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22nd International Symposium on Quality

QUALITY - YESTERDAY, TODAY, TOMORROW

9.-11. lipnja 2021.
June 9th – 11th, 2021
Poreč, Hrvatska/Croatia

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CROATIAN QUALITY MANAGERS SOCIETY

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AN OVERVIEW OF ISO STANDARDS THAT SUPPORT THE DEVELOPMENT OF SMART CITIES

PREGLED ISO NORMI KOJE PODUPIRU RAZVOJ PAMETNIH GRADOVA

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ABSTRACT

The concept of sustainable development and the concept of smart city are two basic concepts of the modern world, created because of urban population growth, climate change, scarcity of resources and other changes and challenges. It can be said that these two concepts came about because of an innovative way of thinking about the crisis that society is in. To facilitate the adaptation of urban areas to new concepts that place emphasis on sustainability in an economic, environmental and social context, ISO has further a range of standards that are not only aligned with the UN Sustainable Development Goals but also the Smart Cities concept. The paper defines standards that cities need to adapt to, or whose requirements they need to meet to achieve sustainable development, and emphasizes the ISO 37120 standard, the first

standard to propose a set of indicators for measuring and monitoring the success of Smart City initiatives.

Key words: *Smart City, Sustainable Development, Sustainable Development Goals, ISO 37120*

1. INTRODUCTION

Negative changes in the environment, as well as the reduction of scarce resources, poverty and other problems that society is facing, have created a need for increasing protection of the current state, as well as an attempt to improve all areas of life. All these changes in the environment have also affected the overall society, which is adapting to the new state. More and more people from rural areas are moving to urban areas, which, as a result of rapid population growth, face a number of problems. These problems of urban areas are closely related to changes occurring in the surrounding area, and it can be said that the problems arising from urban areas additionally stimulate, that is, have negative effects on the overall society. Urban areas around the world have recognized the need to improve the existing situation and significant improvements to the urban management system have been implemented.

Technological growth and development and numerous opportunities have made a significant difference between individual urban areas, regions and even countries. Improvements in the lower level, condition the improvements at the higher level, therefore the need to harmonize the development of regions and urban areas is recognized at the state level, in order to function and improve the development of the whole, i.e. the states and higher levels (such as unions, international organizations, etc.). All this has led to the question of what urban areas should look like, or what components they must have, and how they should be managed. To achieve sustainability and sustainable development. ISO, an International Organization for Standardization, has recognized the importance of these issues and, through a number of standards, enables the orientation of urban and other areas towards achieving sustainable growth and development.

The aim of this paper is to analyse and systematize all ISO standards that help urban areas to achieve the concept of a smart city and which can help urban areas to manage certain areas in the city. Also, this paper aims to highlight the importance of ISO 37120 standards, as well as provide an overview of urban areas certified with that standard. This paper is divided into three key parts. The first part provides an overview of ISO standards and sustainable development goals, as well as standards related to the achievement of sustainable development goals. Sustainable development is closely linked to the

concept of smart cities, where smart cities strive to achieve sustainability and they are essentially sustainable cities. The second part defines standards related to the concept of a smart city, and the last part provides an overview of ISO 37120 and an analysis of all certified urban areas. Ultimately, a conclusion is given at the very end.

2. ISO AND SUSTAINABLE DEVELOPMENT

The concept of sustainable development has three basic components, the environmental, economic and social component. All three components are interconnected and through their actions, ie by achieving the sustainability of these three components, it is possible to achieve sustainable development.

At the UN in New York An Open Task Force created by the UN General Assembly has proposed a set of Global Sustainable Development Goals (SDGs) containing 17 goals that are planned to be achieved by 2030.[1] These 17 goals contain solutions to all the problems that modern society is facing. ISO has published more than 22,000 international standards and related documents that represent globally recognized guidelines and frameworks based on international cooperation. ISO standards help governments, industry and consumers contribute to achieving these goals.

For each of these Sustainable Development Goals, ISO offers a set of standards that contribute to the achievement of those goals. An overview of the goals and the number of ISO standards is shown in the following table.

Table 1. ISO standards that support sustainable development goals

Sustainable development goals	ISO standards related to the goal
1. No poverty - End poverty in all its forms everywhere	68 standards that support the goal. Some of the important standards in the field are: ISO 24000 i ISO 37001.
2. Zero hunger - End hunger, achieve food security and improved nutrition and promote sustainable agriculture	67 standards that support the goal. Some of the important standards in the field are: ISO 22000*ff*, ISO 26000, ISO 20400, ISO 34101.
3. Good health and well-being - Ensure healthy lives and promote well-being for all at all ages	374 standards that support the goal. Some of the important standards in the field are: ISO 11137, ISO 7153, ISO 37101, IWA 18.
4. Quality education - Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all	74 standards that support the goal. Some of the important standards in the field are: ISO 21001, ISO 29993.
5. Gender equality - Achieve gender equality and empower all women and girls	51 standards that support the goal. One of the standards in the field is ISO 26000.
6. Clean water and sanitation - Ensure availability and sustainable management of water and sanitation for all	128 standards that support the goal. Some of the important standards in the field are: ISO 24518, ISO 24521, ISO 30500.

[1] Tomas Hák, Svatava Janoušková and Bedřich Moldan, „Sustainable Development Goals: A need for relevant indicators“, *Ecological Indicators*, 60, 2016, 565-573.

7. Affordable and clean energy - Ensure access to affordable, reliable, sustainable and modern energy for all	150 standards that support the goal. Some of the important standards in the field are: ISO 50001, ISO 52000, ISO 9806, ISO 17225.
8. Decent work and economic growth - Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	169 standards that support the goal. Some of the important standards in the field are: ISO 45001, ISO 37001.
9. Industry, innovation and infrastructure - Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	464 standards that support the goal. Some of the important standards in the field are: ISO 44001, ISO 56002, ISO 56003.
10. Reduced inequalities - Reduce inequality within and among countries	121 standards that support the goal. Some of the important standards in the field are: ISO 26000, ISO 37001.
11. Sustainable cities and communities - Make cities and human settlements inclusive, safe, resilient and sustainable	232 standards that support the goal. Some of the important standards in the field are: ISO 37120, ISO 37122, ISO 37123, ISO 22313, ISO 22326, ISO 22395, ISO 24526.
12. Responsible consumption and production - Ensure sustainable consumption and production patterns	286 standards that support the goal. Some of the important standards in the field are: ISO 20400, ISO 14020, ISO 15392, ISO 20245.
13. Climate action - Take urgent action to combat climate change and its impacts	210 standards that support the goal. Some of the important standards in the field are: ISO 14001, ISO 14064, ISO 14067, ISO 14080.
14. Life below water - Conserve and sustainably use the oceans, seas and marine resources for sustainable development	100 standards that support the goal. Some of the important standards in the field are: ISO 14001, ISO 13009.
15. Life on land - Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss	140 standards that support the goal. Some of the important standards in the field are: ISO 14055, ISO 14000*ff,* ISO 38200.
16. Peace, justice and strong institutions - Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels	66 standards that support the goal. Some of the important standards in the field are: ISO 9600, ISO 37000, ISO 37001.
17. Partnership for the goals - Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development	ISO partner with a large number of international organizations to ensure participation from a diverse array of stakeholders and bring the benefits of standards to all countries, regardless of size or economic status.

Source: Adapted by the author from iso.org

Through these standards, ISO as an organization contributes to the achievement of the goals of sustainable development, that is, overall sustainability. There are several key standards for achieving the concept of sustainability, related to environmental, economic and social sustainability.

An increasingly important standard in the context of environmental sustainability is ISO 14001. Through the implementation and improvement of the quality management system and above all the implementation of ISO 14001, the organization can reduce and control its impact on the environmental component that is part of the sustainability triangle.[2] Social sustainability is support-

[2] Krešimir Buntak, Maja Mutavdžija and Ivana Martinčević, "Influence of smart city components on competitiveness of tourism destination", *In Economic and Social Development* Book of Proceedings of 46th International Scientific Conference on Economic and Social Development, 2019, p. 191.

ed through ISO 26000 - Social responsibility. ISO 26000 provides guidance on how businesses and organizations can operate in a socially responsible way. This means acting in an ethical and transparent way that contributes to the health and welfare of society.[3] In the context of economic sustainability, it is important to emphasize the ISO 9001 standard, which defines how to manage an organization with good quality, which in turn has the satisfaction of the end user as well as other stakeholders and the improvement of overall economic sustainability.

Implementing some of these standards improves the living conditions of a particular area and creates the basis for further improvements. A big challenge for all the countries pursuing the achievement of sustainable development goals is to understand the interrelationships between the goals better with reference to their country development contexts. On the basis of that understanding, the countries should determine which actions are required to maximise their potential.[4] These goals must be implemented in urban development strategies, and must be particularly emphasized when using new technological forms to plan and collect data in a particular area. Also, an important concept that is being developed is the concept of Smart Cities. Developed urban areas today need to develop Smart city strategies, that is, strategies with which they will implement smart solutions in their areas, within the capabilities of a particular urban area, which will work to achieve the goals of sustainability and social improvement.

3. ISO AND SMART CITY

The Smart City concept has evolved in response to growing urbanization. An increasing population in urban areas is demanding adaptation of the system to new changes, but also adapting to the needs of new generations of society.[5] The crisis is a source for innovation and thus the crisis affecting urban areas has been an incentive to create new solutions, which are recognized through the Smart City concept.[6]

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[3] Iso.org, ISO 26000 Social responsibility. https://www.iso.org/iso-26000-social-responsibility.html (pristupljeno: 29.10.2019.)

[4] Lorren Kirsty Haywood, and Nikki Funke, „The Sustainable Development Goals: A New Nexus for Sustainable Development“, Techincal Report, Council for Scientific and Industrial Research, South Africa, 2019.

[5] Krešimir Buntak, Maja Mutavdžija and Matija Kovačić, "Continuous process improvement as a foundation for sustainable organizational development", Proceedings of 20th International Symposium on Quality *Quality – yesterday, today, tomorrow*, Hrvatsko društvo menadžera kvalitete, Zagreb, Pula, 2019, pp. 311-320.

[6] Teawoo Nam and Theresa A. Pardo, "Smart city as urban innovation," Proceedings of the 5th International Conference on *Theory and Practice of Electronic Governance – ICEGOV*, 2011.

Given that the Smart City concept is manifested through several key components, these components must be supported through the relevant standards. The Smart City concept has 6 core components, which are: Smart economy, Smart mobility, Smart environment, Smart living, Smart people and Smart Governance. The economic component of a smart city highlights a knowledge economy or economy based on knowledge, research and development and technological innovations. One of the essential parts of a Smart City is to have environmental sustainability, which refers to the ecological implications of urban growth and development. A smart city should have a large-scale environmental monitoring system: for example, indoor and outdoor air-quality monitoring and measurement and telemetry of noise and pollution.[7] Human and social capital, people, education, learning, and knowledge are of central importance to this concept. Smart Governance and Smart management are the most important component of a Smart City, because those components serve as a foundation for connecting all the other components together. Local authorities must not only use the appropriate technological means (infrastructure, hardware, and software), but also be endowed with an efficient organizational structure.

To realize the concept of a smart city, it is necessary to satisfy the individual components of a smart city. This would mean that if the city meets the indicators and conditions in terms of smart mobility, economy, people and more, it meets the whole concept. ISO made a set of standards that urban areas or associated parts of an area (such as organizations operating in urban areas) can use to comply with the requirements of the concept. Some of these standards are, for example, ISO 50001 - Energy management system or ISO 39001 - Road traffic safety, and the following table illustrates all relevant standards related to the Smart city concept.

Table 2. List of standards related to Smart City concept

ISO 17742	Energy efficiency and savings calculation for countries, regions and cities
ISO 50001	Energy management system
ISO 50006	Energy management systems — Measuring energy performance using energy baselines (EnB) and energy performance indicators (EnPI) — General principles and guidance
ISO 39001	Road traffic safety (RTS) management systems
ISO 39002	Good practices for implementing commuting safety management
ISO 24510	Activities relating to drinking water and wastewater services – Guidelines for the assessment and for the improvement of the service to users
ISO 24511	Activities relating to drinking water and wastewater services - Guidelines for the management of wastewater utilities and for the assessment of wastewater services

[7] J. Ramon Gil-Garcia, Theresa A. Pardo and Teawoo Nam, "What makes a city smart? Identifying core components and proposing an integrative and comprehensive conceptualization", *Information Polity*, Vol. 20, No. 1, 2015.

ISO 24512	Activities relating to drinking water and wastewater services - Guidelines for the management of drinking water utilities and for the assessment of drinking water services
ISO 20325	Guidelines for storm water management in urban areas
ISO 24516	Guidelines for the management of assets of water supply and wastewater systems
ISO 24518	Crisis management of water utilities
ISO/IEC 30182	Smart city concept model – Guidance for establishing a model for data interoperability
ISO/IEC 21972	Information technology – An upper level ontology for smart city indicators
ISO/IEC 27550	Information technology – Security techniques – Privacy engineering
ISO/IEC 27551	Information technology – Security techniques – Requirements for attribute-based unlinkable entity authentication
ISO/TS 37151	Smart community infrastructures – Principles and requirements for performance metrics
ISO/TR 37152	Smart community infrastructures – Common framework for development and operation
ISO 22313	Societal security – Business continuity management systems – Guidance
ISO 22327	Security and resilience – Emergency management – Guidelines for implementation of a community-based landslide early warning system
ISO 22395	Security and resilience – Community resilience – Guidelines for supporting community response to vulnerable people
IWA 18	Framework for integrated community-based life-long health and care services in aged societies
ISO/IEC Guide 71	Guide for addressing accessibility in standards
ISO 45001	Occupational health and safety management systems

Source: Adapted by the author from iso.org

The ISO recognizes the importance of the Smart Cities concept, which is why it releases ISO 37120 in 2018. ISO 37120 certificate or Smart City certification helps cities measure progress with the goal of improving the quality of life in the city. The standards are developed by the leading experts of ISO Technical Committee on Sustainable Development (ISO/TC 286), using the knowledge and experience of 250 cities.[8] (Buntak et al, 2019). ISO 37120 achieves sustainability goals as well as meeting the requirements of the smart city concept.

4. ISO 37120 AND CERTIFIED URBAN AREAS

ISO 37120 certificate, or Smart City certificate, helps cities measure progress, with the goal of improving the quality of life in the city. The standards are developed using the knowledge and experience of 250 cities as mentioned before. ISO 37120 alongside with ISO 37122 and ISO 37123 are family of city indicators standards aimed on achieving sustainable development of communities.

[8] Krešimir Buntak, Maja Mutavdžija and Matija Kovačić, „A review on measuring the success of smart city initiatives. 46. Nacionalna konferencija o kvalitetu - Zbornik radova *Festival kvaliteta 2019*, Kragujevac, Serbia, 2019.

Implementation of the ISO 37120 indicator is key to achieving the sustainable development of an area. The indicators presented through ISO 37120 can serve as a basis for urban development and are further upgraded through ISO 37122 and ISO 37123 standards. ISO 37120 focuses on performance of city services. It was first published in 2014 and a revised version was released in July 2018. ISO 37122 provides indicators for smart cities and was first publicly released in the form of draft international standard in June 2018 and this standard was published in 2019. A third indicator standard ISO 37123 on resilient cities was also published in 2019. These standards have been developed with sustainability as a guiding principle and therefore can be used in conjunction to provide a holistic approach to urban sustainability.[9]

ISO 37120 is divided into 19 areas, ie parts of an urban area, which are: Economy, Education, Energy, Environment, Finance, Governance, Health, Housing, Population and Social Conditions, Recreation, Safety, Solid Waste, Sports and Culture, Telecommunication, Transportation, Urban/Local agriculture and food security, Urban Planning, Wastewater and Water. For each thematic area, indicators (a total of 104 indicators) are defined, based on which it is possible to compare and evaluate urban areas. This comparison, between urban areas that have ISO 37120 implemented, is done by the World Council on City Data (WCCD). The WCCD contains of a network of innovative cities committed to improving services and quality of life with open city data and provides a consistent and comprehensive platform for standardized urban metrics. The WCCD has developed ISO 37120 certification and it offers five ranges of certification level. Certification levels are based on the number of indicators that are present in a specific city. Five certification levels are: Aspirational, Bronze, Silver, Gold and Platinum. In the following table five levels of certification can be seen, as well as the number of indicators needed for a specific level of certification and cities that are certified in that specific level. Every certified city must apply for certification on annual basis.

[9] Aapo Huovila, Peter Bosch and Miimu Airaksinen, "Comparative analysis of standardized indicators for Smart sustainable cities: What indicators and standards to use and when?", *Cities*, 89, 2019, pp. 141-153.

Table 3. Certification levels and certified cities in 2019

Certification level	Indicators needed	Cities at that level
Aspirational	30 – 44 core indicators	None
Bronze	46 – 59 indicators (45 core + 0-14 supporting)	Bahía de Banderas (Mexico)
Silver	60 – 74 indicators (45 core + 15-29 supporting)	None
Gold	75 – 89 indicators (45 core + 30-44 supporting)	None
Platinum	90 – 104 indicators (45 core + 45-59 supporting)	Guadalupe (Mexico); Guelph, Mississauga, Whitby, Yellowknife, Selkirk, Sudbury, Corner Brook, Waterloo, Kitchener, Brant, Edmonton, Brampton, Markham, Mount Pearl, St. John's, Richmond Hill, Charlottetown, Saskatoon, Welland, Cambridge, Quebec City (Canada); Brisbane (Australia); Kópavogur (Iceland)

Source: Author according to dataforcities.org

In 2019, only one city gained Bronze certification level and from all applied cities all of them gained Platinum level. A total of 26 cities applied in 2019, 22 of them are in Canada, 2 in Mexico, 1 in Australia and 1 in Iceland. In 2020 no new cities applied for certification.

Every year a city can gain higher or lower certification level in accordance to needed indicators. Using indicators given by ISO 37120, cities can track their sustainability progress as well as the progress towards becoming smarter. However, using given scale for certification without taking into consideration values of those indicators can raise different questions, such as credibility. Nevertheless, suggested indicators can be used for comparing different global cities and their performances in a specific area which can help cities in achieving desired smart level.

5. CONCLUSION

All the ISO standards mentioned above are used to guide an urban area and assist in planning and decision making related to that area. With the implementation of ISO 37120, urban areas are provided with competitive indicators and guidance for the further development of the area and can compare with best practices in the world. Excluded from the ISO 37120 standard, there are several standards that allow urban areas to align with sustainable development goals, that is, assist urban areas in achieving economic, environmental and social sustainability.

Achieving all the goals of sustainability improves the quality of life of all residents of an area, but also all future generations. The indicators presented through ISO 37120 can be used to identify smart cities and individual analyses

have been conducted through various studies to determine the "smartness" of an urban area using some of the existing 104 indicators. However, it is important to consider the remaining existing standards and their requirements, from which it is also necessary to identify the indicators that are necessary for managing an area or that form the basis for the functioning of an urban area. It is important to emphasize governance, which must be in line with the relevant standards.

The suggestion for further research is to make a detailed description of the remaining norms and their requirements, key to the realization of the Smart City concept and the pre-existing indicators for measuring the success of the Smart Cities Initiative.

Abstract:

PREGLED ISO NORMI KOJE PODUPIRU
RAZVOJ PAMETNIH GRADOVA

Koncept održivog razvoja i koncept pametnog grada dva su temeljna koncepta suvremenog svijeta, nastala kao posljedica rasta broja stanovnika urbanih područja, klimatskih promjena, oskudnosti resursa i ostalih promjena te izazova. Može se reći kako su ta dva koncepta nastala posljedično inovativnom načinu promišljanja o krizi u kojoj se društvo nalazi. Za lakšu prilagodbu urbanih područja novim konceptima, koji naglasak stavljaju na održivost u ekonomskom, ekološkom i socijalnom kontekstu, ISO na raspolaganje dalje niz normi, koje su ne samo usklađene s ciljevima održivog razvoja UN-a, već i konceptom Pametnih gradova. Kroz rad definiraju se norme kojima se gradovi trebaju prilagoditi, odnosno čije zahtjeve trebaju ispuniti, kako bi ostvarili održivi razvoj te se naglašava i norma ISO 37120, prva norma koja predlaže set indikatora za mjerenje i praćenje uspjeha Smart City inicijativa.

Ključne riječi: *Pametan grad, održivi razvoj, ciljevi održivog razvoja, ISO 37120.*

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