The role of technical standards in shaping Smart Cities in Polish cities

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Summary

The purpose of the article is to identify, elaborate and systematize the role of technical standards in the formation of Smart Cities in Poland. The method used was a critical analysis of legal documents and a case study of Warsaw and Krakow, supported by induction and deduction. The results of the study show that the voluntary application of ISO 37120/37122 standards causes fragmentation of implementations and limits the advancement of Polish cities in the rankings of smart metropolises. The author argues that legal sanctioning of key Smart City standards and a mechanism for their regular updating could accelerate digital transformation and increase interoperability of urban infrastructure.

Keywords: Smart City, technical standards, standardization

1. Introduction

Since the dawn of time, cities have been the engines of civilization's development. It was in cities that pioneering concepts were realized and breakthroughs were made. Like a lens, they concentrated knowledge, capital, and power. This resulted from the concentration of people from different social and professional backgrounds in one place, facilitated by international trade, which took place in large, commercial hubs. Cities functioned as key nodes, where trade routes intersected and connected. This attraction led to the influx of people from various corners of the world, contributing to global economic integration and the formation of state structures. As a result, metropolises became centers of innovation and progress.

Despite their long history and continuous growth, cities today maintain their innovative character, continuing to attract talented, open-minded individuals. Regardless of their role, cities remain places with which people want to identify and experience, offering unique opportunities for economic, social, and cultural development and improving the quality of life for residents. The same is true today, with urban centers facing many challenges associated with their further development in the era of the fourth industrial revolution. Urbanization, climate change, and the needs of sustainability all fit into the Smart City concept. It aims to use new technologies and informatization to improve the quality of life for residents. However, the implementation of this concept faces many difficulties. There is a lack of a unified concept and standardization to guide specific actions in line with the Smart City idea. In these circumstances, technical standards do not come to the rescue, mainly due to the lack of obligation to implement them.

The article examines how the application of the most important Smart Cities standard ISO 37120/37122 affects the development of Smart Cities in Polish cities, taking into account its voluntary application.

2. Defining a Smart City

In the face of dynamic social and technological change, the discussion of urban sustainability is increasingly resurfacing. Today's agglomerations are facing challenges arising from increasing urbanization, the digital revolution or the limitations on social mobility brought about by global crises. The rapid development of technology, the economic transformations associated with the fourth industrial revolution and the growing pressure on urban infrastructure are driving local governments to seek innovative solutions. Increasingly, these are taking the form of smart city management strategies, where modern technologies and data analysis play a key role in enhancing the quality of life of residents and improving the functioning of urban systems [3],[10]. Such activities are part of the Smart City concept.

The notion of Smart City can be found in international studies of recommendation, regulatory and standardization significance. It is used and developed in various contexts, which makes it possible to reconstruct a certain range of its meaning [7].

For the purposes of this paper, Smart City is defined as a space in which society consciously uses modern technologies to streamline city management, improve information flow and increase the availability of public services. Smart systems promote resource efficiency, which translates into a higher quality of life for residents and promotes sustainable development in both the public and private sectors [1],[2],[5].

3. Normalizing the Smart City

Since there is no uniform legal definition, international standards organizations are trying to standardize the methodology for describing and implementing the Smart City concept by developing technical standards.

The most important standards are those of ISO, the International Organization for Standardization, as a global body that develops technical standards. The organization has adopted a series of standards for Smart City [6], which, among other things, define urban indicators and the quality of life in cities, as well as define coefficients for the resilience of agglomerations to climate change, crises and disasters.

The international standard ISO 37120:2014, entitled "*Sustainable social development - Indicators of urban services and quality of life*," plays a key role here. The referenced standard defines 100 indicators divided into 17 key thematic areas, such as economy, education, energy, environment and climate change, finance, health, housing, security, transportation, urban planning, water management, solid waste management, telecommunications, recreation, sports and culture, urban agriculture and food security, and governance. The indicators are categorized as core and supporting, allowing for flexibility to tailor the assessment to the specifics of a particular city.

It should be noted that the implementation of the European standard has occurred in the Polish system. In Poland, it is called ISO 37120, and its implementation brings a number of benefits to cities, such as: the ability to compare results with other cities in the world, identification of areas for improvement, increased transparency of city administration activities, building trust among residents and investors. In Poland, the certificate of adoption of this standard, has been obtained by few cities: Gdynia, Gdansk, Kielce, Lublin, Warsaw [8].

Additionally, cities such as Krakow, Wroclaw, Poznan and Lodzare often mentioned in the context of smart city development in Poland, although not all of them have formally implemented the ISO 37120 standard.

The transparent reporting of these indicators fosters trust among residents and investors by providing clear, measurable insights into the city's performance, allowing for informed decision-making, supporting decisions about settling in a city that meets such standards, and building credibility.

4. Legal nature of technical standards in the legal system in Poland

Technical standards play an important role in the regulation of economic and technological processes, serving as a tool to promote the harmonization of standards at the national, regional and international levels. Their purpose is to describe the proven state of technical knowledge,

which indicates the current level of development in a particular field, as well as to facilitate cooperation between different entities.

A key question concerns the legal status of technical standards and their relationship to the Polish legal system. How should these regulations be treated in the context of current legislation?

In the Polish legal system, the sources of universally binding law are defined by the Constitution of the Republic of Poland in Article 87 (1) [4], according to which they include: Constitution, laws, ratified international agreements, regulations. Technical norms are not listed as sources of law in the Constitution, which means that their application is not mandatory unless they are explicitly indicated in a law or regulation.

Under Article 5 (3) of the Law on Standardization, the principle of voluntary application of technical standards is established. The exceptions are cases in which state laws indicate their mandatory application. This law introduces a model of regulation, according to which technical standards are mandatory only when they are referred to in laws or when their application is specified in regulations issued by the competent ministers.

If a technical standard addresses key issues of public safety, health or environmental protection, its application may become mandatory by regulation or law. Examples include building and fire safety standards, the application of which follows directly from the law.

In the context of smart cities, therefore, it is reasonable to conclude that Smart City technical standards are currently voluntary. This, however, can lead to a lack of uniformity in the implementation of technology, which can challenge the consistency of urban systems and their integration with international standards.

An analysis of the Law of September 12, 2002 on Standardization leads to the conclusion that the use of technical standards is voluntary, unless the act provides otherwise. Moreover, a Polish Standard cannot be subject to administrative authority control, which means that an authority cannot impose obligations based solely on the standard. Technical standards in themselves do not impose legal obligations, and their application results from the decisions of business, administrative entities or organizations that implement certain standards.

However, Article 5(4) of the Law on Standardization stipulates that Polish Standards may be referred to in legal regulations, provided that they have been published in Polish. Consequently, in order for a technical standard to become mandatory by law, it is necessary to formally refer to it in the relevant normative act and to ensure the availability of its full version in Polish. If a provision of the law explicitly refers to a particular standard, the entities obligated by that provision must comply with the content of the standard to the extent that it is invoked. This results in the technical norm not automatically acquiring binding force - its application becomes obligatory only when the legislator incorporates it into the legal system, limiting its application to certain areas.

In the standardization system there is a principle that each new version of a technical standard replaces its earlier version. From the moment the new standard is published, the older version is no longer valid and should no longer be used in the standardization trade. The system does not allow a situation in which two versions of the same standard remain valid at the same time - the old version is always replaced by the new one, regardless of the extent of the changes made. However, in the case of technical standards referenced in legal acts, the situation is different. If a standard is referred to in a law or regulation in a specific version, it is not automatically updated when a new version is introduced. Then as long as a particular piece of legislation is not amended, those obliged to apply it must comply with the version of the standard that is indicated in the legislation, even if it is already outdated in the standardization system. In order for a new version of a standard to be considered valid, it is necessary to update the legal provision that refers to it. In practice, the relevant state body must amend the law or regulation to include the new version of the standard. As long as such a legislative process has not been carried out, the application of the new standard remains voluntary, and those required to comply must continue to refer to the version that was indicated in the legal act.

Another important aspect is the language of publication of the standard. The Law on Standardization does not require that all standards be published in Polish, although this is the standard for standards cited in law. However, Article 5(4) of the Law on Standardization requires that standards that are to be directly referenced in legislation be available in Polish.

That is to say if a standard is to be directly cited in a regulation or law, its full translation is necessary to ensure its compliance with the Polish legal order.

In practice, however, if a standard is published in English and has not yet been fully translated, this does not mean that it cannot be used - provided, , that it is not directly referenced in legislation. The Polish Committee for Standardization often allows the use of English-language versions, especially if the standard meets international or European standards (ISO or EN).

5. Scientific conclusions and discussion

The above analysis of the law leads to the deduction that technical standards in Poland are quasi-law. Also in the regulation of Smart Cities. The standards do not have the status of law, but in practice they are treated as a benchmark for action. As a result, this does not translate into dynamic development of the concept in Polish cities. This is evidenced by the IMD Smart City Index [9]. This ranking is created by a Swiss scientific institute in cooperation with the World Smart Sustainable Cities Organization (WeGO). It examines both economic aspects, such as availability of new jobs, ease of starting a new business, affordability of housing) and technological aspects, related to internet speed, availability of online services. It also examines social issues related to health, sense of security, opportunities for education and participation in local government decision-making processes. For an analysis of Smart City development in Poland, compare the last 3 years.

Table 1. Positions of Warsaw and Krakow in the IMD Smart City Index (2023-2025).

Year	Warsaw	Krakow
2025	28	70
2024	38	76
2023	44	79

Source: IMD Smart City Index

To date, there has been no thorough study of how the arbitrary application of Smart Cities technical standards affects the development of the idea in Polish agglomerations. The comparative analysis of the two cities in the ranking conducted in this article proves that the development of Smart Cities in Poland is progressing very slowly. First, their ranking positions have not radically changed in 3 years. Secondly, apart from Warsaw and Krakow, other cities in Poland have not been ranked at all in 3 years. They were not taken into account. A study of the case presented leads to the conclusion that such a result has to do with the arbitrariness of the application of Smart Cities technical nroms in Poland. The lack of specific legal regulations obliging city authorities to implement this idea leaves them free to decide in this regard The solution to such a state of affairs would be to place amendments in the Polish legal order that would clearly define in which situations technical standards can be binding. This could make it possible to create a list of mandatory standards for key areas of operation, including important drivers of smart city development. Such integration of technical standards with legislation could imply efficiency in the implementation of Smart Cities solutions.

6. Summary

The development of smart cities is one of the key directions of modern urbanization, which requires not only the implementation of modern technologies, but also consistent and effective regulations. An analysis of the status of technical standards in the context of Smart Cities shows that although they play an important role in standardizing and harmonizing urban processes, their voluntary nature and lack of explicit regulation in the legal system lead to numerous challenges. The current state of the law leaves local governments with considerable leeway in the implementation of standards, resulting in fragmentation of implemented solutions and lack of interoperability between cities. Also problematic is the lack of a mechanism to automatically update standards in the legislation, which can lead to the use of outdated standards and hinder

the integration of the latest technologies in urban systems

In the face of dynamic technological changes and the growing role of Smart Cities, it is becoming crucial to develop a balanced model of regulation that, on the one hand, preserves the flexibility of technical standards and, on the other, ensures their effective implementation where it is necessary for safety, the quality of life of residents and the efficiency of urban infrastructure. Unifying the rules for the referencing of standards in legal acts, creating a mechanism for their regular updating, and defining minimum standards for digitization and urban management are demands that can contribute to greater consistency in Smart Cities policy in Poland.

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