Smart Cities, Sustainability, and Quality of Life
A comparison of indexes and the indicators they include

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ABSTRACT

There is no consensus on what it means to be a Smart City. Nonetheless, many cities around the world are adopting Smart City initiatives; Information and Communication Technologies (ICT) seem to be the common denominator of all these initiatives. But smart cities should evolve not only in technology but also in sustainable development that supports life quality. Sustainability can be measured by goals provided by the UN and also by indexes such as ISO 37.120:2014. Life quality can be defined by indexes as well, such as the Human Development Index (HDI) or any of several Urban Quality of Life (UQoL) indexes. So an index that measures "smartness" of a city is by necessity quite complex. To get a better sense of the indicators (or themes) such an index should include, we analyzed five indexes: one index of sustainability, one of life quality and three indexes for smart cities. We compared these in terms of the indicators or themes they addressed and then we surveyed the websites of 35 smart city initiatives to see for each indicator / theme we identified how many smart city initiatives considered it. We found that the themes that appeared in the highest number of indexes were also most frequent in smart city initiatives of the cities studied, and also that cities are convergent with tackling the same problems of society nowadays.

Keywords: Smart City, Sustainability, Quality of Life, Index.

1. INTRODUCTION

The term Smart Cities is based on the idea of technological devices' evolution, which had access to internet and could connect to one another through the use of tools such as IoT. The first device to receive the term smart was the smartphone, device able to access internet and expand its utilities using apps. IoT also allowed smartphones to connect to stereo systems, cars, TVs, computers and even houses, which enabled smart phone users to lead a "smart life". To accommodate citizens who live a smart life, digital innovation (DI) needed to materialize itself in the form of social and commercial habitations, where people live and work using smart technologies. Combining smart devices, buildings and life, result in a Smart City [1][2].

Smart Cities then arise as a solution to keep up with technology advancement, digital innovation and to solve social, economic, and environmental problems brought by increasing occupancy of urban and urbanized areas [3]. The trends of great cities to become more and more urbanized, as well a the young productive population seeking those areas, may shed light on an increasing pressure on cities to accommodate those people and provide all the resources they need. This migration may tax a range of city resources such as traffic and mobility, electrical power, public safety and public health. The scale may also tilt in terms of economy, when agrarian uses may loose space to industrial or technological. This trend can be observed in China, for example. Another problem caused by this scenario is the need for cities to improve their infrastructures to accommodate qualified professionals that will carry out this new economy. This is a key challenge for global competitiveness [4].

The concept of a Smart City is not standard, as concluded by [5] who stated that it is a concept still under construction. Amongst specialists, there is a consensus that a Smart City should use information and communication technologies (ICTs) aiming to improve their citizens' life quality [4][6]. [7] agree when stating that Smart Cities "use information and physical technology, combined with Internet of Things, to optimize the city infrastructure and make the city more efficient and more livable". Also agreeing, [4] state that "one working definition of a Smarter City is connecting physical infrastructure, the IT infrastructure, the social infrastructure, and the business infrastructure to leverage the collective intelligence of the city". Companies also participated in the construction of the concept, like the giants IBM, Siemens and CISCO. When launching the project "Smarter Planet" in 2008, IBM set the tone for "more efficient and reliable solutions of social, environmental, economic problems through the latest advances in ICT. The three main features of Smarter Planet solutions are marked with three "i", based on English initials: instrumented, interconnected, and intelligent operation" [4][8].

In light of all these definitions, it is safe to say that citizens' life quality is paramount when constructing a Smart City. The main concern, however, arises when Smart City initiatives focus on technology use and do not necessarily take into consideration life quality, becoming too smart and forgetting the human part of the process. [1] tackled that theme when analyzing some smart city initiatives, such as Songdo neighborhood, in South Korea, as well as Masdar City in the Arabic Emirates. About that, he states that the city gets more and more relegated to the second plan when discussing the city, initial and traditionally of urbanistic essence, shifts to the system engineering field and away from urbanistic matters themselves [1].

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It becomes of extreme importance, then, to search for a standardization of the concept through tools that allow for cities' decision-makers to adopt technologies without forgetting life quality. A proposal for a new index composed of a complete set of indicators may be a way to reach good results in face of this dichotomy.

2. SUSTAINABILITY

The first worldwide adopted concept of Sustainability was put forth in the Brudtland Report in 1987, by the United Nations (UN). In this report, sustainability was defined as equilibrium between society, environment and economy [9]. This concept has been widely accepted throughout the years, used by countries, governments and companies to develop goals in order to achieve sustainable development.

Later, in 2000, the UN decided to set more specific goals, gathering the world leaders in New York to sign the United Nations Millenium Declaration, which held them responsible to adopt a partnership for ending extreme poverty and other major worldwide problems by the date of 2015. The millennium goals were eight:

1. eradicate extreme poverty,
2. achieve universal primary education,
3. promote gender equality and empower women,
4. reduce child mortality,
5. improve maternal health,
6. combat HIV/AIDS, malaria and other diseases,
7. ensure environmental sustainability
8. the global partnership for development.

By 2015, those goals had not been achieved, so the UN decided to host another summit to renew the partnership [10].

In the summit held on September of 2015, another partnership was set with world leaders entitled as the 2030 Agenda for Sustainable Development. In this Agenda, seventeen new goals were set, derived from the 2015 goals. The goals were:

1. no poverty,
2. zero hunger,
3. good health and wellbeing,
4. quality education,
5. gender equality,
6. clean water and sanitation,
7. affordable and clean energy,
8. decent work and economic growth,
9. industry, innovation and infrastructure,
10. reduced inequalities,
11. sustainable cities and communities,
12. responsible consumption and production,
13. climate action,
14. life below water,
15. life on land,
16. peace, justice and strong institutions and
17. partnership for the goals.

We are now, nine years until the deadline and countries are mobilizing to achieve those goals [11].

Another institution that tackled sustainability was the International Standardization Organization (ISO). In 2014, they published ISO 37.120, entitled "Sustainable Development of Communities". The document was developed through an initiative involving nine cities in the countries of Brazil, Canada, Colombia and USA. They provided data that supplied the specialists when creating the model. To organize the process, the Global City Indicators Facility was created, within Toronto University, in Canada. The facility also extended itself to a network, containing over 200 cities sharing their knowledge and results. The Technical Committee – TC 268 was instated to carry out the organizing method of the proposal. When analyzing the Smart City Indicators and ISO 37120, one can observe a synergy of themes, as well as a complementation of each other [12].

All of those initiatives, however, were set to improve the life quality of earth's inhabitants, as well as maintaining its' resources in the future.

Further we will explore the sustainability index provided by ISO.

3. QUALITY OF LIFE

To define quality of life is to follow up with the current tendencies and changes in society throughout the years. Its concept involves economy, society, culture and, lately, environment, as it appears on the sustainability horizon [13]. In the 60's, social indicators arise in the United States, to control population's unhappiness [14].

Urbanism came into light as a factor in this discussion on the 70's, as cities grew and the urbanization process increased. Environmental indicators, then, become more evident in the context. With the many problems derived from urbanization, the term quality of life is born, alongside with environmental quality. Further on, they would become urban quality of life [14]. This concept would gain measure through the first index proposals in the 90's, seeking to survey how those problems would play out in people's lives [15].

The United Nations, then, published the Human Development Index (HDI) in 1990, with indicators on health, education and financial income, using 104 countries to gather data from. This index is used worldwide until the present days, serving as base for cities and countries to create their own [15].

Between 2004 and 2005, Brazilian cities created their quality of life indexes, to help cities' decision makers plan on their initiatives and budget decisions.

For this paper, the city of Belo Horizonte was chosen as a subject for its Urban Quality of Life Index. The index was well designed and has a clear methodology and is responsible for quantifying the availability of services from the analysis of different variables that identify the spatial distribution of infrastructures. [15]. Its construction began in 1994 and concluded in 1996, hosting 33 indicators under 9 criteria within a weighing system. In 2006, the model was modified, to accommodate another criteria and 3 more indicators on a binary system where 1 is ideal and 0, not. Both models are available to consultation in the city's website, as well as all the data used for the construction [16].

4. SMART CITIES

The concept of smart cities (or smart cities) has been discussed as a solution, an alternative to support the growth of urban areas. The growth of urban centers is allied to problems such as population growth, the inefficiency of infrastructure and basic services and the depletion of natural resources, which compromise the quality of life of citizens.

At first, the bibliography of smart cities refers to the application of technologies in cities. This definition does not hold up insofar as it puts technology in the foreground to solve the city's problems. Smart Cities concept begins in 2005 when technology companies Siemens, Cisco, IBM, [17] adopt complex information systems application to integrate the cities operation. The term consolidates technology-based innovation in the planning, development and operation of cities, [18]. At the end of 2009, the term Smart Cities had wide repercussion and acceptance in cities all over the world. In a second moment, the concept has been discussed together with people responsible for urban planning. It includes studies related to the formation of cities, the behavior and needs of people living in society and the procedures responsible for implementing the infrastructure, managers to define the feasibility of interests, resources and investments. A city can be called “smart” when investments in human and social capital, traditional infrastructure and modern ICTs promote sustainable economic growth and high quality of life through the intelligent management of natural resources through participatory governance [19].

For a city to be smart, it is important to consider an ecosystem that connects the variables that involve city life. Systems from different sources need to be able to collect, organize and share data interoperable. This complex system needs to be organized and, for that, the Knowledge Organization System presents itself as a way to do this. Other tools can also be used to support this system [7].

Smart cities as an approach to minimizing urban problems, developing a more sustainable and better city to live in, where the concept stands out as quality of life and sustainability [3][20].

To compose the analysis performed in this paper, two Smart Cities Rankings were studied in order to gather cities as subjects. The first was Top 50 smart city governments. This ranking was developed by Eden Strategy Institute, on 2021. Eden is one of the most notorious consultant companies on Business Innovation Systems in the world. To create this ranking, they gathered information on 235 cities self-entitled as smart through various communication means. Cities were from Africa, Europe, South and North America, Asia and Middle East. They used the following criteria: Vision, Leadership, Budget, Financial Incentives, Support Programs, Talent-readiness, Smart Polices, Innovation Ecosystems and People Centricity [21].

The second ranking was Connected Smart Cities, which took into account three major themes: Smartness, Connection and Sustainability. Within those three, 75 indicators under 11 criteria were considered: Mobility, Urbanism, Environment, Innovation and Technology, Entrepreneurship, Education, Safety, Health, Energy, Governance and Economy. The 2021 edition was developed with information on 677 cities above 50 thousand inhabitants, being 48 over 500 thousand, 274 over 100 thousand and 349 over 50 thousand [22].

As this study was developed in Brazil and takes into account a Quality of Life Index from a Brazilian city, both rankings were used to choose cities from, as the first one didn't show a lot of Brazilian cities

5. SUSTAINABILITY, QUALITY OF LIFE AND SMARTNESS OF CITIES INDEXES

Note on Terminology. An *index* is an instrument (in the sense used in the social science, psychology, and educational testing) for arriving at a total score for a composite variable, such as the *Urban Quality of Life (UQoL)*. An index often consists of a list of *sub-indexes*, such *Quality of Housing* or *Quality of Education*, each of which contributes to the total score. A sub-index, such as *Quality of Housing* consists in turn of *indicators* such as *Indoor air quality*, *Comfort of indoor temperature*, *Acoustic insulation*, or *Building fire safety*.

In light of the relationship explored above between the three pillars of sustainability and life quality, it is important to understand the convergence of indicators. We studies five indexes and their component indicators as a basis for proposing a new, more comprehensive index. We identified the commonality of indicators among these indexes. We studied:

- Two indexes of sustainability, ISO 37.720:2014 and STAR.
- Two indexes of the quality of life, commonly known as an Urban Quality of Life Index (UQoL); we chose the UQoL used by the city of Belo Horizonte, Minas Gerais (Brazil) (called IQVU) and an index published by the European Commission,
- Three indexes of the Smartness Cities discussed in journal papers: Alexopoulos 2019, Cohen 2012, Giffinger 2007.

This is a work in progress. STAR and European Commission were added later and are not fully considered in all analyses.
We identified seventeen themes amongst the seven indexes and put them together to explore how many times the theme appeared on them. The idea is that, the more a theme appeared on the indexes, the more we could consider it to be a common ground for specialists on the priorities they sought to create their indexes.

Table 1 shows seven indexes with the their major themes or indicator groupings (sub-indexes), with a gloss defining the theme taken from the source. This gives the reader a sense of the variety of approaches and of their commonalities.
Our ultimate goal is to compile a well-organized comprehensive list of indicators from many different sources, including the seven listed in Table 1. Table 2 is a first step towards this goal. Looking at the seven indexes, we formulated major themes, reusing/combining wording from the sources. We grouped these themes into major thematic areas to give a better overview of the entire "semantic field". We added the glosses from some of the sources, also indicating the term used in the source for the theme. That should help to clarify the scope of each theme. Table 2 also shows for each source the themes it includes, supporting comparison.
Our next step will be to repeat this process at the level of individual indicators. The result will be a very large table that we will make available on the Web. Contact any of the authors if you are interested.

Table 1 – Indexes of Sustainability, Quality of Life, and Smartness of Cities

SUSTAINABILITY INDEXES

ISO: 37120/2014) (ABNT)
Economy – Employment/ Unemployment Rate/Business/Patent
Education – Culture Commerce and Services
Energy – Consumption/Use per capita
Environment – NO2/SO2/O3 Concentration/Noise Pollution/Green house
Finance – Capital spending/Tax collected/ Debt Service Ratio
Fire and Emergency Response – Number of Firefighters/Disaster/Emergency/Response Time
Governance – Voter Participation/Women employed/Citizens' Representation/Registered Voters
Health – Average Life/ Patient Hospital/Number Nurse/Suicide Rate
Recreation – Square meters of public indoor/outdoor recreation space per capita
Safety – Number of Police officers/Homicides/Response Time/Violent Crime
Shelter – Number of Homeless/Households
Solid Waste – Solid waste per capita/Recycled/Sanitary landfill/Incinerator/Burned
Telecommunication and Innovation – Number internet connections/Cell phones
Transportation – Public Transportation/Personal Automobiles/Vehicle/Transportation facilities
Urban – Jobs/Housing Ratio/Green Area/Trees Planted
Wastewater – Percentage of city population served by wastewater collection/% no treatment
Water and Sanitation – Percentage of city population with potable water supply /Improved

STAR (STAR Communities)
Built Environment – Environmental Comfort/Public Spaces/Housing Affordability
Climate and Energy – GHG/Industry/Resources/Water and Waste/Energy Supply
Economy and Jobs – Business Development/Local Economy/Workforce and Quality Jobs
Education, Arts and Community – Arts/Culture/Diversity
Equity and Empowerment – Human Justice and Rights
Health and Safety – Food/Air Quality/Emergencies
Natural Systems – Green areas and water protection

QUALITY OF LIFE INDEXES

IQVU – Urban Quality of Life Index (UQoL) (Belo Horizonte/MG/BR)
Supply – Supply Equipment /
Culture – Culture Commerce and Services
Education – Child Education/First Grade/Second Grade / **Sport** – Public Spaces for recreation
Shelter – Shelter Quality/Shelter Safety
Urban Infrastructure – Environmental Integrity/ Electrical Energy/Pavement/Public Transportation
Urban Safety – Personal Safety/Patrimonial Safety/Traffic Safety

European Commission (EC) (European Union)
People's Satisfaction with the city – Public transport and Spaces/Health Care/Sports and Culture/Education
People's Views about the city – **Employment/Housing/Foreigners/Safety and Services**
Environment – Air Quality/Noise/Cleanliness/Green Spaces/Climate Change
People's Personal Situation – Life/Housing/Financial Situation/Job Situation

SMART CITIES INDEXES

I1 – SMART CITIES (Charalampos Alexopoulos)
ICT Infrastructures – Free Wi-Fi in public areas/Optical Fiber/Home Network
Environment – Air pollution Measurement Sensors/Noise/Seismograph
Transportation Mobility – Traffic/Intelligent System/Smart Stops/Parking spaces
Health – Health Care tele monitoring systems/Establishment of Municipal Health Center
Waste Management & Water Resources – Online Quality measurement system/Sensors
Energy/Sustainable Development – Photovoltaic Installation/Smart meters for energy consumption
Tourism/Culture – cultural Infrastructure/Electronic local guide/App for mobiles
Economy/Development – Actions promoting entrepreneurship/Innovative Actions
Security – Actions addressing citizens and protection plans and emergencies
e-Government – Electronic voting Application/Electronic Signatures/Municipal Services online

I2 – SMART CITIES (Boyd Cohen)
Environments – Smart Buildings/Resource Management/Sustainable Urban Planning
Mobility – Efficient Transport/Multi-modal Access/Technology Infrastructure
Government – Online Services/Infrastructure/Open government
Economy – Entrepreneurship & Innovation/Productivity/Local and Global Connection
People – Inclusion/Education/Creativity
Living – Culture and well-being/Safety/Health

I3 – SMART CITIES (Rudolf Giffinger)
Smart Economy – Innovative spirit/Entrepreneurship/Economic image and trademarks/Productivity
Smart Mobility – Accessibility/ICT-infrastructure/Sustainable, innovative and safe
Smart Environmental – Natural conditions/Pollution/Environmental Protection/sustainable Resources
Smart People – qualification/Flexibility/Creativity/Participation in public life
Smart Living – Cultural facilities/Health Conditions/Safety/Education/Touristic/Social cohesion
Smart Governance – Participation in decision-making/Public and Social Service/Transparent/Political

Table 2 – Themes for grouping indicators

INDEX / Source of Indicators	#	ISO	STAR	IQVU	EC	I1	I2	I3
Sustainable Development *Environments* – Smart Buildings/Resource Management/Sustainable Urban Planning (I2)	3		X		X	X		
Physical Infrastructure *Urban infrastructure* Environmental Integrity/ Electrical Energy/Pavement/Public Transportation (IQVU)								
Environment NO2/SO2/O3 Concentration/Noise Pollution/Green house (ISO) Air pollution Measurement Sensors/Noise/Seismograph (I1) *Smart Environmental* – Natural conditions/Pollution/Environmental Protection/sustainable Resources (I3) *Urban* – Jobs/Housing Ratio/Green Area/Trees Planted (ISO)	7	X	X	X	X	X	X	X
Energy Consumption/Use per capita (ISO) *Energy/Sustainable Development* – Photovoltaic Installation/Smart meters for energy consumption (I1)	3	X		X		X		
Water Resources Management *Water and Sanitation* – Percentage of city population with potable water supply /Improved (ISO) *Waste Management & Water Resources* – Online Quality measurement system/Sensors (I1)	3	X	X			X		
Waste Management *Solid Waste* – Solid waste per capita/Recycled/Sanitary landfill/Incinerator/Burned (ISO). *Wastewater* – Percentage of city population served by wastewater collection/% no treatment (ISO)	2	X	X			X		
Transportation and Mobility *Transportation* – Public Transportation/Personal Automobiles/Vehicle/Transportation facilities (ISO) *Transportation Mobility* – Traffic/Intelligent System/Smart Stops/Parking spaces (I1) *Mobility* – Efficient Transport/Multi-modal Access/Technology Infrastructure (I2) *Smart Mobility* – Accessibility/ICT-infrastructure/Sustainable, innovative and safe (I3)	6	X		X	X	X	X	X
Fire and Emergency Response Number of Firefighters/Disaster/Emergency/Response Time (ISO)	1	X						
Housing and Shelter *Shelter* – Number of Homeless/Households (ISO). *Shelter* – Shelter Quality/Shelter Safety (IQVU)	4	X	X	X	X			
ICT Infrastructure *Telecommunication and Innovation* – Number internet connections/Cell phones (ISO). Free Wi-Fi in public areas/Optical Fiber/Home Network (I1)	5	X	X	X	X	X		
Life and Health								
Life *Living* – Culture and well-being/Safety/Health (I2) *Smart Living* – Cultural facilities/Health Conditions/ Safety/ Education/ Touristic/ Social cohesion (I3)	4		X		X		X	X
Health Average Life/ Patient Hospital/Number Nurse/Suicide Rate (ISO) Health Care tele monitoring systems/Establishment of Municipal Health Center (I1)	5	X	X	X	X	X		

Safety Number of Police officers/Homicides/Response Time/Violent Crime (ISO) *Urban Safety* – Personal Safety/Patrimonial Safety/Traffic Safety (IQVU) *Security* – Actions addressing citizens and protection plans and emergencies (I1)	5	**X**	**X**	**X**	**X**	**X**		
People Inclusion/Education/Creativity (I2) *Smart People* – Qualification/Flexibility/Creativity/Participation in public life (I3)	4		**X**		**X**		**X**	**X**
Society and Governance								
Governance Voter Participation/Women employed/Citizens' Representation/Registered Voters (ISO) *Government* – Online Services/Infrastructure/Open government (I2) *Smart Governance* – Participation in decision-making/Public and Social Service/ Transparent/ Political (I3)	4	**X**			**X**		**X**	**X**
E-Government Electronic voting Application/Electronic Signatures/Municipal Services online (I1)	1					**X**		
Economy Employment/ Unemployment Rate/Business/Patent (ISO). Including *Supply* – Supply Equipment (IQVU) *Economy/Development* – Actions promoting entrepreneurship/Innovative Actions (I1) Entrepreneurship & Innovation/Productivity/Local and Global Connection (I2) *Smart Economy* – Innovative spirit/Entrepreneurship/Economic image and trademarks/ Productivity (I3)	5	**X**	**X**			**X**	**X**	**X**
Finance Capital spending/Tax collected/ Debt Service Ratio (ISO)	1	**X**						
Education and Culture								
Education Including Child Education/First Grade/Second Grade (IQVU)	4	**X**	**X**	**X**	**X**			
Culture Culture Commerce and Services (IQVU)	4		**X**	**X**	**X**	**X**		
Recreation and Sport *Recreation* – Square meters of public indoor/outdoor recreation space per capita (ISO) *Spor*t – Public Spaces for recreation (IQVU)	2	**X**		**X**				
Tourism *Tourism/Culture* – Cultural Infrastructure/Electronic local guide/App for mobiles (I1)	1					**X**		

Table 3 – Convergence of indexes themes

Themes appearing in		
Five indexes	6	Energy, ICT and infrastructure, environment, health, safety and mobility
Four indexes	5	Housing, culture, economy, education and water management.
Three indexes	5	e-government, waste management, governance, recreation and tourism
One index	1	Emergency response

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The result was that Energy, ICT and Infrastructure, Environment, Health, Safety and Mobility appeared on all five indexes. That indicates that those themes are convergent with the three pillars associated in this study: sustainability, quality of life and smartness. Further on, we decided to test weather that would be the case for cities with actual smart city initiatives.

6. ANALYSIS OF INDICATORS ON CITIES

In order to understand whether these indexes can be applied in real life scenarios, we identified 35 cities that are included in two rankings of smart cities: the "Top 50 Smart City Governments" and "Connected Smart Cities". We then looked for information on each city's smart city initiative on the city's official website and other official information sites in order to identify which of the 17 indicators / themes were mentioned in these materials.

Table 4 shows for each theme the percentage of the 35 cities whose materials mention the theme. That should point out which direction cities are aiming their initiatives and if they are contemplating life quality and sustainability as factors in their developments. The result was that three themes that converged in all five models analyzed, also appeared at the top of the smart city initiatives of the studied cities: environment, mobility and ICT and infrastructure.

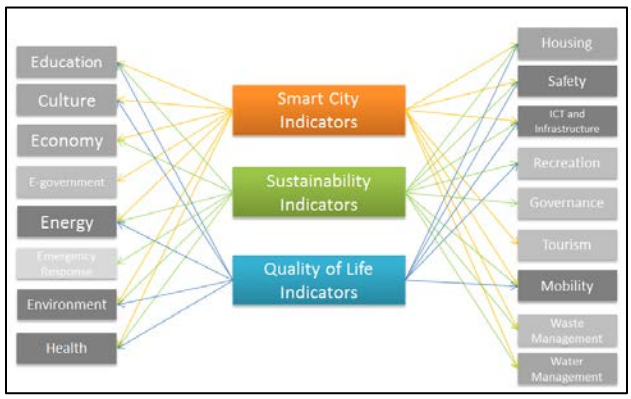

Figure 1 – Convergence Scheme of Indexes

7. CONCLUSIONS

All three pillars considered in this study are convergent when talking about the development of a city. The study of indexes models that were developed from different methods and resulting in similar patterns shows that the entire world is concerned with the same criteria.

The three themes that appeared in all five studied models and were at the top of the analyzed smart city initiatives also converge with UN's Sustainable Development Goals. The Environment theme can be associated with SDGs 6, 7, 12, 13, 14 anb15. Mobility and ICT can be related to SDG number 9.

The theme of Emergency Response was the least popular amongst both specialists' models and cities' initiatives. However, that can be a reflex of the developed cities contained in the study, which not necessarily can mean the same scenario for the ones that are in developing countries.

Table 4

Indicator / Theme	% Cities surveyed	# Indexes in which included	Smart City Initiatives Examples
Environment	94	5	Tridimensional models to identify/prevent heat islands (Lisbon)
Energy	74	5	Solar pavement on Town Square for energy generation (Barcelona)
Water Resources Management	65	4	Three plants of water pollution control (Philadelphia)
Waste Management	82	3	App that indicates the nearest garbage can (NYC)
Transportation and Mobility	88	5	Digital pass system during lockdown (Moscow)
Fire and Emergency Response	44	2	Emergency Operation Center (Milan)
Housing and Shelter	65	4	New buildings must contain green area & solar/wind energy (NYC)
ICT and Infrastructure	85	5	Object detection kit to identify garbage on the streets (Amsterdam)
Health	76	5	Connected Ambulances that share health information (Milan)
Safety	59	6	Real-time monitoring of possible traffic accidents (Adelaide)
E-government	85	2	Open data to government files (Copenhagen)
Economy	88	4	Georeferencing of commercial establishments GEOHUB (LA)
Education	79	4	Use of ICT on schools to encourage startup creation (Beijing)
Culture	74	4	Free access to internet/video on cultural events (Porto Alegre)
Recreation	53	2	Real-time information on available spaces for activities (Lisbon)
Tourism	50	3	Tourist transferring through pods inside the airport (London)

The Smart Cities concept starts in a first generation that had the main focus on the application of technology to solve city problems. With the advancement of applications and deepening the concept of cities, there has been a new generation focused on solving the problems of cities and using new technologies to help and advance in solving problems. The term does not yet have a consensus and fluctuates among professionals from different areas of Architecture, Urban Planning, Engineers, Information and Communication Technology, public managers. Sustainability concepts go hand in hand and converge with the theme of smart cities, as well as quality of life indexes in cities. These indexes have been measured for a long time and now aggregate the concepts of indicators for smart cities. Sustainability and quality of life indexes need to be part of Smart City indexes so that cities can evolve in technology for sustainable development.

The results show that the themes that appear in greater number in the models reflect the number of initiatives in the cities studied. This study confirms the hypothesis that the three pillars of sustainability, urban quality of life index and technology indicators need to converge to face current problems and propose innovations with new solutions.

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