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Different Levels of Smart and Sustainable Cities Construction Using e-Participation Tools in European and Central Asian Countries

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Abstract: Cities are developing strategies to deal with the complex challenges of global change and sustainability. These initiatives have involved the implementation of Information and Communication Technologies (ICTs) as a good driver for achieving sustainability because digital transformation can boost sustainable development strategies, providing opportunities to accelerate transformation. Smart City (SC) models built on empowering people in making public decisions favor access to sustainable development solutions based on knowledge and innovation. Nonetheless, SC experiences around the world denote divergent conceptions of SCs which could lead to different SCs construction. It deserves a more thorough understanding of the nature of collaboration in different settings. Therefore, this paper contributes to the debate on the different uses of ICTs in SCs construction in developing vs. developed countries, by examining the use of ICTs for creating collaborative environments in a sample of SCs in different countries, depending on their economic level, and seeking to identify differences in the objectives pursued by city governments with the use of these technologies. To achieve this aim, e-participation platforms, apps or social media platforms (European and Central Asia SCs) are examined for identifying SCs construction differences between developed vs. developing countries. The findings of this paper put an emphasis on the need for taking into account the differences among SCs in developed vs. developing countries when raking or when performance measurement is designed, because the assessment should be tailored to the cities' particular visions and priorities for achieving their objectives.

Keywords: smart cities; developed and developing countries; e-participation; sustainable development; citizen-centric cities

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1. Introduction

Cities are central for transformative change in improving sustainability [1] and are increasingly developing strategies and action plans to deal with the complex challenges of global change and sustainability [2]. This is explicitly recognized with the inclusion of the Sustainable Development Goal number 11 (SDG#11) «Sustainable Cities and Communities» which is specifically addressed to face most urban challenges not only concerned with environmental issues, but also with urban social, economic, and cultural organization, making the success of accomplishing the SDGs fall on local authorities [3].

To achieve this aim, cities have developed strategies that rely on sophisticated information technologies (ICTs) in creative and innovative ways [4]. The implementation of ICTs seems to be a good driver for achieving sustainability [5]. Under this framework, many cities are actively working in ICT-driven forms of development to build or transform their models toward that of a smart city (SC), which is a concept that has gained a lot of attention in the last years. Although prior research has put into doubt the relationship between smart cities and sustainable cities [6], the smart city movement has gained ground as an enabler of a sustainable and livable urban future [7].

The connection between a smart city as a background and sustainability as a goal is a fact [8], demanding smart city approaches to produce sustainable and livable places of urban centers [9]. Indeed, some authors indicate that cities may be considered smart only if investments ensure sustainability in urban areas through the use of modern technologies [10] which makes the achievement of sustainable and livable cities desired smart city outcomes [7]. In brief, sustainable development depends on access to more and smarter solutions based on knowledge and innovation [11].

Despite previous comments, although many countries around the globe are adopting this idea of SC, they are coming up with their own models of smart cities. Given that, SCs are not only the application and implementation of new and advanced technologies, but they represent a new cultural idea of cities with a new design and approach [12]. Indeed, the definition and objectives of a SC varies from city to city, nation to nation, depending upon the level of development, resource availability, zeal for transformation, and aspirations of city residents [13]. In this regard, the analysis of different SC models could be interesting to understand the SC movement worldwide and the way the sustainability issues are being solved. Nonetheless, the SC rhetoric is produced because no comparative studies are performed in cities with different settings, which could help to identify particularities of SC initiatives and their effects on economic development and regimes of governance, as well as the ways in which the concept travels and mutates [14].

This way, the current situation and trends of urbanization of SCs in developing countries are more miserable and challenging [15] and the smart city idea is still a distant dream for them [16] because they face a lot of problems with ICT implementation due to the presence of poverty, etc. [13], which have made governmental planning, policies and programs more focused on improving human welfare than on engaging citizens in a technological environment [13,17].

By contrast, governments in SCs in developed countries are more pressured to focus on the use of ICTs in creating interactive, participatory, and information-based urban environments [18], as well as in improving public services [19] and the functioning of the administration. The central spirit of these SCs is the need of building structures bases on the negotiated involvement of multiple public and private stakeholders [20,21], and civic participation is a main way of transforming government to make it open and closer to the citizenry needs [22]. Indeed, some authors posit that without an active role of the citizen, the real SCs cannot exist [23].

These divergent conceptions of SCs could lead to a different SCs construction. According to [24], the construction of SCs on the micro level focuses on creating environments livable for the citizens, while on the macro level, focuses on creating an innovative developing environment. Based on previous comments, SCs in developing countries are expected to be more focused on the SCs' micro level construction, whereas SCs in developed countries are expected to emphasize the SCs' macro level construction.

Nonetheless, although interest in SCs is quite high up to now, there is a lack of research regarding the topic of SC construction using ICTs, which could be interesting to know how SCs focus their views on incorporating the sustainability concept in smart city approaches with the aim of achieving sustainable city models [25].

Therefore, this paper contributes to the debate of the different uses of ICTs in SCs construction in developing vs. developed countries, examining the use of ICTs for creating collaborative environments in a sample of SCs in different countries, depending on their economic level, and seeking to identify differences in the objectives pursued by city governments with the use of these technologies. So, the two main research questions in this study are:

RQ1. Are SCs using e-participation technologies for citizen engagement?

RQ2. Are there differences in the e-participation technologies offered by SCs in developed countries vs. developing countries?

To achieve this aim, electronic platforms and mobile applications (apps) or social media platforms represent the use of ICTs to encourage citizen participation in decision-

making, improve the provision of information and services, and enhance transparency, accountability and credibility [26]. This way, in this research, e-participation platforms, mobile apps or social media platforms will be examined for identifying SCs construction differences. This way, we would take a first approach to the SC construction in these cities.

The remainder of this paper is as follows. The next section briefly describes why different settings can promote different understanding of the SC concept, which involve different SCs construction. Then, empirical research is performed regarding the e-participation tools used by the SCs located in countries with different economic levels under the European and Central Asia geographical area. Finally, the conclusion and discussion section bring the paper to an end.

2. Different Realities, Different Smart Cities Construction

Although sustainability has not been generally involved as a main objective in the SC practice [27], the push for achieving the SDGs declared by the United Nations (https://sdgs.un.org/es/goals) (accessed on 15 February 2021) has made recent studies focus their views on the need for incorporating the sustainability concept in SC approaches with the aim of achieving sustainable city models [25]. The SC approach involves urban transformation across city sectors [1] and, specially, in the need for pushing digital innovations on governance issues to achieve SDGs. This way, the role of ICT is related not only to the development of smart initiatives, but also to the challenge of sustainable development in urban environments [10].

In this sense, the implementation of ICTs has favored greater participation by citizens in the creation of public policies and provision of public services. The use of new and advanced technologies allows the disclosure of public information and creates virtual spaces where the citizens can share their opinions and participate in initiatives and projects that will be developed in their region or neighborhood, strengthening, by this way, representative democracy and democratic decision-making processes [28]. In other words, the e-participation provides advantages and benefits such as democratic and legitimacy gains, social inclusion, public policy and service quality improvement and contribution to education [29], which makes it considered a main aim of SCs to achieve greater levels of their citizens' quality of life [30].

Based on this premise, relying on the implementation of ICTs, smart governance is told to create effective, sustainable communities [31], enabling citizen collaboration and public value creation over time [11], and viewing the city as a community among different actors seeking to improve the citizens' quality of life [30]. By empowering citizens in public decisions, a city can unlock forms of smart-sustainable urban development [32,33]. Indeed, the cooperation of actors and the knowledge transfer are at the center of the multidimensional character of a sustainable SC [34].

In this sense, there are many SC initiatives undertaken in SCs, given that they improve the public services, build technological structures, create participatory environments and improve the daily life of citizens. Indeed, the creation and use of ITCs to interact with citizens should be a general pattern of SCs if they want to involve citizens in public decision-making. Therefore, in this paper, the first research question to be solved is:

RQ1. Are SCs using e-participation technologies for citizen engagement?

Despite previous comments, these initiatives have been undertaken from different points of view and conceptions, which have achieved different contributions and consequences. In fact, the concept of the SC is far from being limited to the application of technologies to cities; the SC concept is a fuzzy concept that has not been agreed on nowadays, although there is still a tendency to package SC discourses and effects into a one-size fits all narrative [14]. This way, although many good tools have been implemented in the so-called SCs all around world, a limited unitary vision of the cities exist, which could be a mirror of the cultural situation that is missing in the technology approach [23,35].

Thus, the concept of the SC is far from apolitical and non-ideological, not only for its wider implications on both the urban development [14] and the sustainability of cities [9],

but also for its goals and meaning acquired in different urban settings. Indeed, the SC concept is highly context dependent (country, government, natural resources, IT knowledge, and capacities) [36]. So, the probabilities of a city raising its degree of smartness are contingent on several country-specific variables that outweigh its economic, technological and green advancement rate [37]. Prior research has posited that local communities are likely to resist learning from other cities due to the tendency of relying foremost on local embedded experience [4]. This makes the need to undertake different SC strategies in cities. Thus, SC strategies play a decisive role in how cities choose to take advantage of technology to favor the development of innovation networks, healthy societies, and dynamic economies [38].

This difference in SC strategy is higher between cities in developing and/or in developed countries, because it is argued that the political and cultural issues cannot be ignored while deciding new paradigms and evolving policy interventions for the development of urban areas. In addition, differences are focused on the goals to be achieved and especially in those related to governance models, which are linked to both the social dimension of sustainable cities and the citizens' well-being [39]. This way, the developing countries face poverty problems, security concerns, and a low degree of democracy and corruption [14], while the developed ones are focused on knowledge, innovation and the search of a higher quality of life, which are outcomes that need collaborative and participative models of governance for public value creation [40].

In this regard, governments need to choose the SC strategy according to the urban development stage of the city involved, i.e., existing, or new cities [38]. This way, whereas mostly in the Western world, urban planners endorse the belief that there is no need for new cities, in developing countries, on the other hand, several initiatives have been taken to develop entirely new SCs [38]. For example, in India, the SC narrative has been synonymous with new "greenfield" cities, which now arguably form the new urban utopias of the 21st century [41].

Previous comments make governments and political parties in SCs have alternative priorities. The nature of these differences and how they are negotiated together into the complex assemblage of a SC needs to be teased apart [14]. This way, there is no one way to becoming smart and diverse; cities have embraced distinct advances that indicate their specific circumstances [37].

Under this context, as noted previously, SCs in developing countries are promoting policies that mainly address solving poverty and, by this way, they are more focused on improving human welfare than on engaging citizens in a technological environment [13,17], which remains mostly marginal. Therefore, the following research question is derived:

RQ2. There are differences in the e-participation technologies offered by SCs in developed countries vs. developing countries.

To test previous research questions, the next section of this paper performs empirical research to examine the e-participation tools used by SCs and whether there are real and relevant differences in this matter, with the aim of showing different SCs construction patterns.

3. Methodological Technique and Results

3.1. Sample Selection

In this paper, a SC is identified based on the European Union definition, as "a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies, for the benefit of its inhabitants and businesses" [42]. Thus, our research is focused on European and Central Asia cities labelled as "*Smart*" included in the following international rankings/projects: IESE Business School University of Navarra (see http://www.iese.edu/research/pdfs/ST-0396.pdf) (accessed on 1 February 2021), Asset One Inmobilienentwicklungs AG (see http://www.smart-cities.eu-) (accessed on 1 February 2021), Smart Cities Index 2020 (https://www.imd.org/smart-city-observatory/smart-city-index/) (accessed on 1 February 2021)and finally, we also analyzed

the cities' members of the EUROCITIES network (http://www.eurocities.eu) (accessed on 1 February 2021). These sample cities have been catalogued as SCs in developing countries versus SCs in developed countries, according to the World Bank [43] classification.

Taking into account these considerations, we focus our research on 54 countries in Europe and Central Asia with high-income, upper middle-income and lower middle income [43], where there are 41 countries with SCs (see Table 1). The most sampled SCs are located in high income and upper middle-income countries (51.85% and 20.37%, respectively), with a total of 197 SCs. Therefore, we analyzed 197 SCs located in 41 European and Central Asia countries. To reach our study's goal, we analyzed the e-participation platforms, mobile apps and social media tools used by the local governments of these 197 SCs.

Table 1. Sample selection and descriptive results.

Sample Selection	
Geographical Area	**Countries (Smart Cities)**
Europe	Albania (Tirana); Armenia (Yerevan); Austria (Vienna and Linz); Azerbaijan (Baku); Belarus (Minsk); Belgium (Antwerp, Brussels, Leuven, Ostend, Bruges and Kortrijk); Bosnia and Herzegovina (Sarajevo and Banja Luka); Bulgaria (Sofia and Varna); Croatia (Zagreb and Rijeka); Cyprus (Nicosia); Czech Republic (Prague, Pilsen and Brno); Denmark (Copenhagen and Aarhus); Estonia (Tallinn); Finland (Helsinki, Vantaa, Oulu, Sipoo, Turku, Espoo and Lahti); France (Nice, Paris, Lyon; Reims and Angers Loire Metropole); Germany (Stuttgart, Frankfurt, Duisburg, Munich, Hamburg, Cologne, Leipzig, Dresden, Kiel, Düsseldorf, Nuremberg, Bremen, Karlsruhe, Essen, Muenster, Mannheim and Bonn); Georgia (Tbilisi); Greece (Athens, Amarousion, Heraklion and Thessaloniki); Hungary (Budapest and Debrecen); Ireland (Dublin); Iceland(Reykjavik); Italy (Torino, Napoli, Firenze, Milano, Rome, Cagliari, Pesaro, Bologna, Cesena, Geneva, Arezzo and Palermo); Latvia (Riga); Lithuania (Vilnius and Klaipeda); Luxembourg (Luxembourg); Macedonia (Skopje); Netherlands (Rotterdam, Amsterdam, Eindhoven, Groningen, Almere, The Hague, Haarlem, BrabantStad, Leeuwarden and Utrecht); Norway (Oslo, Bergen and Stavanger); Poland (Wroclaw, Warsaw, Rzeszow, Bydgoszcz, Bialystok, Katowice, Poznan, Lublin, Gdansk and Lodz); Portugal (Lisbon, Oporto, Guimaraes and Braga); Romania (Bucharest, Timisoara, Cluj-Napoca and Constanta); Servia (Belgrade and Novi Sad); Slovakia (Bratislava); Slovenia (Ljubljana); Spain (Bilbao, Malaga, Sevilla, Valencia, Madrid, Barcelona, A Coruña, San Sebastian, Alcobendas, Gijon, Logroño, Terrassa, Zaragoza, Fuenlabrada, Valladolid, Palma de Mallorca and Murcia); Sweden (Stockholm, Göteborg, Nacka, Uppsala, Malmo, Borlänge, Karlstad, Solna, Umea and Kungsbacka); Switzerland (Zurich, Basel, Berna and Lausanne); Turkey (Istanbul, Ankara, Bursa, Beyoglu, Izmir, Osmangazi, Beylikduzu, Nilufer, Linkoping, Gaziantep, Pendik, Kadikoy and Mezitly) Ukrania (Lviv, Odessa, Kyiv and Kharkiv); United Kingdom (Glasgow, Leeds, Liverpool, Manchester, London, Birmingham, Nottingham, Belfast, Newcastle, Derry-Strabane, Brighton, Sheffield, Edinburgh, Sunderland, Bristol and Wolverhampton).
Central Asia	Kazakhstan (Almaty); Russia (Moscow, Saint Petersburg and Novosibirsk)

Table 1. *Cont.*

Descriptive Results		
Cities Income [1]	**With Smart Cities**	**Without Smart Cities**
High-Income	82.35%	17.65%
Upper Middle-Income	84.62%	15.38%
Lower Middle-Income	28.57%	71.43%
Total	75.93%	24.07%
Western Europe Countries		
Cities Income [1]	**With Smart Cities**	**Without Smart Cities**
High-Income	16–69.56%	7–30.44%
Upper Middle-Income	-	1–100%
Total	16–66.67%	8–33.33%
Germany	13.04%	
Spain	12.32%	
United Kingdom	12.32%	
France	12.32%	
Italy	9.42%	
Eastern Europe Countries		
Cities Income [1]	**With Smart Cities**	**Without Smart Cities**
High-Income	10–90.90%	1–9.09%
Upper Middle-Income	8–88.89%	1–11.11%
Lower Middle-Income	1–25.00%	3–75.00%
Total	19–79.17%	5–20.83%
Turkey	23.21%	
Poland	17.86%	
Central Asia Countries		
Cities Income [1]	**With Smart Cities**	**Without Smart Cities**
Upper Middle-Income	2–66.67%	1–33.33%
Lower Middle-Income	-	3–100%
Total	2–33.33%	4–66.67%
Russia	75.00%	

[1] These income ranges are those established by the World Bank (see https://datatopics.worldbank.org/sdgatlas/) (accessed on 1 February 2021). Source: own elaboration.

Regarding the characteristics of the sample selection, Table 1 shows that the SC movement is a widespread phenomenon in the European and Asia Centra countries, because most of these countries are labelled as "*Smart Cities*" (75.93%). There is a total of one hundred and ninety-seven SCs in fifty-four countries, and there is more than one SC in each country (median 1.5), although there are many dispersions (standard deviation 5.00) in the number of SCs implemented in the countries. Given that, 51.27% of the SCs are concentrated in seven Western Europe countries (Germany, France, Spain, United Kingdom, Italy, Netherlands and Sweden). The results show that although the greatest number of SCs are located in the Western European countries (137 SCs, 69.54%, are located in Western European countries vs. 56 SCs, 27.41%, which are located in Eastern Europe countries), the SCs are more distributed in the different countries of Eastern Europe (24 countries with 2.33 SCs in each country). However, there are five countries in Western Europe that do not host SCs, but there are 5.71 SCs by country.

Whereas Germany, Spain, United Kingdom, France and Italy embrace the greater number of SCs in Western Europe, Turkey and Poland embrace mainly the SCs in Eastern Europe and Russia is the country that embraces the highest number of SCs in the Central Asia area. In addition, we can observe that the greater number of SCs are concentrated

in the high-income countries (see Table 1). However, in the case of Eastern European countries, there are four city governments (Azerbaijan, Belarus, Georgia and Macedonia) with upper middle-income and one city government with lower middle income (Armenia), which have undertaken these strategies with the aim of boosting greater economic progress in the region.

Finally, when the mobile apps were analyzed, we classified them in six dimensions (Smart Economy, Smart Mobility, Smart Environment, Smart People, Smart Living and Smart Governance), given that the idea of SCs is rooted in the creation and connection of human capital, social capital and ICTs infrastructure to generate greater and more sustainable economic development and a better quality of life [4]. In addition, with this classification, we will be able to have a clearer idea of the approach that each of the countries have in the implementation of SCs projects and the management models adopted.

3.2. Students t-Test Analysis Method

City governments in SCs around the world are making efforts to make diverse tools and applications (social media, online platforms and mobile apps) available to citizens with the aim of favoring their participation in public affairs [44], thus creating more affordable, participatory and transparent public sector management models [26].

As previously revealed, local governments around the world have carried out huge efforts to offer web-based and mobile devices for usage by citizens to interact with them because these technologies offer greater data storage capacity, activities, systems, software and greater connectivity in real time, favoring e-democracy [22]. Governments have designed service platforms that enable citizens to report incidents and interact with them while on the move [45]. Therefore, the creation and use of new technologies to interact with citizens is a general pattern of SCs, although, as noted previously, differences between SCs in developed vs. developing countries may exist.

Thus, in our research, the data collection method is based on an examination of the official websites of local governments in European and Central Asian SCs in February of 2021 with the specific purpose of collecting data about smart technologies used for e-participation and, concretely, the social media tools used (actively), the e-participation platforms available for citizen engagement in different public affairs, and how many apps are offered by local governments with the aim of improving e-participation in the city governance. This information will be useful for answering the RQ1 of this study.

In addition, in order to answer the second research question previously posed, an independent t-test was run to compare e-participation tools offered in SCs in high versus upper middle-income countries' groups. The students t-test of significance (independent samples of the t-test) is the most powerful test available when comparing the means of two independent groups to determine whether there is statistical evidence that the associated population means are significantly different [46–49].

3.3. Analysis of the Results

RQ1. Descriptive Statistics and Qualitative Analysis

Regarding the offer of e-participation tools by sample SCs, Table 2 shows that the offer of social media is relatively the highest in city governments located in high-income countries. They offer a median of 3 social networks, versus a median of 2 social networks in the case of upper and low middle-income's city governments. In both cases, Facebook, Twitter, and Instagram are the most offered social media by local governments. We can observe that there is a high dispersion (Std. dev. 1.32) in the case of high-income cities; the top positioned cities use six social media channels, while the upper middle-income and lower middle-income cities use 4 and 2 social media channels, respectively. In these last cases, there is less dispersion, with standard deviations of 0.96 and 0.00.

Our analysis shows that the city governments in high-income countries were aware of the substantial advantage that social media offers for sharing opinions and ideas before those located in the upper/lower middle-income countries. Thus, they started to use social media tools in 2008, whereas city governments in upper/lower middle-income countries implemented them after 2011.

On the other hand, although SCs should favor collaboration between citizens and local governments to solve their own problems, express their ideas, influence policy, and so on, the results indicate that not all sample city governments make e-participation platforms available for citizen engagement in public decisions: 71.34% and 92.86% of city governments have not created them (see Table 2). There are SCs located in countries that have carried out a huge effort in this issue. For example, SCs that offer participation platforms are: Finland at 85.71%, Spain and the United Kingdom at 52.94% and France at 47.06%. In this regard, we can observe that e-participation platforms are a challenge for SCs located in both types of countries (developing and developed countries), because the mean scores are zero, although there is a greater dispersion in the particular case of high-income cities (Stand. Dev. 0.47).

Previous research [2,7] highlighted that the environment and context of SCs could propitiate social and technological innovation. Our results seem to confirm this assertion regarding the location of the city because the 54.82% (108/197) of European and Asia Central SCs have mobile applications (see Figure 1). Nonetheless, the level of income seems to be a determinant factor for city governments to use this tool because of the number of apps used by local governments in upper-middle income countries (57.93% versus 39.39%). The lower-middle income country has no apps.

Table 2. Social media tools and e-participation platforms offered by sample local governments.

SOCIAL MEDIA CHANNELS					
High-Income Cities [1]					
Social Media	**No**	**Yes**	**Social Media**	**No**	**Yes**
Facebook	7.93%	92.07%	Linked	96.34%	3.66%
Twitter	15.85%	85.15%	Pinterest	79.88%	20.12%
Instagram	48.17%	51.83%	Youtube	47.55%	52.44%
Median		3.00	**Highest number of social media channels used**		6.00
Standard deviation		1.32	**Lowest number of social media channels used**		0.00
Upper Middle-Income [1]					
Social Media	**No**	**Yes**	**Social Media**	**No**	**Yes**
Facebook	7.14%	95.84%	Linked	96.43%	3.57%
Twitter	10.71%	89.29%	Pinterest	89.29%	10.71%
Instagram	64.29%	35.71%	Youtube	85.71%	14.29%
Median		2.00	**Highest number of social media channels used**		4.00
Standard deviation		0.96	**Lowest number of social media channels used**		0.00
Lower Middle-Income [1]					
Social Media	**No**	**Yes**	**Social Media**	**No**	**Yes**
Facebook	-	100.00%	Linked	100.00%	-
Twitter	-	100.00%	Pinterest	100.00%	-
Instagram	100.00%	-	Youtube	100.00%	-

Table 2. *Cont.*

Median **Standard deviation**			2.00 0.00	**Highest number of social media channels used**	2.00
City Income [2]	**No**	**Yes**	**E-PARTICIPATION PLATFORMS** [1]	
			Country (City—Website)	
			High-Income Smart Cities	
High-Income	71.34%	28.66%	Austria (Vienna—https://www.partizipation.wien.at/de); Belgium (Brussels—https://www.fairebruxelles.be/); Denmark (Copenhagen—https://www.kk.dk/borgerpanelet); Finland (Helsinki—https://kerrokantasi.hel.fi/---http://ruuti.munstadi.fi/); Finland (Vantaa—https://www.kuntalaisaloite.fi/fi); Finland (Oulu—https://www.ouka.fi/vuorovaikutus); Finland (Turku—https://opaskartta.turku.fi/eFeedback/en); Finland (Espoo—https://easiointi.espoo.fi/eFeedback/en); France (Paris—https://www.paris.fr/dossiers/proposer-choisir-agir-3); France (Lyon—https://www.lyon.fr/vie-municipale/democratie-participative); France (Lille—http://www.lille.fr/Participer/La-democratie-participative); France (Grenoble—https://www.grenoble.fr/552-budget-participatif.htm); France (Toulouse—https://jeparticipe.toulouse.fr/processes/bp2019); France (Bordeaux—https://debats.bordeaux.fr/); France (Strasbourg -https://www.strasbourg.eu/participer); France (Nancy—ttps://participez.nancy.fr/processes/democratie-locale); Germany (Stuttgart—https://www.stuttgart-meine-stadt.de/content/bbv/details/68/); Germany (Frankfurt—https://www.ffm.de/frankfurt/de/home); Germany (Belin—https://mein.berlin.de/); Germany (Munich—http://blog.muenchen.de/); Germany (Leipzing—https://english.leipzig.de/services-and-administration/opportunities-for-residents-to-get-involved-and-make-a-difference/thinking-leipzig-ahead/); Iceland (Rykjavik—https://reykjavik.is/en/my-district); Italy (Milano—http://www.comune.milano.it/wps/portal/ist/it/partecipa/referendum); Italy (Rome—http://www.comune.roma.it/web/it/attivita-e-progetti.page); Portugal (Lisbon—https://cidadania.lisboa.pt/); Portugal (Guimaraes—http://op.cm-guimaraes.pt/); Spain (Bilbao—https://www.bilbao.eus/cs/Satellite/bilbaoparticipativo/es/inicio); Spain (Sevilla—https://www.sevilla.org/servicios/participacion-ciudadana); Spain (Madrid—https://decide.madrid.es/legislation/processes/24/proposals); Spain (Barcelona—http://ajuntament.barcelona.cat/participaciociutadana/es/organos-de-participacion-sectoriales); Spain (A Coruña—http://www.coruna.gal/participacion/es); Spain (Alcobendas—https://participa.alcobendas.org/); Spain (Gijon—https://www.gijon.es/es/ayuntamiento/participar); Spain (Zaragoza—https://www.zaragoza.es/sede/portal/participacion/); Spain (Valladolid—https://www.valladolid.es/participacion/es?locale=es_ES); Sweden (Göteborg—http://digitala.goteborg.se/demokrati-och-delaktighet#); Switzerland (Zurich—https://www.stadt-zuerich.ch/portal/de/index/ogd.html); Switzerland (Geneva—http://www.participer.ch/); UK (Leeds—http://www.leeds.gov.uk/council/Pages/Consultations-and-feedback.aspx); UK (Manchester—http://www.manchester.gov.uk/councildemocracy); UK (Birmingham—https://www.birmingham.gov.uk/info/20014/schools_and_learning/1313/full_participation); UK (Nottingham—https://www.nottinghamcity.gov.uk/engage-nottingham-hub); UK (Belfast—https://yoursay.belfastcity.gov.uk/); UK (Newcastle—https://www.letstalknewcastle.co.uk/); UK (Derry Strabane—https://haveyoursay.derrystrabane.com/); UK (Brighton—https://consultations.brighton-hove.gov.uk/); UK (Coventry—https://letstalk.coventry.gov.uk/)
Upper Middle-Income	92.86%	7.14%	
Lower Middle-Income	100.00%	-	
			Upper Middle-Income Smart Cities	
			Russia (Moscow—https://ag.mos.ru/?onsite_from=main_page); Russia (Saint Petersburg—http://gorod.gov.spb.ru/)	

Table 2. *Cont.*

High-Income Cities	**Median**	0.00	**Highest number of e-part. platforms**	2.00
	Standard deviation	0.47	**Lowest number of e-part. platforms**	0.00
Upper middle-Income Cities	**Median**	0.00	**Highest number of e-part. platforms**	1.00
	Standard deviation	0.26	**Lowest number of e-part. platforms**	0.00

[1] All websites were accessed on the period 1 February 2021–15 February 2021. [2] These income ranges are those established by the World Bank (see https://datatopics.worldbank.org/sdgatlas/) (accessed on 15 February 2021). Source: own elaboration.

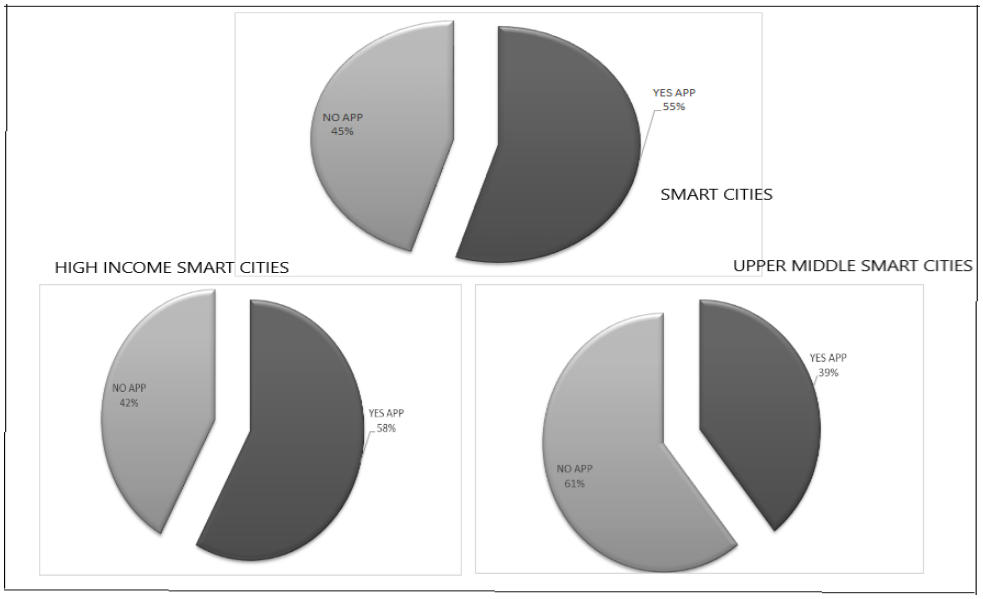

Figure 1. Apps offered by sample local governments in European and Central Asian smart cities.

These apps mainly address the improvement of the quality of life of the citizenry by offering tourism information, cultural events, showing the best events of leisure and culture sports, museum festivals, cinema, children's activities, theatre and dance, programs, prizes and competitions, music, conferences and so on (40.77%) (see Figure 2), i.e., the Smart Living apps are the main mobile applications created by local governments in sample SCs. Examples of these apps are those that allow the citizens to find the best events of leisure and culture, sports, museums, festivals, cinema, children's activities, theater and dance, programs, professional events, prizes and competitions, leisure, music, conferences, congresses, parties, exhibitions, courses, workshops and so on.

There are smart mobile apps (Smart Mobility) that focus on improving the use of public transport and offer information about time schedules, traffic jams, bus or taxi prizes, and places where the citizens can share or rent a bike, or park cars in public parking (30.66%). Examples of these apps are those that provide information about: checking the balance of your card and recharging your mobile card with bus voucher trips; checking bus lines, stops, schedules, and travel on the city map; calculating how to move to any address or place of interest in the city using any means of sustainable transport, alone or in combination.

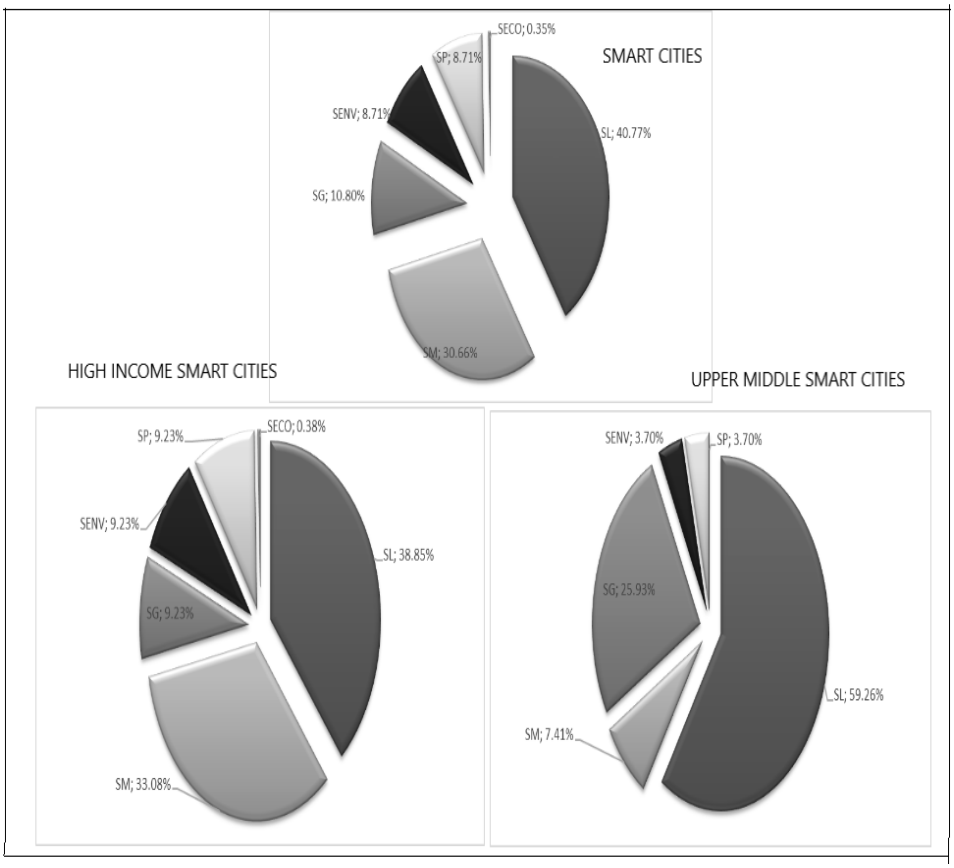

Figure 2. Characteristics of Smart Apps offered by sample local governments in European and Central Asian Smart Cities. **Note:** Smart Living (SL); Smart Mobility (SM); Smart Governance (SG); Smart Environmental (SENV); Smart People (SP) and Smart Economy (SECO). **Examples:** Smart Living (Bordeaux Agenda and Müchen Smart City App); Smart Mobility (Tisséo metro tranvía and Linz Linien); Smart Governance (Tu Murcia and A Coruña Aberta); Smart Environmental (Slim Melden Groningen andDüsseldorf bleibt sauber); Smart People (Ung i Kungsbacka) and Smart Economy (Parques Empresariales Málaga).

However, there are few smart governance applications (10.80%) that favor citizens' participation in public issues and generate new users' collaborative experience with local government and other stakeholders (universities, non-profit organizations or enterprises). This result indicates that public managers and politicians are not really interested in favoring an active citizen collaboration with the city in the generation of open data, improving public services, and sharing opinions and experiences. Examples of these apps are those that generate new users' collaborative experiences with the city, given that they allow the user to act as a sensor by allowing them to actively collaborate with the cities in the generation of open data, participatory budgeting, co-designing public services, and so on.

In addition, the results suggest that the development and implementation of these technological advances has been different among sample cities according to the group of countries to which they belong, according to their income level. In the case of SCs located in high-income countries, the apps created by city governments are more focused on Smart Mobility that those created by upper middle-income countries (33.08% versus 7.41%). By contrast, the Smart Living apps are relatively more offered by the city governments in upper middle-income countries (59.29% versus 38.85%), although the greatest difference is focused on the offer of Smart Governance apps by upper middle-income countries, which is much higher than those created by SCs in high-income countries (see Figure 2). It favors participation in citizens in decision-making, public and social services, disclosure of public information, political strategies and public policies.

Regarding the demand for using these apps by citizens, results indicate that the evolution and development of these apps have been different (see Table 3).

Table 3. Score, citizens' opinions and downloads apps.

High-Income Smart Cities [1]								
Characteristics	**Score [2]**			**Citizens' Opinions**		**Downloads**		
Smart Living Apps	0–1.9	4	3.96%	Average	1032.92	10–50	3	3.09%
	2–2.9	7	6.93%			50–100	2	2.06%
	3–3.9	38	37.63%			100–500	11	11.34%
	4–5	43	42.57%			500–1000	9	9.28%
	NO	9	8.91%			1000–5000	26	26.80%
	Average		**3.78**			5000–10,000	15	15.46%
						10,000–50,000	17	17.53%
						50,000–100,000	7	7.22%
						100,000–500,000	6	6.19%
						5,000,000+	1	1.03%
Smart Mobility Apps	0–1.9	4	4.66%	Average	14,469.9	10–50	1	1.19%
	2–2.9	16	18.60%			100–500	2	2.38%
	3–3.9	37	43.02%			500–1000	3	3.57%
	4–5	27	31.40%			1000–5000	8	9.52%
	NO	2	2.32%			5000–10,000	9	19.71%
	Average		3.49			10,000–50,000	20	23.81%
						50,000–100,000	8	9.52%
						100,000–500,000	22	23.81%
						5,000,000–1,000,000	5	5.95%
						1,000,000–5,000,000	4	4.76%
						5,000,000+	2	2.38%
Smart Environmental Apps	0–1.9	0	0.00%	Average	58.53	10–50	2	9.09%
	2–2.9	5	20.83%			100–500	3	13.63%
	3–3.9	6	25.00%			500–1000	1	4.54%
	4–5	7	29.17%			1000–5000	10	42.45%
	NO	6	25.00%			5000–10,000	2	9.09%
	Average		**3.42**			10,000–50,000	3	13.63%
						50,000–100,000	1	4.54%
Smart Governance App	0–1.9	0	0.00	Average	2179.53	100–500	3	13.04%
	2–2.9	5	20.83%			1000–5000	8	34.78%
	3–3.9	7	29.17%			5000–10,000	5	21.74%
	4–5	7	29.17%			10,000–50,000	5	21.74%
	NO	5	20.83%			100,000–500,000	1	4.35%
	Average		**3.49**			500,000–1,000,000	1	4.35%
Smart Economy Apps	3–3.9	1	100.00%	Average	19.00	500–1000	1	100%
Median			1.00			**Highest number of Apps**		12.00
Typical deviation			2.19			**Lowest number of Apps**		0.00

Table 3. *Cont.*

Upper Middle-Income Smart Cities [2]								
Characteristics	**Score [1]**			**Citizens' Opinions**		**Downloads**		
Smart Living Apps	0–1.9	0	0.00%	Average	1168.93	1000–5000	3	20.00%
	2–2.9	2	12.50%			5000–10,000	1	6.67%
	3–3.9	5	31.25%			10,000–50,000	5	33.33%
	4–5	8	50.00%			50,000–100,000	1	6.67%
	NO	1	6.25%			100,000–500,000	3	33.33%
	Average		**3.76**					
Smart Mobility Apps	3–3.9	2	100.00%	Average	1892.00			
	Average		**3.30**			100,000–500,000	2	100%
Smart Environmental Apps	3–3.9	1	100.00%	Average	292.00			
	Average		**3.30**			10,000–50,000	1	100%
Smart Governance Apps				Average	5320.00	50–100	1	14.29%
	2–2.9	1	14.29%			100–500	1	14.29%
	3–3.9	2	28.57%			10,000–50,000	2	28.57%
	4–5	4	57.14%			100,000–500,000	1	14.29%
	Average		**3.30**			500,000–1,000,000	1	14.29%
						1,000,000–5,000,000	1	14.29%
Median				0.00		**Highest number of Apps**		6.00
Standard deviation				1.62		**Lowest number of Apps**		0.00

[1] These income ranges are those established by the World Bank (see https://datatopics.worldbank.org/sdgatlas/) (accessed on 5 February 2021). [2] Score of the mobile application assigned by its users. To synthesize the information and offer a better idea, it has been offered by ranges. Source: own elaboration.

The Smart Living Apps are more used by the citizens in upper middle-income countries, with an average score of 3.78 and more than 10,000–50,000 downloads. By country, the Smart Mobility Apps are more used by the citizens in high-income countries, with an average score of 3.49 and more than 10,000–50,000 downloads.

The main difference in the use of mobile applications can be found in the Smart People Apps. These apps are used by citizens in SCs located in high-income countries (9.23%), whereas there is only one app of this kind of application that has been offered and, of course, used by citizens, in upper middle-income countries. There is only one Smart Economy app in high-income countries, so the development of these apps is a challenge in the future that will have to be considered by SCs. Finally, the use of the Smart Governance app is very different. The citizens in upper middle-income countries download more these apps than the citizens in high-income countries; the score is much higher, as well as the average of opinions. Finally, we can observe that there is a great difference between both types of cities, given that there are twice as many mobile apps in the case of high-income cities because these SCs offer 12 mobile apps, although there is a great dispersion (Stand. Dev. 2.19). In the case of upper middle-income cities, a median of zero mobile apps are offered, although they have a smaller dispersion (Stand. Dev. 1.62).

RQ2. Students t-test results

This paper tests whether differences between levels of income in the countries in which sample SCs are located can affect the different SCs construction and, in particular, their positions regarding the use of e-participation tools for citizen involvement. This way, RQ2 of this research tests whether differences in the e-participation technologies offered by SCs in developed countries vs. developing countries exist.

To perform this test, we have identified the SCs between SCs located in high-income vs. upper middle-income countries with a binary variable (0/1) and we have examined the number of social media platforms offered by sample SCs (from 0 to 6), the existence of an e-participation platform (0/1) and the number of apps created by the city government

(from 0 to 12). Then the independent samples' *t*-tests have been employed using the data collected previously in an observation of the official webpages of the sample SCs.

In this regard, our results show that, regarding social media and apps, the inequality of variances is met at 10% of the significance level (see Table 4). The assumption of the equality of variances is based on the premise that the population variances of the variable being analyzed for each group are equal. Else, the validity of the results can be jeopardized [50]. Equally, for the particular case of e-participation platforms, the Levene's test showed that the variances are not equal between the groups of sample SCs.

Additionally, significant differences were found in two of the three variables used (social media and e-participation platforms), for the two groups of SCs according to the income level of the country in which the SCs are located ($p = 0.066$ for social media and $p = 0.000$ for e-participation platforms). Since these p-values are nearly at the 10% and 5% significance level, it is nearly impossible to reject the statistics' null hypothesis of equal means and it can be concluded that these e-participation technologies offered by SCs in developed countries vs. developing countries are significantly different. It means that there is a different SCs construction regarding e-participation tools offered by SCs located in high-income countries and SCs located in upper middle-income countries. Indeed, according to the mean of the group statistics, SCs in high-income countries present higher measures in all e-participation tools than SCs in upper middle-income countries.

By contrast, for the particular case of the creation of apps, it seems that our research does not find significant differences between the groups analyzed ($p = 0.158$) and therefore it seems that no differences are present in the SCs construction regarding this technological advance.

Table 4. Statistical independent sample *t*-test for the difference of e-participation construction in sample smart cities (SCs) according to the income level of the countries in which there are located.

		Group Statistics					Levene's Test for Equality of Variances		t-Value	df	Mean Difference	Std. Error Mean	95% Confidence Interval of the Difference		Sig. (2-Tailed)
		N	Mean	Std. Deviation	Std. Error Mean		F-Value	Sig.					Lower	Upper	
Social Media	SCs in high income countries	165	3.04	1.33	0.10	Equal variances assumed	3.425	0.066	2.515	196	0.606	0.241	0.131	1.088	0.001
	SCs in upper middle-income countries	33	2.42	0.83	0.14	Equal variances not assumed			3.407	69.79	0.606	0.178	0.251	0.961	
E-participation platform	SCs in high income countries	165	0.30	0.47	0.04	Equal variances assumed	88.066	0.000	3.201	196	0.267	0.833	0.102	0.431	0.000
	SCs in upper middle-income countries	33	0.03	0.17	0.03	Equal variances not assumed			5.603	137.15	0.267	0.048	0.173	0.361	
Apps	SCs in high income countries	165	1.47	2.177	0.169	Equal variances assumed	2.010	0.158	1.4787	196	0.588	0.398	−0.196	1.372	0.141
	SCs in upper middle-income countries	33	0.88	1.536	0.267	Equal variances not assumed			1.857	60.94	0.588	0.317	−0.045	1.221	

Source: Own Elaboration.

4. Conclusions and Discussion

This paper analyzes the different SCs construction patterns between smart cities located in developed vs. developing countries. To achieve this aim, this paper analyzed how the SC concept can be understood with a different meaning which is proved to be context dependent. Findings in a sample of SCs located in the European and Central Asian countries grouped by their economic level indicate that SCs are more frequent in developed countries than those in developing countries. In addition, SCs in high-income countries undertake the highest number of smart projects and make more e-participation tools available for citizen engagement in public decisions. These differences are statistically significant for the creation of social media profiles and e-participation platforms. Therefore, the findings show evidence of differences in SCs construction according to the income level of countries in which SCs are located and it confirms the research questions in this study.

Perhaps the difference between the SCs construction is also reflected in the meaning of the SC concept in both types of analyzed cities in this paper (those in developed vs. developing countries). The first ones have solved poverty problems of the population and seek to increase the quality of life of citizens in the way of making new technologies as the main vehicle for both connecting communities to meet the needs of governments, citizens and other stakeholders, and making innovation and knowledge the key aspects of the SC. Thus, this notion works to make a city knowable and controllable in new, more fine-grained, dynamic and interconnected ways that improve the performance and delivery of public services while supporting access and participation [51].

The second ones have not yet solved the poverty problems in the city and are more focused on the urban planning field where the term "smart city" is often treated as an ideological dimension according to which being smarter entails policies and programs for targeting sustainable development, economic growth, better quality of life for their citizens, and creating happiness [52]. Thus, from this perspective, ICTs, in conjunction with human and social capital and wider economic policies, are used to leverage growth and manage urban development rather than to make a city smart [53]. Therefore, two models of SCs are used for one concept. The first one focused on a socio-technological lens and it is reliant on a technocratic and technological perspective; the second one focused on an urban planning perspective which encompasses human capital, education, economic development and governance [51].

Another finding of this paper is the use of technological tools for communicating information more than for public participation. Indeed, social media tools are being used more than e-participation platforms and/or mobile application (apps) by sample SCs. Recent studies indicate that social media have been increasingly used for urban analysis and modelling, often combined with conventional and new datasets [54]. Nonetheless, these tools are being used as a channel of communication under the public sector management lens but not as a participative mechanism with citizens [55]. In this sense, the use of e-participation platforms is almost testimonial; very few cities use this channel to encourage citizen participation in public affairs.

As social media technologies could require government organizations to give up significant control over contest or over the way in which communications and relationships with stakeholders are handled [56], policymakers may perceive the higher participation of citizens as a source of additional 'noise'. This could be one reason for the statistical difference found in the SCs construction patterns regarding this technological tool between SCs in high-income countries and SCs in upper middle-income countries. Also, although social media technologies could be used for improving service delivery [32,57] and political participation [58,59], our findings confirm the prior research [60] and indicate that these technologies are only being used by sample smart cities for organization and as communication channels for broadcasting public services with the information provided by them, especially regarding cultural events and city news. Future research should, therefore, focus on this subject and analyze whether social media is being used for government interaction with the aim of improving citizen participation in decision-making and of improving

collaboration among government agencies internally. Hiring specialists in managing social media technologies, such as community managers, or training employees could be relevant in this issue.

Therefore, the findings confirm that SCs located in high-income countries are usually focused on the creation of official apps addressed to manage all dimensions of the SCs, while SCs located in upper-middle income countries do not offer any official apps. This evidence confirms that large cities with a large population are trying to change the management of public services, as well as improve sustainability. Cities with high income are carrying out strategies, initiatives and projects to deal with the complex challenges of global change and sustainability. Hence, mobile apps focus on aspects of offering citizens sustainable resources for mobility.

In any case, sample SCs in high and upper middle-income countries do not offer many smart governance apps, which mainly address allowing citizen involvement in public decisions. This could be the reason why no significant differences have been found in the data of this research. In addition, a digital divide of citizens in SCs in lower-middle income countries could be produced, perhaps due to their technological infrastructure or cultural settings. Therefore, future research could analyze the impact of these technological tools on both the efficiency of local governments and democracy in order to examine better the reasons of these differences among the SCs in different contexts.

Also, the findings from the demand side show that citizens in SCs located in high-income countries usually use smart mobility and smart people apps, while citizens in SCs located in upper-middle income countries are usually using smart governance and smart living apps. These differences from the demand side confirm previous comments regarding the different settings in which SCs are working in and the different strategies that each one of them is pursuing. This way, the highest concern of citizens in SCs located in high-income countries is about mobility and education, whereas citizens in SCs located in upper-middle income countries are more concerned with e-democracy and on improving their quality of life.

Future research could undertake an e-survey and interview citizens to better explore their different uses of these apps. Also, future research could explore the cause of the devolution of power of citizens in SCs located in both lower and upper-middle income countries. For example, recent research in Indian SCs posits that although there is a consensus regarding the need for the devolution of powers to urban local bodies, the cities are caught between the directives of the central government and the strong presence of the state parastatal organization [61]. Perhaps this situation in developing countries may not allow the transfer of powers with the citizenry because the cities do not hold the power.

Finally, taking into account previous comments, the findings of this paper put an emphasis on the need for taking into account the differences among SCs in developed vs. developing countries when ranking or performance measurements are designed because the assessment should be tailored to the cities' particular visions and priorities for achieving their objectives, which confirms the ideas posited by Albino [62]. In fact, if these rankings are robust, they should be built around a shared understanding of what smart means, and due to the different challenges and responses of each city, these smartness indicators must be comparable, although sufficiently refined to take into consideration the local contest granularity of each place.

The SCs should tend to generate the virtual environment that favors effective participation in the municipalities' public affairs, perhaps through participatory budgeting initiatives. Similarly, these cities will face enormous technological challenges in the coming years, since they will have to carry out initiatives and projects that favor the implementation of emerging technologies for the provision of public services, as well as favor collaboration with citizens, all in redundancy of an improvement in the citizens' quality of life and improvement of the region's wealth. Managing and implementing these challenges may cause a greater rift between SCs in developed countries compared to cities in developing countries. To avoid this, leadership is required by international associations or organiza-

tions that act as a virtual space where the experiences lived by each of the municipalities can be shared, so that a knowledge base can be created that can be extrapolated to other municipalities with fewer resources and fewer possibilities.

In conclusion, our study demonstrates differences in SCs construction which are not only shown in the different meaning that the SC concepts take on each one of the settings analyzed in this paper, but also in the use of e-participation tools that are being offered and used by the citizenry in the SCs in developed vs. developing countries. Much research is necessary in this issue and future research avenues have been identified in the paper. We encourage scholars to undertake research in this field of knowledge.

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