koprivnica-Križevci county
18.	<b>Number of physicians per 100 000 population</b>	The number of general or specialized practitioner whose work place is in the city divided by one 100 000th of the city's total population.	816.2736/ 100000	991,1894/ 100.000	591,32 / 100000	Regional level – Koprivnica-Križevci county



HOUSING						
19.	% of city population living in inadequate housing (core)	The number of people living in slums (number of households in substandard or insecure housing multiplied by current average household size) divided by the city population; the result multiplied by 100 and expressed as a percentage.	0,03%	0,03%	0,03%	National level - Central Bureau of Statistics
POPULATION AND SOCIAL CONDITIONS						
20.	% of city population living below the international poverty line (core)	The number of people living below the poverty threshold (as recorded by the World Bank) divided by the total current population of the city; the result multiplied by 100 and expressed as a percentage.	14,77%	14,77%	14,77%	National level - Central Bureau of Statistics
RECREATION						
21.	Square meters of public outdoor recreation space per capita	The square meters of outdoor public recreation space (city owned or other recreation land within the city) divided by the population of the city.	3.58 m <sup>2</sup> /capita	3,5864 m <sup>2</sup> /capita	<b>3,87</b> m <sup>2</sup> /capita	Local level – City of Koprivnica
22.	Square meters of public indoor recreation space per capita	The square meters of indoor public recreation space (city owned or other recreation buildings within the city) divided by the population of the city.	0.11m <sup>2</sup> /capita	0,1182 m <sup>2</sup> /capita	<b>0,23</b> m <sup>2</sup> /capita	Local level – City of Koprivnica
SOLID WASTE						
23.	Total collected municipal solid waste per capita per year	The total amount of solid waste (household and commercial - with exclusion of sewage network waste and construction and demolition waste) generated in tonnes divided by the total city population.	0.30 t/ per capita	0,3003 t/capita	<b>0,14 t/ per capita</b>	Local level - Local utility company
24.	% of the city's solid waste that is recycled	The total amount of the city's solid waste that is recycled in tonnes divided by the total amount of solid waste produced in the city in tonnes; the result multiplied by 100 and expressed as a percentage	26,29%	26,29%	<b>63,00%</b>	Local level - Local utility company
TELECOMMUNICATION AND INNOVATION						
25.	Number of internet connections per 100 000 population	The number of internet connections in the city divided by one 100 000th of the city's total population.	50.628,40/ 100 000	53.849,19/ 100.000	<b>56.006,72/ 100.000</b>	National level - Croatian Regulatory Authority for Network Industries (HAKOM)
TRANSPORTATION						
26.	Annual number of public transport trips per capita	The total annual number of public transport trips originating in the city, divided by the total city population.	0.0061 capita/year	0,0061 per capita/yr	<b>0,2 per capita/year</b>	Local level - Local utility company
27.	Transportation fatalities per 100 000 population	The number of fatalities (deaths) related to transportation of any kind (automobile, public transportation, bicycling, walking, etc.) within the city borders, divided by 100 000th of the city's total population.	0/ 100.000	9,7/ 100.000	7/ 100.000	National level - City police station
WASTEWATER						
28.	% of population with access to improved sanitation	The total number of people using improved sanitation facilities divided by the total city population; the result multiplied by 100 and expressed as a percentage.	95%	95%	95%	Local level - Local utility company
WATER						

29.	<b>Total domestic water consumption per capita (liters/day)</b>	The total amount of the city's water consumption in liters per day for domestic use divided by the total city population. <i>*only domestic use - water consumed for industrial and commercial purposes shall be excluded.</i>	110 l/capita/day	107,78 l/capita/day	121,13 l/capita/day	Local level - Local utility company
30.	<b>Average annual hours of water service interruption per household</b>	The total sum of hours of interruption multiplied by the number of households impacted, divided by the number of households. Incidents of complete shutoff, low flow restrictions, boil water advisory, water main flushing, planned and unplanned interruptions are included.	0,54 hrs/yr/household	0,4372 hrs/yr/household	<b>0,27 hrs/yr/household</b>	Local level - Local utility company

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**Table 2.: Indicators value of City of Koprivnica to other cities according WCCD ISO 37120**  
 (Source: Komunalac d.o.o (2017), <https://dashboard.dataforcities.org/>)

Indicator	Koprivnica	Compared city	
Number of internet connections per 100 000 population (2016)	50.628,4	21.181,30	Dubai
		49.642,00	Amsterdam
		72.423	Boston
Number of businesses per 100 000 population (2016)	1.626,07	6.031	Dubai
		9879	Amsterdam
Transportation fatalities per 100 000 population (2016)	0	1,36	Barcelona
Nitrogen dioxide (NO2) concentration (2016)	13,6 µg/m3	29.89 µg/m3	Bogota
		28.02 µg/m3	Los Angeles
City's unemployment rate (2016)	10,37%	5,3%	Boston
		4,7%	San Diego
Youth unemployment rate (2016)	8,5%	13,6%	Boston
		7,8%	Melbourne
		21,6%	Toronto
Total domestic water consumption per capita (liters/day) (2016)	110 l/capita/day	100.88 l/capita/day	Haiphong
Total collected municipal solid waste per capita per year (2016)	0.30 t/ per capita	0.30 t/ per capita	Haiphong
Fine particulate matter (PM2.5) concentration (2016)	15,5 µg/m3	14.2 µg/m3	London
		8,96 µg/m3	Toronto
		19,6 µg/m3	Taipei

#### 4. LIMITATION AND FUTURE RESEARCH

In collecting data for this study, as well as in its subsequent analysis, it is understandable that there are limitations that could have influenced the final results. Specifically, the implementation of the ISO standard over the past ten years has been carried out in very few cities in Croatia (Rijeka, Dubrovnik). On the other hand, the human and technological capacities of local administration, and sometimes financial constraints, pose obstacles to the implementation of proposed measures to achieve the specified indicators. Furthermore, in 2023, there are still limitations on data accessibility and open data platforms, which are often either unavailable or only partially accessible. The owners of databases have to give especial permission for access and further use to users. Frequently, the data obtained are not in a suitable format for further analysis and processing, necessitating data adaptation to a form appropriate for the purpose of this study. Aware of these limitations, public administration should continue developing open data platforms that not only contribute to transparency but also enable their use in the continued development of cities, municipalities, as well as public and private companies. Authors find it important to mention that there exist other contemporary trends that shape and oversee community sustainability from the perspectives of environment, social responsibility, and governance. The inception of this concept dates back two decades.

The current approach is termed the Environment-Social-Governance (ESG) business approach, and within the European framework, public authorities are presently engaged in the development and promotion of a taxonomy aimed at ensuring standardization in gauging the extent of developmental sustainability and the responsibility towards future generations. The principal distinction between the ESG concept and the ISO 37120 sustainability monitoring concept lies in the fact that ISO 37120 is precisely oriented towards local government (specifically cities, not municipalities), whereas ESG is becoming or will become obligatory for economic entities. The authors intent to make a new direction in the research of monitoring sustainability by comparing the advantages of implemented ISO 37120 with the ESG methodology and OECD methodology.

## 5. CONCLUSION

Considering the research questions and hypotheses, conclusions have been drawn that the ISO 37120:2014 and/or 37120:2018 standard has proven to be a quality tool for measuring the sustainability and success of local self-government, as it uniquely provides a model through which this can be monitored. From the very list of indicators in the ISO 37120 standard, it is predetermined what data needs to be collected, or rather, what information needs to be acquired to determine, measure, or calculate the indicators value. So far, there has been one amendment to the standard that eliminated certain previous indicators and introduced new ones. Nevertheless, it is still possible to compare results easily and effectively from previous years with the current ones. The research has shown that not all data is publicly available, not all data is in a suitable format for indicators, or some data simply doesn't exist. As this concerns a small amount of inaccessible data, its impact on the overall result is nearly negligible. To improve this situation, it is necessary to digitize databases, enable open access, search, sorting, and extraction of data and information in a machine-readable format, and store them in online locations that are accessible, reliable, and permanent.

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