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Stowarzyszenie Księgowych w Polsce

The indicators included in ISO 37120 and performance measurement in smart cities

Wskaźniki zawarte w ISO 37120 a pomiar efektywności w inteligentnych miastach

MAGDALENA KOWALCZYK[*], **IZABELA RĄCKA**[**]

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Abstract

Purpose: Local government units are undergoing a shift in management practices driven by the implementation of the New Public Management (NPM) doctrine. One element of NPM is the measurement of performance in local government. As cities grow, the new concept of 'smart cities' is rapidly developing. However, it is difficult to determine how to measure the level of 'smartness'. This paper focuses on measuring the performance of smart cities using the indicators included in ISO 37120.
Methodology/approach: In the theoretical part, we overview the aims of performance measurement within NPM and the idea of smart cities. Meanwhile, the empirical part includes statistical data to analyse performance measurement using the indicators included in ISO 37120.
Findings: Performance measurement is possible using the indicators included in ISO 37120. The indicators make it possible to compare the results of cities in various countries. Thus, standardising the indicators is the key to the development of smart city performance measurement.
Originality/value: Our findings will be of value for future research about using ISO standards for the performance management of smart cities. Our research is also important for implementing NPM in local government.
Research limitations: Due to a lack of data, the observation period is too short to make a more in-depth analysis.
Keywords: smart cities, local government, ISO 37120, performance measurement.

Streszczenie

Cel: W jednostkach samorządu terytorialnego możemy zaobserwować zmiany w metodach zarządzania, które są wynikiem wdrażania doktryny Nowego Zarządzania Publicznego (NPM).

[*] Dr hab. Magdalena Kowalczyk, university professor, Poznań University of Economics and Business, https://orcid.org/0000-0002-4254-0799, magdalena.kowalczyk@ue.poznan.pl

[**] Izabela Rącka, PhD, Calisia University, https://orcid.org/0000-0002-2344-0901, i.racka@uniwersytetkaliski.edu.pl

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Jednym z elementów NPM jest pomiar osiągnięć w samorządzie terytorialnym. Obecnie w gminach miejskich szybko rozwija się nowa koncepcja „inteligentnych miast". Trudno jest jednak określić, jak zmierzyć poziom „inteligencji" miast. Niniejszy artykuł koncentruje się na problemie pomiaru efektywności inteligentnych miast przy użyciu wskaźników zawartych w normie ISO 37120.
Metodyka/podejście badawcze: W części teoretycznej omówiono cele pomiaru efektywności w ramach NPM oraz idee inteligentnych miast. Część empiryczna zawiera wyniki analizy statystycznej wskaźników zawartych w normie ISO 37120.
Wnioski: Pomiar efektywności jest możliwy przy użyciu wskaźników zawartych w normie ISO 37120. Wskaźniki te umożliwiają porównanie wyników miast w różnych krajach. Standaryzacja wskaźników jest kluczem do rozwoju pomiaru efektywności inteligentnych miast.
Oryginalność: Przedstawione wyniki będą miały wartość dla przyszłych badań nad wykorzystaniem norm ISO do efektywnego zarządzania inteligentnymi miastami. Przeprowadzone badania są również ważne dla wdrażania NPM w samorządach lokalnych.
Ograniczenia: Ograniczeniem artykułu jest zbyt krótki okres obserwacji, aby można było dokonać bardziej wnikliwej analizy, wynikający z braku dostępu do danych.
Słowa kluczowe: inteligentne miasta, samorząd lokalny, ISO 37120, pomiar efektywności.

Introduction

For many years, there have been changes in management methods in local government. The main reason for this is the implementation of the New Public Management (NPM) doctrine, which is sometimes called a new philosophy of management in the public sector. One of the administrative doctrines of NPM listed by Hood (1991, pp. 4–5) is explicit standards and measures of performance (Mixon, Treviño, 2010, p. 250). That is why performance measurement has been recognised as an important issue in the public sector. The implementation of performance measurement has been acclaimed as a tool for achieving better management and the more efficient use of resources, as well as for increasing transparency in local government (Brusca, Montesinos, 2016, p. 507), especially now with the very rapid development of cities. Due to rapid population growth, many cities face several issues, e.g., the overexploitation of resources, an inadequate number of services, and rising pollution. Yet, they must find solutions to these challenges while pursuing sustainable goals (Bifulco et al., 2016, p. 132).

The solution for this situation is the concept of the 'smart city'. In recent years, the term has attracted much attention from policymakers, business leaders, and citizenship in general (Capdevila, Zarlenga, 2015, p. 267). Winkowska et al. (2019, p. 71) investigated the increasing importance of cities in the development of many regions and countries, which are supported each year by the increasing number of smart city initiatives. The basis for developing the smart city concept is a developed broadband infrastructure, digital spaces, e-administration, e-services, and online knowledge management tools (Budziewicz-Guźlecka, 2017, p. 23). However, the development of the smart city brings with it the problem of how to measure their performance. Mattoni et al. (2020, p. 2) stated that there is a need to develop quantitative models that can put the smart city theory into practice and apply a global

and holistic view in the planning phase. This paper focuses on measuring the performance of smart cities using the indicators in ISO 37120.

The remainder of the paper is organised as follows. The next section presents the literature review in relation to the smart city and performance measurement concept, which forms the theoretical background for our research. The following section outlines the research methods and presents the results of the research and the statistical analysis. The last section includes the discussion and conclusion.

1. The theoretical background

1.1. The concept of the smart city

Many smart cities have emerged since the 1990s. An increasing number of cities around the world are striving to gain intelligence, and thus, the need for standardisation and performance measurement is growing (Moustaka et al., 2020, p. 829). However, the problem is that there is no single definition of what a smart city is. While some define them as cities that use information and communication technologies (ICTs) to increase inhabitants' quality of life and promote sustainable development (Capdevila, Zarlenga, 2015, p. 267), others argue that the concept is multifaceted and encompasses the qualities of the people and communities within the city, not just the ICT (Albino et al., 2015, p. 18).

There are four core themes for a smart city: society, the economy, the environment, and governance. The society theme signifies that the city is for its inhabitants or the citizens. The economy theme signifies that the city is able to thrive with continuous job growth and economic growth. The environment theme indicates that the city will be able to sustain its function and remain in operation for current and future generations. Finally, the governance theme suggests that the city is robust in its ability to administer policies and combine the other elements (Mohanty et al., 2016, pp. 3–4). Yahia et al. (2019, p. 2) studied the concept of collaborative governance within smart cities, exploring organisational structures that can support and promote smart and sustainable collaborative networks.

The biggest difference between traditional cities and smart cities is that in traditional cities, systems interact only with their environment. This means that systems are mostly stand-alone and not interoperable with other systems. In smart cities, by contrast, systems are interconnected by energy or information links, and information management becomes increasingly important (Lom, Pribyl, 2020, p. 10). It is clear that the smart city involves more than the mere technological aspect, and this reductionist view has been subject to much criticism. Although the human-centric view adds an important dimension, it does not cover enough; the governance perspective is similarly limited (Vandercruysse et al., 2020, p. 2). For a comprehensive understanding of smart cities, we must consider the development of smart services and applications that are capable of supporting the ecosystem of needs, functions and imperatives (Lytras et al., 2020, p. 2). Specifically, developing transformative

and innovative solutions is critical to strengthen the already strained urban infrastructure to keep pace with the increasing service delivery demands and to meet the rising expectations of citizens for improved quality of life (Sharifi, 2020, p. 1).

Smart cities promote a sustainable lifestyle, and infrastructure, innovation, and technology are the components that make them efficient and self-sufficient (Chamoso et al., 2019, p. 323). These components work together, generating and aggregating data, using analytical tools to convert that data into usable information, and fostering organisational structures that encourage collaboration, innovation, and the application of that information to solve public problems (*Trends in smart city development*, 2016, p. 11). Given the rapid pace of technological advancements, the smart city is best considered not as an end-point but as an unending process (Stone et al., 2018, p. 235). Smart city construction can significantly improve urban eco-efficiency (Yao et al., 2020, p. 8).

Summarising the smart city assessment is a relatively nascent but rapidly growing area of research and practice (Mora et al., 2017). As smart city initiatives continue to proliferate, it becomes critical to use assessment schemes to facilitate better-informed decision-making (Sharifi, 2020, p. 14).

1.2. Performance measurement as one of the NPM doctrines

In recent years, NPM doctrines worldwide have advocated for the adoption of private sector-styled accounting and performance measurement practices for public sector organisations (Adams et al., 2014, p. 57). Implementing NPM principles is a deliberate action taken to improve the efficiency and effectiveness of the public service and organisations (Hayer, 2011, p. 422). According to Bogt (2008, p. 210), NPM can be regarded as a functionalist approach in that one of the most important objectives of the changes it proposes is to increase economic efficiency and effectiveness in public sector organisations. The most common and frequently used NPM tools and instruments, with their advantages and disadvantages, involve the use of performance measures, with an emphasis on output and controls and that objectives are met through performance audit and control (de Vires, Nemec, 2013, p. 7).

Measuring performance is something that all organisations do, either systematically and thoroughly or ad hoc and superficially. Nonetheless, they do it. Performance measurement is an important tool for making judgements and making decisions (Parker, 2006, p. 63). The Kuwaiti (2004, p. 59) performance measurement process is defined as a collection of related activities designed to identify and collect data and transform them into relevant, understandable, and actionable performance information. This information enables accurate assessment of how well strategic, tactical, and operational objectives have been achieved and forms the basis of reward and appraisal systems.

Nyhan and Martin (1999, p. 348) define performance measurement as the 'regular collection and provision of information on the effectiveness and quality of government programs'. Its primary function is to monitor the achievement of organisational and managerial goals. It is also to serve for planning, steering and decision-making. Conversely, Pollanen (2005, p. 5) states that the measurement of

achievements in the public sector focuses on the efficiency of organisational units and implemented programmes. This means that smart cities bring together considerations about digitisation and the use of ICT in several cross-cutting dimensions of urban life: quality of life, leisure and entertainment, education, access to public services, participation, representation, and interest aggregation, and employment, entrepreneurship, innovation and business models all within the constraints of limited city space (Lytras et al., 2020, p. 2).

Performance measurement is becoming more widespread within local government. The task of measuring performance in the public sector is complicated due to attitudes and organisational arrangements, diversity of tasks, and technical difficulties (Ghobadian, Ashworth, 1994, p. 49). Thus, organisations in the public and private sectors around the world are struggling with their performance measurement systems. In particular, they are finding it difficult to develop cost-effective, meaningful measures that drive performance improvement without causing unintended negative consequences (Moullin, 2007, p. 181).

Performance measurement systems identify problems and benefits related to the activities of a local government unit. The main advantage is that the measures relate to all areas of the activity in local government. Performance measurement is essential for residents and those for whom the services are provided. However, the inherently social (qualitative) nature of most local government activities makes it difficult to establish and utilize effective performance measures (Szołno, 2016, p. 94).

Therefore, the challenge is to identify a process where performance measurement can be made more effective and successful in the public sector and to overcome some of these limitations (Goh, 2012, p. 34). The popularity of performance measurement as an instrument for implementing local, regional, state-wide, or national public strategies is growing. The popularity of total quality management systems boosted the inclusion of non-financial indicators in performance measurement systems across sectors (Greiling, 2005, p. 556). The gap between what is technologically feasible, what is politically possible, and what is usable cannot be bridged without engaging all stakeholders, i.e., the research community, the policymakers, and the end users, who are the citizens (Lytras et al., 2020, p. 2). Yahia et al. (2019, p. 2) define a smart and sustainable collaborative network as one that includes government agencies and external stakeholders, including citizens, that are able to collaborate to better achieve a common goal. In particular, they are able to resist failure and adapt to changes to guarantee the sustainability of the network.

Smart cities are cities 'for people'. They are places where residents appreciate locality, understood as identity, pride, or the use of regionally produced goods. People want to develop their interests among the locals. All of this makes the city a friendly place in which to live, which is one of the basic principles of the smart city concept (Ryba, 2017, p. 89).

Organisations routinely face difficult decisions regarding the management of their stakeholders. For example, organisations must ask what is right for their specific situation or needs and how to balance competing stakeholder claims. This results in the broader question of whether stakeholder engagement is a precondition for organisational decision-making (Richter, Dow, 2017, p. 428).

2. Research question

Dall'O' et al. (2017, p. 195) claim that the need to measure the smartness of cities gave rise to different projects aimed at outlining a procedure for evaluating cities using indicators that support the rating of such smartness. Huovila et al. (2019, p. 142) developed a taxonomy for comparing smart, sustainable city indicators according to their conceptual urban focus (types of urban smartness and sustainability), relevant sectoral application domains (energy, transport, ICT, economy, etc.) and types of indicators (input, process, output, outcome, impact). Most research explores the indicators, measurement, and economic effect of eco-efficiency; however, little attention has been paid to the effect of a city's development mode regarding eco-efficiency (Yao et al., 2020, p. 8). It is very important to remember that a smart city assessment must take into account that cities have different visions and priorities for achieving their objectives, but they must promote the integrated development of different aspects, both hard and soft (Albino et al., 2015, p. 17).

There are many original methods for assessing the performance of a smart city. The most comprehensive methods include Smart City PROFILES, City Protocol, and the European Smart City Ranking. Additionally, various key performance indicator (KPI) based methods are becoming popular, in particular, the Collection Methodology for the KPI for Smart Sustainable Cities, the Conceptual Smart City KPI Model, KPI Selection to Assess Smart City Solutions, CITY keys indicators, and the Triple-helix network model for smart cities' performance (Janik et al., 2019, p. 118). The problem is that even if some cities have development indicators and performance measures, they are only for internal use, often tailored to the cities' individual development goals, thus preventing comparisons with different cities (Marvić, Bobek, 2015; Warnecke et al., 2019 p. 655).

To measure the degree of sustainability of smart cities, we should consider a range of parameters, including public management, social cohesion, governance, technology, urban planning, environment, mobility and transport, international projection, human capital, and economy (Chamoso et al., 2019, p. 323). The indicators included in ISO 37120 can be used to measure the services and quality of life in cities.

Haras and Zimmer (2015) demonstrate how ISO 37120 can be employed to evaluate the sustainable development of cities and their level of smartness. These indicators not only make it possible for cities to implement a 'smart' strategy but They can support better delivery of services and better living conditions. They could also support innovation and the development of a dynamic and innovative economy in cities.

The ISO standards on sustainable cities were developed by the 'City indicators' working group of the 'Sustainable cities and communities' committee. They were first published in 2014, and a revised version was released in July 2018 with the addition of 28 new indicators, the removal of 24 outdated ones, and a slight modification to 10 existing indicators (Huovila et al., 2019, p. 143).

The core promise made by ISO 37120 and the World Council on City Data (WCCD) is that all cities can be accurately measured by the same set of indicators and thus be made meaningfully comparable (White, 2020, p. 10). This concept leads us to the research question: *Are the indicators in ISO 37120 suitable for measuring the performance of smart cities?*

3. Research method and findings

3.1. Research design and settings

Our research utilises information from the WCCD website (December 2019). The WCCD was founded in Canada in 2014 and exists to help cities and communities of all sizes globally embrace ISO-standardised, independently verified, and globally comparable city data. This data allows them to make data-driven decisions on management, planning, and investment while enabling them to monitor progress and results and become more sustainable, safe and resilient, prosperous, inclusive, and smart (www.dataforcities.org). ISO 37120-2018 includes 104 KPIs across 19 themes, all of which cities prioritise to measure performance in delivering city services and enhancing quality of life.

ISO 37120-2018 states that the indicators were selected to make reporting as simple and inexpensive as possible and, therefore, reflect an initial platform for reporting (ISO, ISO 37120-2018, p. 13).

The profile indicators in ISO 37120-2014 (Table 1) describe the population of the cities, showing the structure, such as the age of inhabitants and the number of immigrants. The housing indicators show the number of households, occupancy per unit, dwelling units owned and rented, and density per square kilometre. The economic indicators describe household income, annual inflation, the cost of living in the city, and city product per capita. The type (local, regional, county) and operating and capital budget total and per capita are described by the government profile indicators. The last part of the profile indicators delivers information about geography and climate – region, climate type, land and area, annual temperature, and rain and snowfall (ISO, ISO 37120, 2014, p. 104). The 2018 revision (ISO 37120-2018) includes some changes in the groups of indicators. The 24 indicators include a detailed description of certified units.

Table 1. Comparison of the profile indicators of ISO 37120-2104 and ISO 37120-2018

Theme areas	ISO 37120-2014	ISO 37120-2018
People	13	–
Energy	–	2
Finance	–	2
Housing	4	6
Economy	9	3
Government	5	–
Geography and climate	8	–
Population and social conditions	–	6
Transportation	–	2
Urban planning	–	3
Total	**39**	**24**

Source: ISO 37120-2014, ISO 37120-2018.

The core indicators are considered essential for steering and assessing the performance in managing city services and delivering quality of life. The core and supporting indicators are classified into themes according to the different sectors and services and the area of application of each type of indicator when reported on by a city (ISO, ISO 37120-2014, p. 14). Table 2 shows a comparison of the indicators included in ISO 37120-2014 and ISO 37120-2018.

Table 2. Comparison of the indicator areas in ISO 37120-2104 and ISO 37120-2018

Themes area	ISO 37120-2014		ISO 37120-2018	
	Core indicator	Supporting indicator	Core indicator	Supporting indicator
Economy	3	4	1	7
Education	4	3	4	2
Energy	4	3	5	2
Environment	3	5		
Environment and climate change			3	6
Finance	1	3	2	2
Fire and emergency response	3	3		
Governance	2	4	1	3
Health	4	3	4	2
Housing			2	2
Population and social conditions			1	2
Recreation	0	2	0	2
Safety	2	3	5	5
Shelter	1	2		
Solid waste	3	7	5	5
Sport and culture			1	2
Telecommunication			0	2
Telecommunication and innovation	2	1		
Urban/local agriculture and food security			1	3
Urban planning	1	3	1	3
Wastewater	5	0	3	1
Water and sanitation	3	4		
Transportation	4	5	2	5
Water			4	3
Total	**45**	**55**	**45**	**59**
	100		**104**	

Source: ISO 37120-2014 and ISO 37120-2018.

3.2. Data collection

We analysed all the cities that had been certified up to 2019. In our research, all the cities were certified using the indicators included in ISO 37120-2014. In ISO 37120-2018, some areas of reported issues were changed. It does not include fire and emergency response or shelter. Some new areas are included, such as housing, population and social conditions, sport and culture, urban/local agriculture, and food security.

Using the information from the WCCD website, we analysed 62 cities from six continents (Table 3). The cities were certified in different years:

- 2014 – 6 cities,
- 2015 – 7 cities,
- 2016 – 20 cities,
- 2017 – 19 cities,
- 2018 – 10 cities.

The descriptive statistics of indicators reported by the certified cities are shown in Table 3.

Table 3. Descriptive statistics

	Themes area	Number of ratios	Mean	Median	Mode	Standard deviation
1	Economy	7	5.98	7.00	7.00	1.694
2	Education	7	6.42	7.00	7.00	1.313
3	Energy	7	5.90	7.00	7.00	2.046
4	Environment	8	5.81	6.00	7.00	1.872
5	Finance	4	3.42	4.00	4.00	1.181
6	Fire and emergency response	6	5.19	6.00	6.00	1.199
7	Governance	6	5.27	6.00	6.00	1.357
8	Health	7	6.37	7.00	7.00	1.382
9	Recreation	2	1.65	2.00	2.00	0.704
10	Safety	5	4.31	5.00	5.00	1.262
11	Shelter	3	2.37	3.00	3.00	0.834
12	Solid waste	10	8.53	10.00	10.00	2.487
13	Telecommunication and innovation	3	2.76	3.00	3.00	0.645
14	Transportation	9	8.02	9.00	9.00	1.751
15	Urban planning	4	3.42	4.00	4.00	0.897
16	Wastewater	5	4.58	5.00	5.00	1.195
17	Water and sanitation	7	6.11	6.50	7.00	1.161

Source: authors' own elaboration.

As the descriptive statistics show, fewer indicators were reported in the environment group (with a mean of 5.81) and solid waste (8.53). In the environment group, the mode of the reported indicators was less than the standard. The median in the environment group was 6.00, and in the water and sanitation group, it was 6.50.

Table 4 shows that the number of cities that achieved certification varied by continent. North America and Europe had the most certified cities.

Table 4. The certificated cities

Continent	City	No
Africa	Cape Town, Johannesburg, Minna, Tshwane	4
Asia	Ahmedabad, Amman, Dubai, Haiphong, Jamshedpur, Makati, Makkah,Pune, Shanghai, Surat, Tainan City, Taipei, Tbilisi, Vijayawada,	14
Australia	Brisbane, Greater Melbourne, Melbourne LGA	3
North America	Boston, Cambridge, Ciudad Juarez,Doral, Guadalajara, Leon, Los Angeles, Mississauga, Oakville, Piedras Negras, Portland, Quebec City, Saint Augustin, San Diego, Shawinigan, Surrey, Toronto, Torreon, Vaughan, Welland, Whitby	21
South America	Bogota, Buenos Aires	2
Europe	Aalter, Amsterdam, Barcelona, Eindhoven, Gdynia, Heerlen, Helsinki, Kielce, Koprivnica, London, Oslo, Porto, Rotterdam, Sintra, the Hague, Valenczia, Zagreb, Zwolle,	18

Source: authors' own elaboration.

The descriptive statistics in Table 3 and the data on certified cities divided into continents in Table 4 allow us to formulate the following research question:

1. Is there are differences in the reporting of ISO 37120 indicators between continents?
2. Is there are relationships between the reported areas of ISO 37120 indicators?

3.3. Data analysis and findings

The data analysis of our empirical material involved two stages. In the first stage, we investigated the difference in the reporting indicators between the continents. We used the Kruskal–Wallis nonparametric test (Imam et al., 2014, p. 2) as the equivalent of the one-way analysis of variation (Table 5).

The analysis shows the difference between Africa and Europe, North America, and Asia in reporting indicators in terms of the economy, education, energy, environment, fire and emergency response, governance, urban planning, and wastewater. Since the 1960s, when most countries in Africa gained political independence from their colonial masters, Africa has experimented with a variety of development strategies.

However, the continent has come full circle without any significant socioeconomic achievement and still lags behind the rest of the world in almost every aspect of development (Magbadelo, 1996). There are also some differences in the profile indicators between Asia and Europe.

Table 5. The result of the Kruskal-Wallis test

	Indicators	Value of test statistic	Continent	p-value*
0	Profile indicators	0.040	Asia – Europe	0.001
1	Economy	0.001	Africa – North America	0.000
2	Education	0.024	Africa – Europe	0.002
3	Energy	0.025	Africa – North America	0.000
4	Environment	0.021	Africa – Asia	0.002
			Africa – Europe	0.001
5	Finance	0.201		
6	Fire and emergency response	0.002	Africa – Europe	0.002
			Africa – North America	0.001
7	Governance	0.003	Africa – Europe	0.001
			Africa – North America	0.001
8	Health	0.057		
9	Recreation	0.456		
10	Safety	0.071		
11	Shelter	0.435		
12	Solid waste	0.104		
13	Telecommunication and innovation	0.039		
14	Transportation	0.125		
15	Urban planning	0.024	Africa – Europe	0.002
			Africa – North America	0.001
16	Wastewater	0.017	Africa – North America	0.000
17	Water and sanitation	0.403		

* for $p < 0.05$

Source: authors' own elaboration.

In the second part of the research (Table 6), we used Spearman's rho to determine whether there is any correlation between the indicators. Spearman's rho is a nonparametric or distribution-free rank statistical measure of the strength and direction of an arbitrary monotonic association between two ranked variables, or one ranked variable and one measurement variable (Xiao et al., 2016, p. 3869).

Table 6. The result of Spearman's rho

	PI	Ec	Ed	En-y	Envir	Fin	Fr-e Em	Gov	Hth	Rec	Sf-ty	Shlt	Sld - Wte	Tel and Inn	Tran	Ur Pl	Wst	W-er sanit
Ec	0.361** 0.004	1.000																
Ed	0..467** 0.000	0.606** 0.000	1.000															
En-y	0.434** 0.000	0.691** 0.000	0.525** 0.000	1.000														
Envir	0.285* 0.025	0.527** 0.000	0.422** 0.001	0.530** 0.000	1.000													
Fin	0.378** 0.002	0.472** 0.000	0.591** 0.000	0.510** 0.000	0.335* 0.008	1.000												
F-re Em	0.181 0.160	0.556** 0.000	0.453** 0.000	0.528** 0.000	0.441** 0.000	0.282* 0.026	1.000											
Gov	0.337** 0.007	0.448** 0.000	0.552** 0.000	0.448** 0.000	0.329** 0.009	0.491** 0.000	0.516** 0.000	1.000										
Hth	0.282* 0.026	0.421** 0.001	0.435** 0.000	0.608** 0.000	0.299* 0.018	0.415** 0.001	0.424** 0.001	0.384** 0.002	1.000									
Rec	0.285* 0.025	0.485** 0.000	0.393** 0.002	0.587** 0.000	0.418** 0.001	0.490** 0.000	0.282* 0.026	0.493** 0.000	0.471** 0.000	1.000								
Sf-ty	0.292* 0.021	0.527** 0.000	0.517** 0.000	0.554** 0.000	0.367** 0.003	0.508** 0.000	0.603** 0.000	0.519** 0.000	0.581** 0.000	0.501** 0.000	1.000							
Shlt	0.326** 0.010	0.436** 0.000	0.639** 0.000	0.555** 0.000	0.394** 0.002	0.631** 0.000	0.251* 0.049	0.360** 0.004	0.484** 0.000	0.568** 0.000	0.430** 0.000	1.000						
Sld Wte	0.341** 0.007	0.492** 0.000	0.514** 0.000	0.535** 0.000	0.366** 0.003	0.441** 0.000	0.435** 0.000	0.436** 0.000	0.541** 0.000	0.510** 0.000	0.574** 0.000	0.468** 0.000	1.000					
Tel Inn	0.299* 0.018	0.278** 0.028	0.462** 0.000	0.424** 0.001	0.245 0.055	0.278* 0.029	0.338** 0.007	0.355** 0.005	0.273** 0.032	0.158 0.220	0.355** 0.005	0.201 0.117	0.408** 0.001	1.000				
Tran	0.197 0.126	0.477** 0.000	0.659** 0.000	0.448** 0.000	0.434** 0.000	0.410** 0.001	0.278* 0.029	0.427** 0.001	0.499** 0.000	0.343** 0.006	0.493** 0.000	0.550** 0.000	0.522** 0.000	0.230 0.073	1.000			
Ur Pl	0.283* 0.026	0.573** 0.000	0.562** 0.000	0.657** 0.000	0.436** 0.000	0.565** 0.000	0.522** 0.000	0.482** 0.000	0.278* 0.029	0.554** 0.000	0.598** 0.000	0.455** 0.000	0.543** 0.000	0.383** 0.002	0.402** 0.001	1.0000		
Wst	0.322* 0.011	0.608** 0.000	0.579** 0.000	0.702** 0.000	0.440** 0.000	0.447** 0.000	0.474** 0.000	0.423** 0.001	0.528** 0.000	0.507** 0.000	0.605** 0.000	0.464** 0.000	0.572** 0.000	0.355** 0.005	0.511** 0.000	0.622** 0.000	1.000	
W-er sanit	0.351** 0.005	0.539** 0.000	0.408** 0.001	0.567** 0.000	0.300* 0.018	0.488** 0.000	0.469** 0.000	0.369** 0.003	0.421** 0.001	0.430** 0.000	0.478** 0.000	0.458** 0.000	0.433** 0.000	0.334** 0.008	0.298* 0.019	0.488** 0.000	0.509** 0.000	1.000

p-value for * $p < 0.05$, ** $p < 0.01$

Source: authors' own elaboration.

The data show that there is a high correlation between some indicator areas reported by the cities. There is a high correlation between economy and education and between energy and wastewater. According to ISO 37120, the economic indicators represent a city's potential as measured by indicators such as the unemployment rate, the assessed value of commercial and industrial properties, and the percentage of the city population living in poverty. Education is one of the most important aspects of human development. That is why the indicators address the issue of educational opportunity by indicating how widespread formal education is in the city among the school-age population. The energy indicators help to gain an understanding of how much electricity is currently being consumed, which is needed to effectively manage the generation, consumption, and conservation of electricity. The wastewater indicators are important for the city's health, cleanliness, and quality of life.

The indicators in the area of education are correlated with shelter. Slums are one of the biggest problems in cities. They are growing and becoming permanent features of urban landscapes. Having a home is a basic need, which is why this standard underlines the problem of homelessness. The indicators reported in the shelter area are also correlated with finance. In the area of finance, the main indicator is the debt-service ratio, which is widely accepted as a measure of sound financial management.

The indicators in the area of energy are correlated with health, urban planning, and wastewater. In the area of health, life expectancy reflects a population's overall mortality level. Life expectancy is closely connected with health, which is an integral part of development. The number of in-patient public hospital beds is one of the indicators that monitor the level of health service delivery.

There is also a correlation between the indicators in the areas of transportation and education. For transportation, an important issue is the number of kilometres of high-capacity public transport system. Urban planning indicators are correlated with wastewater. In the urban planning area, the main indicator shows the amount of green area, natural and semi-natural area, parks, and other open spaces in the city.

This research shows that there is a natural link between some areas of city activities.

4. Discussion

This research has shown that it is necessary for smart cities to use performance measurement tools that are aligned with the idea of NPM. The indicators can help classify all areas of a city's activities into groups and measure their level of realisation. Steel (2014) demonstrates that using the ISO 37120 framework to show the results of city activities mainly involves non-financial indicators. This aligns with Kowalczyk (2018, pp. 160–161), who stated that, according to over 50% of respondents (employees of financial departments of municipalities), non-financial measures make it possible to assess the effectiveness of those tasks of municipalities that cannot be measured using financial indicators.

By measuring performance using all the indicators included in ISO 37120, cities can identify areas requiring improvement. Our research revealed stark differences between regions (North America vs. Asia, Africa vs. Europe, and Asia vs. Europe) in reporting indicators. The Spearman's rho analysis indicates there are dependencies between certified areas of smart city activities. Andgelidou (2014, p. 9) suggests that cities should move towards becoming a smart city by selecting a few domains or areas that need to be improved urgently.

The use of performance indicators and benchmarking enables the evaluation of service provision efficiency and facilitates the adoption of best practices. The problems that may arise when introducing performance indicators in local government mainly concern achieving consensus on the design and standardisation of indicators for various entities, the method to be used for calculations, and the selection of analytical criteria to be applied to the values obtained (Navarro-Galera et al., 2008).

Our research shows that the standardised nature of the indicators in ISO 37120 makes it possible to compare cities. Benchmarks provide a strategic tool for assessing the sustainability impacts of urban development (Warnecke et al., 2019). Siverbo (2014, p. 121) underlined that benchmarking is a management accounting innovation and can be used for performance measurement and improvement in the public sector.

The undoubted benefits of using the ISO 37120 standard include increased effectiveness of unit management and service delivery and providing information to facilitate informed decision-making at the local level (Steele, 2014). Our research shows a high correlation between the economy and education and that education correlated with shelter. Van Vinden (et al., 2007, p. 333) argued that the development of the human capital stock is influenced by the development of educational qualifications (skills or level).

In recent decades, cities have emerged on the global stage as economic powerhouses, engaging in world markets to create more jobs, attract global talent and investment, and spur long-term, sustainable economic growth (WCCD for the united sustainable development goals, 2019, p. 18).

We conducted our research at a time when all the information about the indicators reported by the cities was readily available. Currently, however, it is not possible to get information about the indicators reported by the certified cities. White (2020, p. 10) states:

> The […] WCCD have also placed restrictions on the availability and use of indicator data and have cut away the messy metadata that gives them context. This makes it difficult to assess which cities it might be possible to compare and with which indicators this might be meaningfully accomplished.

White (2020, p. 10) states that it is not the WCCD's aim to reduce these data to a single index that linearly ranks cities on the performance of their services and the lifestyle of their inhabitants. Instead, it hopes to generate a database of apples-to-apples data through which more meaningful analysis and visualisation can be performed.

The idea of such a website with all the data, including information about the achievements of smart cities, is helpful in improving the management of local government. The problem is that these data are not currently available for all stakeholders. If we want to use the full potential offered by the reporting of achievements using indicators in ISO 37120, the data of all the certified cities should be public, as they were earlier.

Conclusion

Our research shows that it is possible to obtain information about different areas of city activity. This is especially important since all the areas that are measured by the indicators in ISO 37120 are connected with the tasks for which local government units are responsible. They must provide a secure and stable environment in which enterprises can flourish. They are responsible for physical infrastructure – roads, water supply, waste management, and ICT – all of which are necessary prerequisites to economic activity. Moreover, local government units address the needs of their citizens for public health, education, housing, local transportation services, cultural and recreational facilities, child care, and other public goods and services (The role of local governments in territorial economic development, 2016, p. 5).

Our findings will be of value for future research about using ISO standards to manage the performance of cities. Whitfield suggested (2019, pp. 44–45): "There is a great need to evaluate the performance of various sustainable development frameworks to discover which are the most effective and successful, and make the strategic changes necessary to improve future developments." Our research is also important for implementing the NPM doctrine in local governments.

The limitation of this article is that information about certified cities is not available now. To show whether the changes in certified cities are positive or negative, we need data from more than one year.

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