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ISO 37120 sustainable development indicators: Rio de Janeiro and the Latin American scenario

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Abstract: The socio-economic-environmental performance indicators have proved to be an important tool for monitoring and deciding in the management of cities, aiming at a more sustainable urban development. ISO 37120 represents a milestone in the standardization of sustainability indicators, enabling the comparison between different locations. The purpose of this study is to apply ISO 37120 to Rio de Janeiro and to analize both this process and the city's performance in the Latin American scenario. There was an extensive documentary research to calculate the indicators of Rio de Janeiro. The comparison was made among Latin American cities that already had applied the standard and was based on standardized core indicators grouped according to sustainability axes. The application of the standard revealed weaknesses in obtaining data for Rio de Janeiro and managed to identify the city's strengths and weaknesses in comparison with the others.

Keywords: Sustainability indicators; sustainable cities; governance for sustainability; urban management; urban planning.

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São Paulo. Vol. 26, 2023

Original Article

DOI: http://dx.doi.org/10.1590/1809-4422asoc0132r2vu2023L3OA

Introduction

Sustainable development achievement based on balance among its three axes (economic, environmental, and social) is one of the most significant challenges cities have faced in the last decades. Urgency in seeking more sustainable cities results from the accelerated urban-growth pace that has intensified its negative reflexes, such as environmental degradation, lack of basic infrastructure, mobility issues, and poverty increase (GOMES, 2019).

Challenges to urban sustainability are even more prominent in developing countries since their cities sometimes grow in an unordered way (GARCÍA-AYLLÓN, 2016), following the patrimonial logic of the privileged ones, due to the colonial past of these nations (MARICATO, 2000). This is the case of Latin America, one of the world's most urbanized regions: 81% of its population lived in urban areas in 2018 (UNITED NATIONS, 2019b). However, these cities are marked by profound social inequality (MEIRELLES, 2016), as is observed in this region's high poverty, informality, and criminality indices (KLIKSBERG, 2002).

Despite the consensus about the term 'sustainable development', which was first seen in the Brundtland Report and defined as 'the development that meets current needs without compromising the ability of future generations to fulfill their own needs' (WORLD COMMISSION ON ENVIRONMENT AND DEVELOPMENT, 1987), its measuring remains a challenge. In this context, sustainability indicators stand out as important tools for decision-making and planning of sustainable cities since they act in diagnosing and monitoring actions focused on this goal (HIREMATH et al., 2013).

The demand for information applicable in the analysis, formulation, and implementation of public polices to contribute to a more efficient allocation of resources has been growing (JANNUZZI, 2017). However, indicators must be able to translate much more than quantitative information to allow the empirical interpretation of reality (SANTAGADA, 2007).

From then on, many approaches have emerged to help develop sustainability indicators and composite indices (COHEN, 2017; VEIGA, 2010). However, there was no uniformity among matrices because they were too heterogonous and because there was no consensus about the best set of indicators (MACEDO; RODRIGUES; TAVARES, 2017; TANGUAY et al., 2010). It is interesting to standardize these indicators since it would allow comparing different cities and observing their best practices, so they could work as a reference for other cities that could become benchmarks. Besides, the standard approach enables following-up cities' long-term development, pointing out positive elements and aspects to be improved. Thus, a standardized indicators methodology provides comparison parameters to subsidize managers' decision-making, although without giving pre-set answers, excluding the need for additional information, or even of adopting other methodologies.

Accordingly, ISO 37120:2014 'Sustainable development of communities – indicators for city services and quality of life' was launched; it represents an important update in sustainable development indicators for cities. This standard defines and sets methodologies for calculating 100 indicators that approach several aspects of cities to diagnose their development.

The World Council on City Data (WCCD) is the leading ISO 37120 certifying organ; it already counts on more than 100 certifications in its portal (WCCD, 2018). Despite the adhesion to this instrument by different-sized cities in different regions of the globe, there is still a gap in the scientific literature about this subject, including its application processes and associated analyses.

By experiencing the process of its application in Rio de Janeiro City and comparing the recorded results to indicators' values observed for other Latin American cities, the present study aimed to understand the ISO 37120 standard's approach better. Besides, even based on a certain degree of arbitrariness, the goal was to systematically explore indicators as part of sustainability thematic axes: social, economic, and environmental.

The choice made for Rio de Janeiro City was substantiated by its national relevance and authors' knowledge about its local daily life, since it allowed the best perception of information from the indicators. The study is expected to contribute to outspreading this international instrument to measure urban sustainability, as well as to depict the difficulties and potentials of its application and analysis processes so that it can boost and drive its adoption by other municipalities in Brazil and abroad.

Sustainable development

Sustainable development axes

The unsustainability of the growth model based on finite natural resources' exploration is clear (MEADOWS et al., 1972), and it opened room for discussions about new parameters to drive the sense of development. This movement disregarded this concept of its strictly economic bias and allowed sustainable development to stop being seen as controversial and utopic (VEIGA, 2017).

From that point onwards, several events promoted by the United Nations have built important milestones for the understanding of sustainability (EUSTACHIO et al., 2019), which is now seen as a balance among economic, environmental, and social aspects: the three sustainability axes defined in the Declaration of Johannesburg (WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT, 2002). One only finds real development when these axes work in harmony.

Yet, it is necessary to stop seeing these three axes as antagonistic because, sometimes, improvements in aspects of one axis can positively impact the others, be it right the way or in the long term. Thus, sustainable development must be understood as a long-term process driven by a national plan (BEZERRA; BURSZTYN, 2000) to reduce future impacts (CANEPA, 2007).

The association between economic and social development must be understood from the perspective of the analysis applied to the influence of one axis over the other. From the social perspective, economic growth would not be a target but a means to reach

well-being and social justice (SOUZA, 2003). On the other hand, social advancements can also have a positive impact on the economy, as shown by estimates, according to which Latin America would witness a GDP increase by 25% if it reached security indicators in line with those recorded for other countries in the world (CUÉ, 2016).

The World Bank quantified the economy's deep dependence on human and social capital in a study carried out with 192 countries. This survey has shown that these capital forms corresponded to 64% of all economic growth (UNITED NATIONS DEVELOPMENT PROGRAMME, 1996). Improvement in human capital is mainly based on education, which became one of the most profitable public investments, given the technological advances that turn knowledge into the central resource for economic progress (HANUSHEK; WÖSSMANN, 2007; KLIKSBERG, 1998) and for the consequent improvement in individuals' income. The social capital, in its turn, results from culture, values, and interactions within society.

Regarding the environment, i.e., how society relates to nature (GONÇALVES, 2020), economic activities have developed in a predatory way, and environmental preservation was for long seen as an obstacle to growth. Discussions about sustainability aim at changing the concepts of nature, which turned from a mere source of resources to means for human survival (MARÇAL, 2005).

Finally, the interaction between environmental and social aspects is the least conflicting one. The performance of environmental indicators, such as air and water quality or sanitation conditions, directly impacts populations' health and well-being. Yet, there are other parameters whose impact cannot be fully measured so far, such as damage caused by urban noise, the use of chemical substances, and even climatic change (AGÊNCIA EUROPEIA DO AMBIENTE, 2008; CUNHA et al., 2013).

ISO 37120 standard

ISO 37120 standard: 'Sustainable development of communities – indicators for city services and quality of life' was launched in 2014 and revised in 2018. The standard provided the methodology to calculate 100 indicators in its first version. These indicators were divided into 17 thematic sections (from section 5 to 21 of the standard). Indicators in each section are divided into core indicators, essential for the best understanding of the topic in question, and supporting indicators, totaling 46 and 54 indicators, respectively. Indicators can be measured in any city, municipality or location.

Given the universal profile of this standard, it does not aim at defining absolute reference values for indicators since it would not allow assessing cities' performance due to their mere application. Accordingly, performance analysis must happen through comparisons between different localities or city data throughout time. The standard sets profile indicators to feature the cities; they help identify cities that present similar realities; therefore, they would gather comparison parameters.

The first version of the standard in Brazil was named ABNT NBR ISO 37120:2017 and was updated in 2021. The Special Study Committee on Sustainable Cities and Communities (CEE-268) carried out the revision work. The first author of the present article is a member of this committee; she translated the standard into Portuguese and added notes to it to make a parallel to the Brazilian context.

ISO 37120 is in compliance with the Sustainable Development Goals (SDG) of the UN's 2030 Agenda (UNITED NATIONS, 2019a), whose last version addressed the association between its indicators and the follow-up of 9 of the 17 existing SDGs.

Besides the standardization process, this set of indicators is the basis for yearly certifications carried out by the World Council on City Data (WCCD), which plays an important part in the standardization and outspread of urban metrics. Certifications are validated after an audit in results and hierarchized according to the number of both core and supporting indicators provided by cities (CITYNET, 2016). Cities' performance is not considered for their certification, but their transparency. There are no records of WCCD-certified cities in Brazil, and only a few records of this topic are in the scientific literature. However, a relevant step was taken in 2022 when ABNT, a Brazilian certifying entity, developed a certification process for the ISO 37120 standard. Three cities have been certified, so far, namely: São José dos Campos, Pindamonhangaba, and Jundiaí (ABNT, 2023).

Methodology

Standard application in Rio de Janeiro

The sustainability indicators for Rio de Janeiro City were calculated based on requirements pointed out by ABNT NBR ISO 37120:2017. Its first version was adopted because data of the analyzed cities are the outcome from certifications prior to the ISO 37120 review. Documental research was carried out to consult census data, inventories, and studies performed by the City Hall and other bureaus and agencies in charge of sectors approached in the standard to get the necessary information for indicators' composition.

Indicators recorded in 2010 for the capital of Rio de Janeiro State were taken as a research reference, given the deep dependence on data gathered by the 2010 census carried out by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*, IBGE). It was the last decennial census recorded in Brazil due to delay caused by the pandemic, budgetary cuts, and changes in IBGE's direction board.

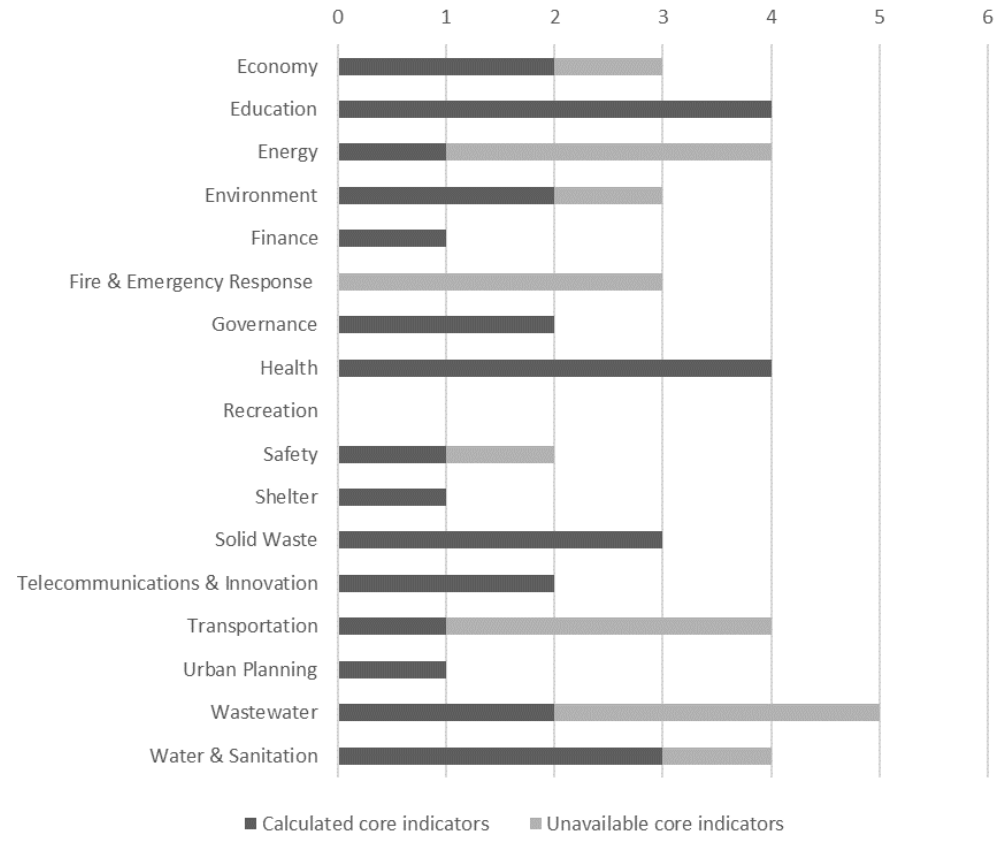
ISO 37120 application in Rio de Janeiro City led to the calculation of 30 core indicators of the 46 ones and of 30 supporting indicators of the 54 existing ones. The graphic in Figure 1 shows the distribution of indicators classified as essential over the standard's 17 thematic axes. It points out the number of topics open to calculations for Rio de Janeiro State's capital and those unavailable for calculation, according to a previously conducted survey.

The section aimed at wastewater has the most significant number of core indicators, although only 40% are available for Brazilian cities. Other sections, whose number of indicators did not exceed 50% of the total, were energy, transportation, and fire &

emergency response. This last one did not have any representative among the calculated indicators.

The total number of indicators regarding the education, health, solid waste, telecommunications & innovation and urban planning topics were calculated.

Figure 1 – Number of core indicators per section in ISO 37120



Source: The authors, 2023.

Analysis of indicators

An option was made to make a comparative analysis between cities in Latin America since the ISO 37120 approach encourages comparing different locations to interpret indicators recorded for Rio de Janeiro City. It was done because these cities present common features: located in developing countries with several similar social issues. Therefore, they would fit as a parameter to measure the performance of Rio de Janeiro State's capital,

respecting its own particularities.

WCCD-certified Latin American cities were selected for the study (the certification limit was the year 2015). These cities, and their values, are available on the platform, namely: Bogota (Colombia), Buenos Aires (Argentina), Guadalajara (Mexico), and León (Mexico). Some information about the compared cities can be seen in Chart 1.

Chart 1 – General information about the compared Latin American cities

General information				
Bogota	Buenos Aires	Guadalajara	León	Rio de Janeiro[1]
Country				
Colombia	Argentina	Mexico	Mexico	Brazil
Population (people)				
7,674,366 (2013)	2,890,151 (2010)	4,664,559 (2010)	1,514,077 (2014)	6,320,446 (2010)
Population density (people/km²)				
4,835.77	14,450.80	5,316.35	1,261.73	5,266.26
HDI				
0.800[(2)]	0.878[(2)]	0.824[(3)]	0.776[(3)]	0.799[(4)]
Certification reference year				
2014	2015	2015	2015	2010

Source: WCCD. (1) IBGE, 2010a. (2) GLOBAL DATA LAB, 2022. (3) PNUD, 2019. (4) IBGE, 2010b.

The analysis was limited to core indicators, which were able to be applied in calculations for Rio de Janeiro City. Supporting indicators were excluded from the current study because the research privileged a more detailed investigation and this process was only feasible to develop with a smaller set of elements.

Some data-transformation processes were carried out to compare different indicators. The first was the inversion of values when their statement had negative content; in other words, when a higher value recorded for a given indicator would point to a direction opposite from that of sustainable development. Inversion was performed through complementary value to assess rates and frequencies, such as the case of unemployment rates, used to calculate employment rates. In their turn, the other cases were based on signal inversion, by turning positive values into negative ones, such as the case of greenhouse gas emissions per ton *per capita*. Accordingly, in further analyses, the higher the indicator values, the better the cities' performance in ensuring the sustainable development of their urban spaces.

The second transformation corresponds to data standardization through the transformation of each variable into standard scores (*z*), at mean equal to zero (0) and standard deviation equal to one (1). This procedure aimed at ruling out the effect of different scales on different variables (HAIR JR. *et al.*, 2009).

If any indicator calculated for Rio de Janeiro City was unavailable for the other cities, the missing value would be replaced by the mean recorded for this indicator in the remaining cities. Thus, after indicators were standardized, the missing values started corresponding to zero.

A systemic analysis of indicators was used as an attempt to rank Rio de Janeiro's performance within the Latin American scenario, from the sustainable development perspective, given the extension of aspects approached by the standard. Accordingly, it was suggested to gather indicators representative of environmental, economic, and social aspects. Regarding the urban context, an indicator can influence more than one sustainability axis, mainly when one observes the city holistically. However, for the present study, indicators were categorized according to aspects directly expressed or affected by their values. For example, the pollutants' emission issue was dealt with as an environmental indicator, whereas health was approached as social indicator, although pollution's effects on human health are broadly known.

Indicators were not subjected to quantitative validation since it was out of the present study's scope. However, the coherence of values was checked through qualitative analysis and a search for elements taken as relevant for each context. There was no intention to approach each topic deeply. From the results' reproducibility viewpoint, this is only understood if the same group of indicators is adopted.

Chart 2 introduces the herein-analyzed core indicators and the section's classifications. They were represented in environmental [En], economic [Ec], and social [So] axes from the sustainability perspective. The ones that have demanded values' inversion were highlighted in bold; their statements must be read through reversed meaning in the axes-based analysis.

Chart 2 – Core indicators calculated for Rio de Janeiro

Section	Core indicators
Economy [Ec]	**5.1. City's unemployment rate**
	5.3. Percentage of city population living in poverty

Section	Core indicators
Education [So]	6.1. Percentage of female school-aged population enrolled in schools
	6.2. Percentage of students completing primary education: survival rate
	6.3. Percentage of students completing secondary education: survival rate
	6.4. Primary education student/teacher ratio
Energy [Ec]	7.2. Percentage of city population with authorized electrical service
Environment [En]	**8.2. Particulate matter (PM10) concentration (x10-6 g/m³)**
	8.3. Greenhouse gas emissions measured in tonnes per capita
Finance [Ec]	**9.1. Debt service ratio (debt service expenditure as a percentage of a municipality's ownsource revenue)**
Governance [So]	11.1. Voter participation in last municipal election (as a percentage of eligible voters)
	11.2. Women as a percentage of total elected to city-level office
Health [So]	12.1. Average life expectancy
	12.2. Number of in-patient hospital beds per 100,000 population
	12.3. Number of physicians per 100,000 population
	12.4. Under age five mortality per 1,000 live births
Safety [So]	**14.2. Number of homicides per 100,000 population**
Shelter [So]	**15.1. Percentage of city population living in slums**
Solid waste [En]	16.1. Percentage of city population with regular solid waste collection
	16.2. Total collected municipal solid waste per capita (tons)
	16.3. Percentage of the city's solid waste that is recycled
Telecommunications and innovation [Ec]	17.1. Number of internet connections per 100,000 population
	17.2. Number of cell phone connections per 100,000 population
Transportation [En]	**18.4. Number of personal automobiles per capita**
Urban planning [En]	19.1. Green area (hectares) per 100,000 population

Section	Core indicators
Wastewater [En]	20.1. Percentage of city population served by wastewater collection
	20.2. Percentage of the city's wastewater that has received no treatment
Water and sanitation [En]	21.1. Percentage of city population with potable water supply service
	21.2. Percentage of city population with sustainable access to an improved water source
	21.3. Percentage of population with access to improved sanitation

Source: ABNT, 2017. Adapted by the authors,2023.

Results and discussion

Indicators calculated for Rio de Janeiro City within the Latin American scenario

Results recorded for the core indicators calculated for Rio de Janeiro City and those available at the WCCD portal for Bogota, Buenos Aires, Guadalajara, and León, are shown in Table 1. This table provides indicators' original values without any statement inversion or standardization process.

Table 1 – Original indicators for Rio de Janeiro and cities in Latin America

Core indicators	Bogota	Buenos Aires	Guadalajara	León	Rio de Janeiro[1]
5.1. [%]	9.00	4.36	5.30	4.72	7.28
5.3. [%]	10.19	29.07	33.30	49.99	11.10
6.1. [%]	98.71	96.80	75.19	81.83	94.26
6.2. [%]	NA	95.36	95.20	98.48	95.08
6.3. [%]	NA	65.80	83.40	96.33	78.17
6.4. [student/ teacher]	26.83	8.90	31.00	26.92	31.59
7.2. [%]	97.40	98.62	99.19	57.00	99.38
8.2. [x10^{-6} g/m^3]	47.90	24.00	49.26	50.65	67.00
8.3. [ton *per capita*]	2.43	4.40	4.61	3.34	3.58
9.1. [%]	NA	3.58	21.27	11.75	18.47
11.1. [%]	47.41	77.00	62.14	62.10	79.55
11.2. [%]	24.77	33.33	32.35	40.00	15.38
12.1. [years]	78.00	77.20	75.18	75.40	75.70

Core indicators	Bogota	Buenos Aires	Guadalajara	León	Rio de Janeiro[1]
12.2. [/100,000 inhab.]	NA	247.96	93.58	181.37	335.49
12.3. [/100,000 inhab.]	26.99	NA	151.25	224.64	547.53
12.4. [/1,000 live births]	14.30	8.40	12.37	12.20	15.80
14.2. [/100,000 inhab.]	NA	6.06	19.80	10.96	29.50
15.1. [%]	6.44	8.52	8.60	29.74	22.84
16.1. [%]	99.91	98.00	97.46	98.00	98.67
16.2. [t]	NA	0.52	0.38	0.24	0.49
16.3. [%]	0.06	4.90	3.91	0.00	0.08
17.1. [/100,000 inhab.]	17,404.00	160,244.82	8,545.09	5,093.00	15,145.00
17.2. [/100,000 inhab.]	NA	34,743.20	110,286.78	85,749.10	112,690.00
18.4. [*per capita*]	0.13	0.75	0.39	0.30	0.25
19.1. [ha /100,000 inhab.]	43.30	62.46	4,465.48	14.96	730.52
20.1. [%]	98.36	96.80	97.16	98.90	70.12
20.2. [%]	63.92	60.06	21.00	8.93	13.48
21.1. [%]	98.99	97.42	97.60	98.90	97.89
21.2. [%]	99.87	97.42	97.60	100.00	98.89
21.3. [%]	98.36	92.03	97.16	100.00	99.15

Source: WCCD. Adapted by the authors, 2023. (1) Elaborated by the authors, 2023.
NA - Not available.

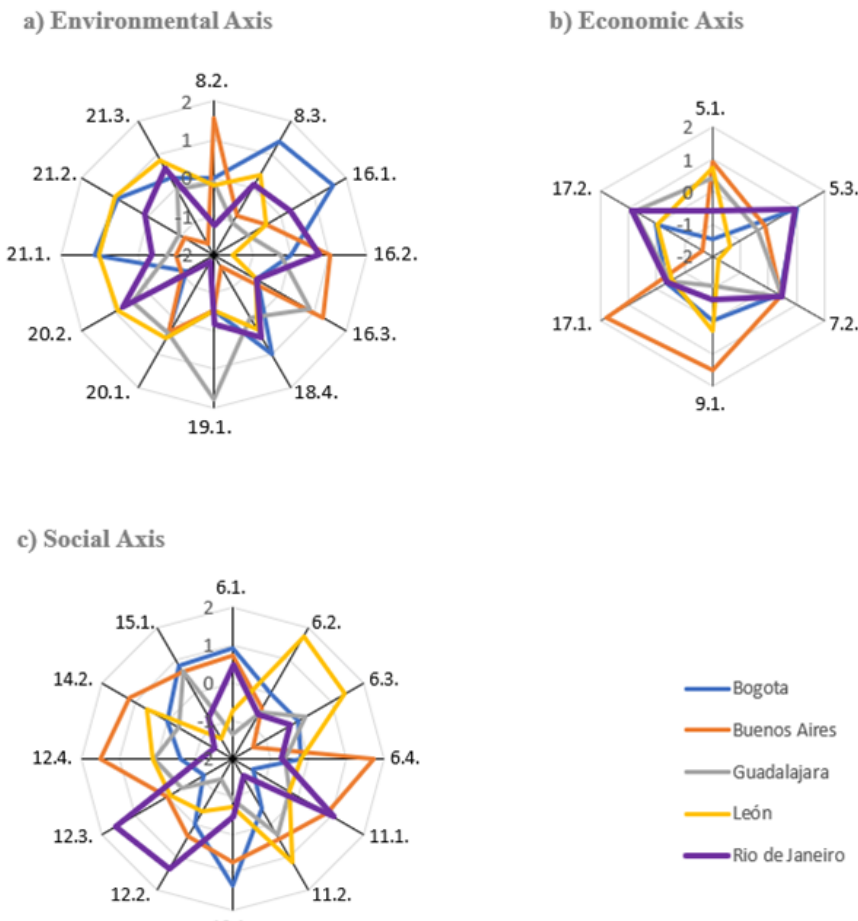
Given the number of compared cities and the volume of indicators and different scales, comparing indicators showed the difficulty of analyzing cities' performance from different sustainability aspects. Accordingly, an option was made to make the analysis based on segmenting the indicators by axes.

Indicators' analysis based on the sustainability axes

Data transformations were carried out based on the gathered values; indicators were grouped according to the sustainability axes that best represented them. Thus, each

axis was expressed in a radar graphic (Figure 2) to enable a general visual analysis of each city's indicators without interference from different scales. Assessment per axis aims at providing an overview of Rio de Janeiro Indicators within the Latin American context to corroborate the coherence of recorded values and the potential of using ISO 37120 from the sustainability viewpoint. However, there was no attempt to exhaust the analyses of each topic addressed by the standard.

Figure 2 – Indicators from different Latin American Cities after the inversion and standardization process. The graphic shows the data of (a) environmental, (b) economic, and (c) social axes



Source: The authors, 2023.

Comparative analysis for Latin America – Environmental Aspect

Graphic in Figure 2a shows the cities' environmental aspect. Indicator 8.2 concerns the particulate matter (PM10) concentration. Buenos Aires stood out for its best

performance, whereas Rio de Janeiro recorded one of the worst indices for this indicator. Item 8.3, in turn, regards greenhouse gas emissions; Bogota is the benchmark among the assessed cities since it recorded the lowest emission *per capita*.

The Colombian city also stood out for indicator 16.1, which corresponds to the rate of urban population with access to regular solid waste collection; however, data about the total amount of collected solid waste (item 16.2) were not available. The best performance observed for this item was recorded for Buenos Aires, which was followed by Rio de Janeiro. Despite the broad collection of domestic waste available for the population in Latin American cities, the recycled waste rate remains insignificant, as shown by indicator 16.3.

If one has in mind that Rio de Janeiro City presents the biggest public cleaning company in Latin America (RIO DE JANEIRO, 2009): Comlurb, then it is possible stating that the city has the potential to improve its performance. Accordingly, in 2008, this municipality implemented the Municipal Plan of Integrated Solid Waste Management. One year after the current study's reference time, it created the Waste Treatment Center and the Waste Sorting Plants to broaden recycling (RIO DE JANEIRO, 2013).

Indicator 18.4 refers to the number of personal automobiles *per capita*. Given its impact on greenhouse gas emissions, it was classified on the environmental axis. Bogota was the location accounting for the smallest number of vehicles, whereas Buenos Aires presented the highest rate for this item; it stood out among other WCCD-certified cities.

Green areas were measured based on item 19.1 of the standard. These spaces are essential for temperature maintenance and air quality improvement; therefore, it helps improving the population's quality of life. Guadalajara has a significant advantage, since this city has the most extensive green area per 100 thousand inhabitants. Rio de Janeiro has the most extensive urban forest in the world, but the city ranks second position in this item among Latin American cities.

Section 20 of ISO 37120 regards wastewater; its collection and treatment are essential for environmental protection. Indicator 20.1 measures the rate of urban population assisted by wastewater collection and distancing systems. This rate is higher than 95% in Latin American cities, except for Rio de Janeiro City, which only reaches approximately 70% of the population. The population in Rio de Janeiro City that does not have access to wastewater collection is concentrated in Planning Area 5, which encompasses 21 neighborhoods (INSTITUTO TRATA BRASIL, 2015).

However, wastewater collection does not mean that it is further treated. Indicator 20.2, which expresses the rate of wastewater that gets some treatment, was best represented by León – Rio de Janeiro City followed it. Bogota and Buenos Aires recorded more than 60% of wastewater without any treatment.

According to data in its respective section, water and sanitation services have broad coverage in the group of Latin American cities. Indicator 21.1 corresponds to the rate of the population provided with drinking water supply, and indicator 21.2 regards the population with access to water sources appropriate for consumption. Cities recorded rates higher than 97%, with an emphasis on León. Item 21.3 points out the rate of the

population with access to improved sanitation; Buenos Aires recorded the worst performance for this indicator: 92% of inhabitants with access to it.

Overall, cities were not linear in environmental indicators' performance because the same location sometimes leads the Latin American ranking in one indicator, and, sometimes, records the worst values for others, such as the case of Buenos Aires and León. The Mexican city, for example, stands out in sanitation and water supply sections but records the worst performance for indicators about solid waste and green areas.

Rio de Janeiro City, in its turn, did not stand out in any of the environmental indicators within the Latin American context since it presented an intermediate performance in this sustainability axis. The main elements for Rio de Janeiro State's capital regarded the concentration of particulate matter and the rate of urban population assisted by wastewater collection and distancing system – indicators 8.2 and 20.1, respectively.

Comparative analysis set for Latin America – Economic aspect

Indicators that express sustainable-development economic aspects, according to the ISO 37120 application, were grouped in the graphic shown in Figure 2b. Section 5 approaches the economy topic. Unemployment rate is dealt within indicator 5.1. Buenos Aires presented the best performance and the lowest rate for this item among the assessed cities. In their turn, residents in Bogota are the ones mostly suffering from a lack of job positions.

Another core indicator to this assessment lies on the rate of population living in poverty: item 5.3. Rio de Janeiro City stood out in this item; however, its values are not a reference to be reached by the other cities since one of the SDGs regards ruling out extreme poverty by 2030 (UNITED NATIONS, 2015). It was observed that, back in 2015, approximately 50% of the population in León lived below the poverty line; this performance placed the Mexican city in the worst position among all WCCD-certified cities, in this item.

The percentage of city's population with authorized electrical service – indicator 7.2 – was classified as part of the economic axis, given its close association with cities' infrastructure and with the resources of its residents, mainly among the most vulnerable populations. León's performance in this item corroborated this association because the city presented the worst indices for this indicator among all WCCD-evaluated cities. The other Latin American cities accounted for low power supply rates – Rio de Janeiro City accounted for the highest value recorded for this indicator.

Concerning municipality finances, indicator 9.1 addresses the debt service ratio; it points out the expansion in debt service as a percentage of a municipality's ownsource revenue. ISO 37120 warns about the different interpretation levels applied to the recorded values. The debt service ratio was unavailable to Bogota, and the lowest rate was recorded for Bueno Aires. Rio de Janeiro City recorded a rate significantly higher than that for the Argentinean capital; its rate increased compared to the previous year due to expenditures with interest rates and amortizations. This strategy aims at making loans

in the World Bank to amortize debts with the Federal State - the debt with the Federal State is based on much higher interest rates, and it contributes to reducing the values recorded for this indicator in the long-term (RIO DE JANEIRO, 2010).

The topic 'telecommunications and innovation' was incorporated into the economic axis because it approaches the city's connectivity level and access to information. It is based on the number of internet and cell phone connections per 100 thousand inhabitants – indicators 17.1 and 17.2, respectively. It is worth highlighting that the time difference between cities' reference years can strongly impact interpretation because it regards technologies that develop fast. In any case, Rio de Janeiro City accounted for the highest rate of cell phones per inhabitant.

Buenos Aires leads the cities in the number of internet connections; conversely, it has the lowest mobile phone connections in the Latin American scenario. León, in turn, recorded the lowest rate of internet connections, and it does not have data about mobile telephony.

Accordingly, when it comes to the economic axis, the city with the best performance is Buenos Aires, which leads in three of the six assessed indicators. Then, there is Rio de Janeiro City, which stands out within the Latin American scenario in this sustainability axis, and from the perspective of making improvements based on the introduced analysis, such as strategies to reduce the indebtedness of this Brazilian city.

Comparative analysis applied to Latin America – Social Aspect

The social aspect was represented by indicators found in the graphic depicted in Figure 2c. The total number of core indicators set to education in Rio de Janeiro City was calculated. The worst results recorded for the Percentage of female school-aged population enrolled in schools – item 6.1 – belonged to the assessed Mexican cities; the lowest rate was recorded for Guadalajara.

Survival rates in primary and secondary education are the topics of indicators 6.2 and 6.3, respectively; both were unavailable for Bogota. Truancy is much more significant in secondary education, in all compared cities, except for León, which presented the best performance in these indicators.

The survey on the association between the number of students per teacher in primary education - item 6.4 – only considers public education institutions. Rio de Janeiro City recorded the worst performance among the Latin American cities, and this datum can impact the quality of municipal public education. The best student/teacher ratio was recorded for Buenos Aires.

Core indicators for governance are approached in item 11 of the standard. They regard the rate of voter participation in the last municipal election and the rate of elected women compared to the total number of elected individuals. Rio de Janeiro City led the other cities in item 11.1; however, it is necessary to know that voting is mandatory in Argentina, Brazil, and Mexico. Voters in Mexico are not subjected to sanctions if they do not show up to vote (CENTRAL INTELLIGENCE AGENCY, 2020). The difference

in the obligation to vote between countries can explain the lower participation rate in the Colombian city.

Rio de Janeiro City was the one that least elected women for public offices, as shown in item 11.2, which reinforces the need for gender equality policies, since it is a SDG. On the other hand, León stood out in Latin America for female representativeness in politics.

Health service is essential for the population's quality of life: it is assessed in section 12 of the standard. Indicator 12.1 measures the average life expectancy in cities – amplitude reaches almost three years in Latin America. Similar to other indicators, discrepancies are observed between different regions in the world or at the national level, as can be seen in the comparison of health indicators recorded for different Brazilian states (INSTITUTO DE PESQUISA ECONÔMICA APLICADA, 2009).

Rio de Janeiro City's performance stood out in the Latin American scenario when indicators 12.2 and 12.3 were analyzed. They regard the number of hospital beds and the number of physicians per 100 thousand inhabitants. However, different from what was expected, this result seems not to reflect on the quality of health services from a broader perspective. It is so because indicator 12.4, which measures the mortality rate of children under 5 years old, recorded the worst value in this city. It is important to point out that numbers refer to public and private health systems as a whole, and it can highlight inequalities in assistance among the whole population in Rio de Janeiro City.

Similar to social inequality, violence is one of the problems causing serious damage in Latin America. The 'safety' core indicator recorded for Rio de Janeiro City was based on the number of homicides per 100 thousand inhabitants - item 14.2 of the standard. The capital of Rio de Janeiro State accounted for the worst homicide index; its numbers were quite different from those of cities presenting data available for this indicator.

Finally, the right to housing is addressed in the topic 'shelter', which is introduced by the indicator focused on the rate of the population living in slums. León was the city with the worst performance in this indicator. The presence of slums pointed toward other issues, such as real-estate speculation and lack of basic infrastructure services (IBGE, 2010c). As for item 15.1, the Mexican city was followed by Rio de Janeiro City, which, according to the 2010 demographic census, recorded the largest absolute population living in abnormal agglomerates among all Brazilian municipalities (IBGE, 2010c).

Thus, different from what happens in the economic aspect, the social axis does not present cities that positively stand out compared to others. Guadalajara, which does not lead in any of the other analyzed items, is an exception; it recorded the best performance for this indicator. The other cities presented the same number of best performances for the assessed indicators. Accordingly, Rio de Janeiro City stood out for recording the worst performance in the assessed items among the five assessed cities.

Standard application and governance for sustainability

The analysis of Rio de Janeiro City's indicators depicts the complexity of defining and assessing sustainable development. Sustainability indicators work as a basis to evaluate the performance of adopted policies, to point out changes to be made, and to develop future actions to make cities more sustainable by analyzing trends and through continuous learning (GHOSH; VALE; VALE, 2006; HJORTH; BAGHERI, 2006). Therefore, they must be able to measure the processes best contributing to maintaining and perpetuating this system over time (HÁK; MOLDAN; DAHL, 2007).

However, it is necessary to have this tool in line with complementary data that can best contextualize the indicators. Accordingly, the role of the scientific community would encompass helping better understand information obtained from indicators by informing their implications, deficiencies, interpretations, and likely use (GALLOPÍN, 1996). It must be similar to what was observed in studies focused on assessing the pertinence of applying ISO 37120 in arctic cities (Berman and Orttung, 2020) and the analysis of transportation systems in European cities based on the standard (Hajduk and Litavniece, 2019).

Furthermore, the application and analysis of indicators are not enough to reach sustainable development. It is necessary having constant policies to increase and monitor data capable of helping to plan and decision-making. These actions are only effective if they are substantiated by integrated management; these tools must be actually used to promote measures to boost continuous improvements in urban systems. Thus, governance for sustainability comprises institutional, legal, and political structures, as well as social participatory and market processes (MOURA; BEZERRA, 2016).

For example, data collection in Rio de Janeiro City showed the relevance of standardizing information indicators and systems. Despite the large number of data found during the documental search, many did not correspond to the information required by the standard. Some of the observed obstacles were a lack of clarity about the methodology adopted to collect specific data and the range of the surveys; many of them did not provide data at the municipal level. The dependence on decennial census data and other studies based on long intervals was also a barrier to public policy monitoring.

However, it is possible noticing a movement in the assessed municipality in the last few years aimed at enhancing governance for sustainability purposes. In 2021, the Sustainable Development and Climatic Action Plan was launched by Rio de Janeiro City; it integrated a long-term planning and management matrix in compliance with the UN's SDGs (RIO DE JANEIRO, 2021). In 2020, the WWF had already awarded the city with the 'Challenge of Cities for the Planet', in Brazil. This is an international award in sustainability. Initiatives like this one point towards the maturity of discussions about this topic in cities and the potential for officially adopting indicators in ISO 37120 as the best way to encourage benchmarking and debate at the international level.

Conclusions

ISO 37120 application in Rio de Janeiro City showed some difficulties getting data about the municipality, mainly because of barriers caused by the lack of standardization of urban indicators. Nearly two-thirds of core indicators were available for this city, but

a lack of data about wastewater treatment, electric power consumption and public transportation capacity caused the main gaps in data.

The selection of the group of indicators taken as essential by ISO 37120, to the detriment of the complete set of indicators calculated for Rio de Janeiro City, made it possible to perform a much more comprehensive analysis of Rio de Janeiro State's capital and of the other assessed Latin American cities, when it comes to their environmental, economic and social issues. Locations with a history of similar problems were chosen as parameters rather than just world standards that do not consider local realities.

Rio de Janeiro City showed great weakness in the social axis; it presented the worst values for many indicators within Latin America, but it got the best economic performance. Thus, this finding points towards the need for better balance among these axes. The Argentinean capital had the best balance among these sustainability axes; it presented the best global performance.

The worst economic indices in Mexico were recorded for León City, whereas Guadalajara recorded intermediate performance in several aspects - the social axis was the most critical. In its turn, Bogota presented extremes in all assessed axes; its indicators were sometimes benchmarks in the region and sometimes accounted for worst references in the Latin American scenario. The Colombian city presented the most significant number of unavailable indicators among the compared cities.

Finally, the present study highlights the relevant role of ISO 37120 in standardizing sustainable development indicators, given its importance and range. The fact that it has a smaller number of basic indicators per thematic axis is compensated by the possibility of a broader standard application, regardless of city size or location. Besides the benefits of standardization, the certification process created by WCCD makes it easier for a global database to expand the sharing of best practices for sustainable development. Another advantage is encouraging cities to enhance their data gathering and outspread systems. It would help cities reach greater transparency, which benefits either public administration or citizens' access to information.

Thus, despite limitations caused by the number of analyzed indicators, study results can contribute to identifying critical points for Rio de Janeiro City's performance in sustainable development. It can also help fulfill the data availability gap in certain fields. It can also work as an illustration and booster for the application and analysis of standard ISO 37120 by other Brazil municipalities and abroad.

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Submitted on: 27/06/2020
Accepted on: 03/03/2021
2023;26:e01322

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AMBIENTE & SOCIEDADE 25 anos 25 años 25 years

SciELO

Indicadores de desenvolvimento sustentável ISO 37120: o Rio de Janeiro e o cenário latino-americano

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Resumo: Os indicadores de desempenho socioeconômico-ambiental constituem uma importante ferramenta para o monitoramento e tomada de decisão na gestão das cidades, visando um desenvolvimento urbano mais sustentável. A ISO 37120 representa um marco na padronização dos indicadores de sustentabilidade, possibilitando a comparação entre diferentes localidades. O objetivo do presente estudo é a aplicação da ISO 37120 para o Rio de Janeiro e a análise tanto deste processo quanto do desempenho do município no cenário latino-americano. Para o cálculo dos indicadores da capital fluminense, foi realizada uma extensa pesquisa documental. A comparação se deu com cidades da América Latina que já haviam aplicado a norma e a partir dos indicadores essenciais normalizados e agrupados segundo os eixos da sustentabilidade. A aplicação da norma revelou fragilidades na obtenção de dados para o Rio de Janeiro e conseguiu identificar os pontos fortes e fracos da cidade em relação às demais.

Palavras-chave: Indicadores de sustentabilidade; cidades sustentáveis; governança para sustentabilidade; gestão urbana; planejamento urbano.

São Paulo. Vol. 26, 2023

Artigo Original

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Indicadores de desarrollo sostenible ISO 37120: Río de Janeiro y el escenario latinoamericano

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São Paulo. Vol. 26, 2023
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Resumen: Los indicadores de desempeño socioeconómico-ambiental son una herramienta importante para el monitoreo y la toma de decisiones en la gestión de las ciudades, con el objetivo de un desarrollo urbano más sostenible. ISO 37120 representa un hito en la estandarización de los indicadores de sostenibilidad, permitiendo la comparación entre ubicaciones. El objetivo de este estudio es aplicar ISO 37120 a Río de Janeiro y el análisis de este proceso y el desempeño del municipio en el escenario latinoamericano. Para calcular los indicadores de la ciudad, se realizó una extensa investigación documental. Se compararon las ciudades de Latinoamérica que ya habían adoptado la normativa y se basaron en los indicadores esenciales normalizados y agrupados según los ejes de sostenibilidad. La aplicación de la normativa, ha revelado debilidades en la obtención de datos para Río de Janeiro y logró identificar los puntos fuertes y débiles de la ciudad en relación con otras.

Palabras-clave: Indicadores de sostenibilidad; ciudades sostenibles; gobernanza para la sostenibilidad; gestión urbana; planificación urbana.