Analyzing the Influence of the Smart Dimensions on the Citizens' Quality of Life in the European Smart Cities' Context

Manuel Pedro Rodríguez Bolívar

Abstract In the last years, the creation of public value in the smart cities (SC) is conceived as a strategic approach to public management based on the promotion of networked governance with the aim at improving the quality of life (QoL) of the cities' residents (Rodríguez Bolívar, Proceedings of the 52nd Hawaii International Conference on System Sciences, 3325–3334, 2019). This chapter seeks to analyze whether SC are those with a higher QoL in the urban environment as well as to investigate the smart dimensions that could have an influence on the QoL of the cities' residents. Findings based on a sample of European smart cities indicate that the smart city's promise of increasing the citizen's QoL is true, but it seems to be mainly focused on the outcomes (smart living dimension) and not on other smart dimensions that focus on the process to obtain the outcomes (smart governance, smart economy, or smart environment, for example).

Introduction

In the age of new technologies (ICTs), one of the main challenges and urban dimensions of the new wave of cities is the pursuit of increasing the quality of life (QoL) of the cities' residents (Makkaoui, Lachhab, & Bakhouya, 2017). Indeed, citizens are exerting pressure on the public administrations not only for implementing ICTs but also for them to have an impact on their QoL through the generation of public value.

The smart city (SC) concept arises in this context as a first attempt to use the great potential that ICTs offer to support the creation of public values through democratic governance (Moore, 2013), improving local democracy and making public administrations efficient (Allwinkle & Cruickshank, 2011). Therefore, although there remains some lack of clarity over what public value is (Williams & Shearer, 2011), in this chapter public value creation must be understood as a strategic

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approach to public management based on the promotion of networked governance (Moore, 2013) with the aim at improving the citizen's QoL (Rodríguez Bolívar, 2019).

This issue makes public administrations to go beyond the pursuit of efficiency towards the generation of common values that citizens and other stakeholders desire (Williams & Shearer, 2011) with the active help of co-producers and partner organizations (Benington, 2011).

Thus, based on the post-material position combined with a technocratic perspective on good governance, the concept of public value is built on the use of public assets to improve the QoL at individual and collective levels (Moore, 2017) through citizen satisfaction with the achievement of social outcomes (Boivard & Loeffler, 2012; Moore, 2013) and instituting both innovative collaboration (Meijer & Rodríguez Bolívar, 2016) and democratic governance in municipalities (Moore, 2013), mainly with the use of new technologies into the SC's framework (Thorne & Griffiths, 2014). Therefore, public value management situates public organizations in a wider network of stakeholders who have to be involved in the public value creation (Moore, 2013; Williams & Shearer, 2011), in which the use of smart solutions becomes the main goal for improving the QoL (Bătăgan, 2011; BSI, 2014; Stockholm, 2006).

Consequently, public managers must focus on the identification and measurement of the elements necessary to create public value (Sherman, Weinberg, & Lewis, 2002), which is the result of aligning three interrelated processes in a strategic triangle (Moore, 1995): (1) defining public value, (Allwinkle & Cruickshank, 2011) building and sustaining a group of diverse stakeholders to create an authorizing environment, and (Barsi, 2018) mobilizing the resources from inside and outside the organization to achieve the desired outcomes.

Nonetheless, despite the relevance of public value creation, the most striking feature in the public value literature is the relative absence of empirical investigation of either the normative propositions of public value or its efficacy as a framework for understanding public management (Williams & Shearer, 2011). As noted previously, the public value approach is understood as the framework for increasing the QoL in the urban environment and, by this way, this chapter tries to fill the gap in understanding whether the SC framework allows a higher QoL. The first question here is:

RQ1. How is the transition possible from the objective measures of city smartness to an intangible entity of QoL?

On the other hand, smart cities involve the extensive and intensive application of ICT to several spheres of functioning in a city which makes necessary to identify certain characteristics of the cities for their evaluation with a ranking methodology (Giffinger et al., 2007). Although different rankings of SCs have been proposed (Cohen, 2011; Giffinger & Gudrun, 2010; IESE, 2019), a generally accepted methodology is that based on the six main characteristics or smart dimensions identified by Giffinger et al. (2007) (smart economy, smart people, smart governance, smart mobility, smart environment, and smart living). These dimensions are also valid for analyzing the QoL.

In fact, although Eurostat and representatives of the EU Member States have designed an overarching framework for analyzing the QoL through eight dimensions, which feed into the measurement of the overall experience of life (EU, 2016), these dimensions can be identified with, at least, five of the smart dimensions of SCs (all of them except for smart mobility). In particular, these dimensions of QoL seek to capture and balance objective measures of income, living conditions, education or health, with subjective measures such as an individual's appreciation of their living environment, how safe they feel, or whether they can rely on friends/family (EU, 2016).

Despite previous comments, there has been surprisingly little research on the evaluation of the influence of smart dimensions on the QoL, as it is the main expected outcome of embedded smart technologies for cities and citizens into the urban space. Therefore, the second research question of this research is:

RQ2. How can the different smart dimensions influence the citizen's QoL in SCs?

In brief, this chapter seeks to analyze whether the new wave of SCs impacts on a higher QoL in the urban environment and how this impact is produced, analyzing how the smart dimensions could have an influence on the higher level of the QoL in SCs. To achieve this aim, this chapter collects information about the "smartness" of European cities and the widely used QoL rankings in order to test whether the label of SC, as well as the type of smartness of the SC, could be associated with a higher degree of citizen's QoL.

The remainder of this chapter is as follows. The next section makes some comments regarding the link between SCs and the increase of the citizen's QoL in the urban environment. In the third section of the chapter, the empirical research performed is presented, describing the sample selection and the methodology of research. Then, the main results of our study are shown and, finally, the discussions and conclusion section brings the chapter to an end.

The Quality of Life in Smart Cities

The rapid transition to a highly urbanized population has led cities and urban areas to rely on an intensive use of information and communication technologies (usually ICTs), as a way of solving economic, social, and environmental challenges. This intensive use of ICTs has given place to the so-called smart cities (SCs) and has become the best way for improving the QoL in the urban environment as enjoyed by the city's residents (Cunha Rodrigues, 2018). The QoL is, therefore, the broader goal in SC, but it is often linked to all the policies of the local government (Dameri, 2013), which demands the implementation of new governance models (Rodríguez Bolívar, 2018a) where the citizen participation plays a key role for urban planning's commitment to QoL (Cárcaba, González, Ventura, & Arrondo, 2017).

From this perspective, SCs can be considered as an urban strategy aiming at improving the QoL of those in the city, safeguarding the environment and reaching economic development at the same time (Barsi, 2018). In this regard, a study carried out in Spain found that citizens consider QoL improvement and public services quality as the main utilities of smart cities (Centre of Innovation of the Public Service & IE Business School, 2015). Thus, the city governance should be addressed to increase the QoL of the citizens, which makes the evaluation of the smart governance to be linked to the measure of individual well-being and satisfaction in the city in a comparable and dynamic way through the impacts of public policies on the QoL of the citizens (something that goes beyond the mere outputs or services provided) (Cárcaba et al., 2017) since the QoL indexes are considered as tools for measuring long-term public value creation (Benington, 2011), which is a very complex goal (Barsi, 2018).

City rankings have been used as tools for generating discussions and debates on smartness, competitiveness, and QoL, helping to rethink formerly elaborated strategies and development priorities. Indeed, rankings provide an empirical base for assessing specific strengths and weaknesses in a benchmarking process and they can be applied as guiding instruments for future city development, in particular in a functional way (Giffinger, Haindlmaier, & Kramar, 2010). Therefore, the link between SC rankings and QoL rankings seems to be strong that should be analyzed.

In addition, the QoL has been viewed as part of the profile of a "competitive city" too and has been employed by city agencies to make their location attractive to different global capitals, which has emphasized place characteristics instead of adopting other groups' views of QoL (Rogerson, 1999). The QoL research should then be at the front and center in this process of evaluating people's relationship to their environment within the city (Jeffres, Bracken, Jian, & Casey, 2009), and QoL metrics should be seriously factored into any smarter strategy (Thorne & Griffiths, 2014).

Nonetheless, aggregated macroeconomic figures have been used in order to track the progress of societies, but it oversimplifies the problem (Cárcaba et al., 2017). So, it is unsurprising that the QoL indexes be relevant to complement macroeconomic figures with socio-economic figures summarizing welfare in society, although measuring the QoL of the citizens is far from being an easy task, being especially at the city level where the information of QoL is still not very well developed (Cárcaba et al., 2017).

In brief, SCs are aimed at creating more participative governments (Rodríguez Bolívar, 2018a) with the aim of taking citizen-centric decisions and improving their QoL through the intensive use of ICTs (Yeh, 2017). This new scenario improves the conditions to achieve a more livable environment and stronger economic prospects to improve citizens' QoL (Lee, Hancock, & Hu, 2014). Thus, this chapter analyzes whether SCs have achieved their main outcome of getting a higher QoL in the urban environment. Also, this chapter analyzes the "smart" source of the QoL and the influence that the different aspects of smart governance could have on greater levels of QoL. To achieve this aim, the next section of this chapter discusses an empirical research we performed in the European SCs looking for their position in relevant

QoL rankings and investigating the influence of the different smart dimensions on the citizen's perceptions of QoL.

Empirical Research

Sample Selection

This chapter is based on the European setting because the European integration process has reduced differences in economic, social, and environmental standards and norms providing a common market, which makes cities more similar in their preconditions (Giffinger et al., 2007). The data collection method of this chapter is based on two different sample groups of cities. The first one is composed of the largest-size European cities labeled "smart" by a European project sponsored by Asset One Immobilienentwicklungs AG (from 300,000 to one million inhabitants) because large and dense cities are highly productive and innovative (Harrison & Donnelly, 2011) which impacts on a higher QoL for their inhabitants (Glaeser, 2012; Jacobs, 2016).

This selection method (http://www.smart-cities.eu) ranks SCs based on more than 30 factors, grouped into six dimensions (Giffinger & Gudrun, 2010): smart economy, smart people, smart governance, smart mobility, smart environment, and smart living. This phase of our sample selection process collects 88 SCs to the sample selection.

The second group of sample cities is composed of those European cities considered as "Non-smart cities" (NSCs). This second group is difficult to be selected because every city could attain a different level of smartness within a range, rather than falling in "black and white" categories of smartness or not. Nonetheless, while the adoption of up-to-date technologies does not guarantee the success of smart city initiatives, Nam and Pardo (2011) and EU (2016) argue that technology is obviously a necessary condition for a smart city.

Therefore, in this chapter, other 88 European cities have been selected which, according to the criteria indicated above, are not labeled "SCs." To achieve this aim, we have avoided both those cities listed in the European project mentioned before and those that are members of the EUROCITIES network (see http://www.eurocities.eu/), which is composed of the local governments of the main European cities that are working actively to become smart to increase their QoL using ICTs in the city.

To obtain a homogenous sample, the sample cities labeled "SCs" have been sorted by country, and then the same number of NSCs has been selected from each one of these European countries (88 NSCs in total). These selected NSCs have the highest population (once removing those labeled as "smart") since dense cities tend to become smart. In a second stage, this selection process removes the NSCs with a population under 300,000 inhabitants with the aim of using the same criteria as that used for cities classified as SCs. Therefore, the total number of NSCs in this chapter reduces to 12. This way, our final sample selection, following the previously mentioned selection process, consists of a total of 100 European cities (88 SCs and 12 NSCs).

Data and Method

The measurement of QoL is a complex task based on objective data and/or on subjective citizen's perception (Cunha Rodrigues, 2018; EUROSTAT, 2018). Although there are differences between the two methods of measuring the QoL, Kaklauskas et al. (2018) have recently demonstrated that the scores and rankings used have revealed a good level of congruity between the ranks obtained by employing the different methods and data have been proved to be similar.

So, this research collects data from four different relevant QoL rankings, two of them—EUROSTAT and NUMBEO[1]—based on the citizen's feelings or perceptions (participative rankings), and two others—MERCER and EIU[2]—based on the measurement of different quantitative dimensions that encompass the QoL ranking (non-participative rankings).

All QoL rankings used in our research are referenced to 2015 since it is the last year in which all of them have been published simultaneously, although some of them are already updated. Descriptive statistics and graphical methods are used to show the position of the different sample cities in the QoL rankings with the aim at answering RQ1.

Regarding RQ2, this research has been based on the position ranked for each city on each of the QoL ranking and, for the special case of EUROSTAT, it has been based on the responses to a question included in this ranking regarding the satisfaction of citizens with their life into their city and its link with the score that this city has obtained in the European project sponsored by Asset One Immobilienentwicklungs AG (mentioned previously) on each one of the six smart dimensions or characteristics that an SC could have. The hypothesis testing was performed using multiple linear regression models (MLR). The initial proposed MRL model for RQ2 is, the following:

$$\begin{aligned} SL_i = {} & \beta 0 + \beta 1 * S - Economy_i + \beta 2 * S - People_i + \beta 3 * S - Governance_i \\ & + \beta 4 * S - Mobility_i + \beta 5 * S - Environment_i + \beta 6 * S - Living_i \end{aligned}$$

where SL is the position (NUMBEO, MERCER, and EIU) or the proportion of persons who are satisfied living in their city (EUROSTAT), and S-Economy, S-People, S-Governance, S-Mobility, S-Environment, and S-Living are the scores obtained for each one of the sample SCs in each one of these smart dimensions in the European project mentioned before.

Although the total number of sample cities in our research is 100, not all of them appear in all the selected QoL rankings. Nonetheless, the use of all these QoL

[1] See http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/urban/survey 2015_en.pdf and https://www.numbeo.com/quality-of-life/region_rankings.jsp?title= 2015&region=150, respectively.

[2] See https://www.imercer.com/uploads/GM/qol2015/h5478qol2015/index.html and http://media.heraldsun.com.au/files/liveability.pdf, respectively.

rankings could provide great objectivity to the data collected in our study limiting the influence that particular criteria used could have on these QoL rankings. Thus, the 30.49% of the total European cities included in the EUROSTAT ranking (25 cities out of 82 indexed European cities), the 29.82% of the total European cities included in the MERCER ranking (17 cities out of 56 indexed European cities), the 30.56% of the total European cities included in the EIU ranking (11 cities out of 36 indexed European cities), and the 41.38% of the total European cities included in the NUMBEO ranking (24 cities out of 58 indexed European cities) are included in the sample selection.

Analysis of Results

RQ1. How Is the Transition Possible from the Objective Measures of City Smartness to an Intangible Entity of QoL?

Table 1 in Annex shows the QoL ranking characteristics regarding the range of cities in each one of the quartiles of the rankings as well as the number of European cities included into each one of the rankings. In this regard, while European cities are mainly concentrated on the Q1 and Q2 of the non-participative rankings (MERCER and EIU), they are equally distributed into the different quartiles in the participative QoL rankings (EUROSTAT and NUMBEO). Therefore, results indicate differences between objective measures and citizen's perceptions of QoL, which could mean the existence of a gap between outcomes and the impact that these outcomes could have on the citizen's perceptions of the QoL.

On the other hand, Table 2 in Annex shows the descriptive statistics of the data and collects the position that sample SCs and NSCs get on each one of the QoL rankings. To begin with, sample selection of our study represents, at least, the 30% of the European cities indexed in the QoL rankings, which means that the sample selection of this research allows us to obtain significant findings for future research.

Table 1 Characteristics of QoL rankings

		The range of cities in each quartile					Number of European cities in the selected QoL rankings				
		Total	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Total
Objective rankings	MERCER	230	1–57	58–114	115–172	173–230	31	18	4	4	57
	EIU	140	1–35	36–70	71–105	106–140	18	12	4	2	36
Subjective rankings	EUROSTAT	82	1–20	21–41	42–62	63–82	20	21	21	20	82
	NUMBEO	58	1–14	15–28	29–42	43–58	14	14	14	16	58

Source: Own elaboration

Table 2 Descriptive statistics

		Smart cities														
		Frequency	Relative frequency over sample SCs (%)	Frequency in Qi position in the QoL ranking				Relative frequency over Qi position of total European cities in the QoL ranking (%)				Median	Standard deviation	Min	Max	Range
				Q_1	Q_2	Q_3	Q_4	Q_1	Q_2	Q_3	Q_4					
Objective rankings	MERCER	17	19.32	11	6	0	0	35.48	33.33	–	–	40	33.72	6	99	93
	EIU	11	12.50	6	4	1	0	33.33	33.33	25.00	–	33	20.37	10	72	62
Subjective rankings	EUROSTAT	25	28.41	8	5	8	4	40.00	23.81	38.10	20.00	41	24.11	4	81	77
	NUMBEO	24	27.27	7	8	7	2	50.00	57.14	50.00	12.50	23	13.77	2	52	50

Source: Own elaboration

In addition, all sample cities included in the QoL rankings are labeled "SCs." Indeed, NSCs are not present in any of the selected QoL rankings. This result could indicate that the smartness of a city can produce higher QoL.

On the other hand, results in Table 2 in Annex indicate that sample SCs are mainly present in the subjective QoL rankings in which they represent more than the 25% of all sample SCs. Indeed, whereas 25 and 24 SCs are present in the QoL rankings of EUROSTAT and NUMBEO, only 17 or 11 SCs are ranked in the best positions in the QoL rankings of MERCER and EIU.

Nonetheless, although the highest number of sample SCs is concentrated on the best quartiles of all the QoL rankings, it is especially true in QoL rankings based on objectives indicators. In fact, almost all sample SCs are concentrated in the Q1 and Q2 in the QoL rankings of MERCER and EIU. By contrast, these sample SCs are dispersed into the different quartiles in the QoL rankings of EUROSTAT and NUMBEO—see Table 2 in Annex. This result seems to confirm the existence of a gap between objective measures of the citizen's QoL and their perceptions regarding this matter.

Finally, results obtained in the median scores of the sample SCs in Table 2 in Annex confirm that median scores of the sample SCs are below the limit of the Q1 values in the MERCER and EIU rankings, whereas median scores of sample SCs fit within the range of values of the second quartile or in the third quartile of the EUROSTAT and NUMBEO rankings.

In a more detailed analysis of the cities, we can also appreciate graphically the findings in Fig. 1 in Annex. In this figure, we can observe the position of each one of the sample SCs and NSCs in the selected QoL rankings as well as the quartiles in each of the rankings.

RQ2. How Can the Different Smart Dimensions Influence the Citizen's QoL in SCs?

The MLR model is applied to find the statistically significant independent variables to predict citizen's QoL on each one of the analyzed QoL rankings. The summary of MLR results is displayed in Table 3 in Annex.

As it can be seen in Table 3, in all models proposed using each one of the QoL rankings, the value of R^2 ranges from 0.683 to 0.94, which is very high. Also, the independence analyses indicate that the Durbin-Watson test is over 1.5—see Table 3. Therefore, the constructs used are independent.

Also, collinearity analysis is performed using SPSS software. According to our results, tolerance analysis shows that all values obtained for the constructs are under 0.5—see Table 3 in Annex—except for the particular case of the EUROSTAT QoL ranking. These results obtained under 0.5 in the tolerance analyses mean that the probability of multicollinearity is high; only in the case of EUROSTAT QoL ranking there is no multicollinearity. In fact, the lower tolerance scores, the higher

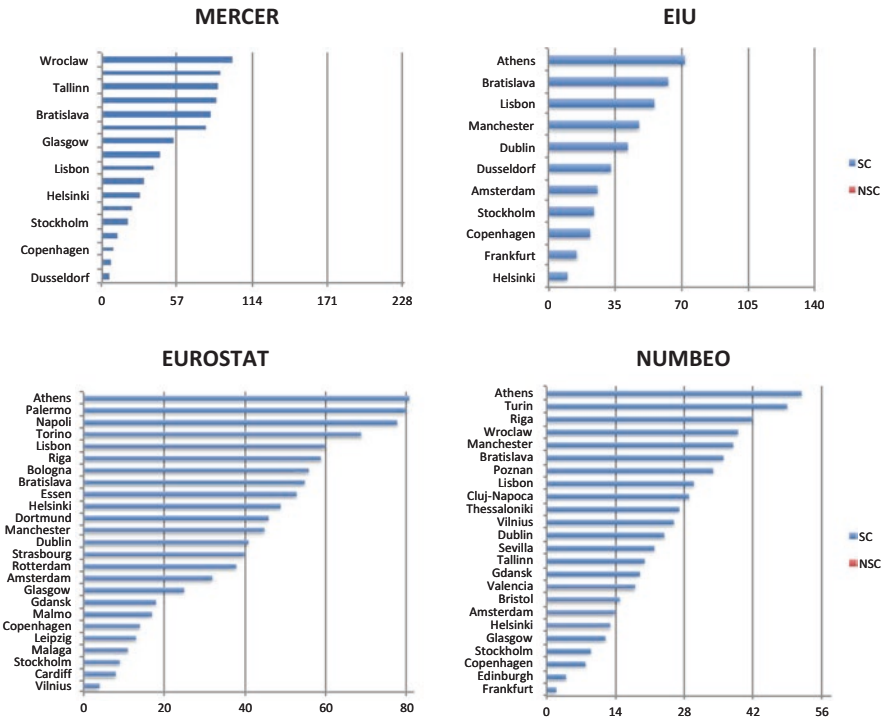

Fig. 1 Objective and subjective QoL rankings—How is the transition possible from the objective measures of city smartness to an intangible entity of quality of life?

multiple correlations, and inversely (Field, 2013). Furthermore, variance inflation factors (VIF) for all independent variables are high and over 2 (except for the case of EUROSTAT QoL ranking), which again implies that the multicollinearity is high.

Therefore, the model that can explain the link between the ranking of SCs and the QoL ranking is that designed for the EUROSTAT QoL ranking. The rest of models have been modified using the stepwise MLR method (backward method). Using this method some attributes are removed until the VIF and tolerance analyses indicate that no multicollinearity problems exist. This way, the final models of our tests are presented in Table 3, in which NUMBEO QoL ranking is linked to smart economy, smart people, and smart environment, MERCER QoL ranking is linked to smart economy and s-governance, and EIU QoL ranking is linked to smart economy and smart environment.

Results of the EUROSTAT QoL model show that smart economy, smart mobility, and smart living are the most important constructs in the citizen's perceptions about their satisfaction of living in their city (p-value under 0.05). Nonetheless, the smart economy seems to show a negative influence on the citizen's perception of QoL.

Table 3 MLR: coefficients and independence and collinearity analysis

Initial models							
Participative QoL rankings							
	EUROSTAT						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.867	0.751	0.691	4.14986		1.519	
Constructs	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	90.494	1.111		81.432	0.000		
TOTAL S-ECONOMY	−7.039	2.025	−0.567	−3.477	0.002	0.775	1.364
TOTAL S-PEOPLE	3.084	2.051	0.266	1.503	0.145	0.718	1.390
TOTAL S-GOVERNANCE	−1.022	3.039	−0.087	−0.336	0.740	0.550	1.770
TOTAL S-MOBILITY	6.641	2.850	0.527	2.330	0.028	0.595	1.689
TOTAL S-ENVIRONMENT	−0.784	3.053	−0.056	−0.257	0.799	0.606	1.654
TOTAL S-LIVING	9.267	3.193	0.658	2.902	0.008	0.594	1.689
	NUMBEO						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.826	0.683	0.571	9.02363		1.798	
Constructs	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	28.688	2.684		10.688	0.000		
TOTAL S-ECONOMY	−6.657	4.720	−0.382	−1.410	0.177	0.254	3.940
TOTAL S-PEOPLE	−11.201	8.754	−0.515	−1.279	0.218	0.115	8.683
TOTAL S-GOVERNANCE	8.183	7.158	0.370	1.143	0.269	0.178	5.610
TOTAL S-MOBILITY	11.476	13.843	0.456	0.829	0.419	0.062	16.218
TOTAL S-ENVIRONMENT	−9.453	10.054	−0.344	−0.940	0.360	0.140	7.158
TOTAL S-LIVING	−14.010	10.730	−0.556	−1.306	0.209	0.103	9.722
Non-participative QoL rankings							
	MERCER						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.895	0.801	0.682	19.01765		2.132	

(continued)

Table 3 (continued)

Constructs	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	57.624	14.176		4.065	0.002		
TOTAL S-ECONOMY	−26.848	10.198	−0.661	−2.633	0.025	0.315	3.171
TOTAL S-PEOPLE	16.332	21.215	0.258	0.770	0.459	0.177	5.656
TOTAL S-GOVERNANCE	−16.989	20.102	−0.329	−0.845	0.418	0.131	7.641
TOTAL S-MOBILITY	−12.433	33.536	−0.206	−0.371	0.719	0.064	15.505
TOTAL S-ENVIRONMENT	−10.205	35.709	−0.169	−0.286	0.781	0.057	17.559
TOTAL S-LIVING	10.345	36.561	0.183	0.283	0.783	0.048	20.960
	EIU						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.970	0.940	0.821	8.86136		3.133	
Constructs	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	56.819	15.351		3.701	0.034		
TOTAL S-ECONOMY	−16.470	6.239	−0.641	−2.640	0.078	0.337	2.969
TOTAL S-PEOPLE	−6.719	19.544	−0.199	−0.344	0.754	0.059	16.913
TOTAL S-GOVERNANCE	1.464	14.661	0.047	0.100	0.927	0.091	10.996
TOTAL S-MOBILITY	3.293	32.506	0.106	0.101	0.926	0.018	54.803
TOTAL S-ENVIRONMENT	−19.501	40.087	−0.428	−0.486	0.660	0.026	39.024
TOTAL S-LIVING	−0.075	36.870	−0.002	−0.002	0.998	0.018	56.016
Final models							
Participative QoL rankings							
	EUROSTAT						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.867	0.751	0.691	4.14986		1.519	
Constructs	Unstandardized coefficients		Standardized coefficients	*t*	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	90.494	1.111		81.432	0.000		
TOTAL S-ECONOMY	−7.039	2.025	−0.567	−3.477	0.002	0.775	1.364

(continued)

Table 3 (continued)

TOTAL S-PEOPLE	3.084	2.051	0.266	1.503	0.145	0.718	1.390
TOTAL S-GOVERNANCE	−1.022	3.039	−0.087	−0.336	0.740	0.550	1.770
TOTAL S-MOBILITY	6.641	2.850	0.527	2.330	0.028	0.595	1.689
TOTAL S-ENVIRONMENT	−0.784	3.053	−0.056	−0.257	0.799	0.606	1.654
TOTAL S-LIVING	9.267	3.193	0.658	2.902	0.008	0.594	1.689
	NUMBEO						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.826	0.683	0.571	9.02363		1.798	
Constructs	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	28.914	2.017		14.336	0.000		
TOTAL S-ECONOMY	−3.430	3.175	−0.197	−1.080	0.293	−0.622	−0.235
TOTAL S-PEOPLE	−4.083	4.278	−0.188	−0.954	0.351	−0.658	−0.209
TOTAL S-ENVIRONMENT	−14.316	5.096	−0.520	−2.809	0.011	−0.759	−0.532
Non-participative QoL rankings							
	MERCER						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.895	0.801	0.682	19.01765		2.132	
Constructs	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	59.767	4.923		12.140	0.000		
TOTAL S-ECONOMY	−28.183	6.760	−0.694	−4.169	0.001	−0.867	−0.744
TOTAL S-GOVERNANCE	−13.261	8.584	−0.257	−1.545	0.145	−0.723	−0.382
	EIU						
	R	R^2	Adjusted R^2	Standard error of estimation		Durbin-Watson	
	0.970	0.940	0.821	8.86136		3.133	
Constructs	Unstandardized coefficients		Standardized coefficients	t	Sig.	Collinearity statistics	
	B	Standard error	Beta			Tolerance	VIF
(constant)	55.750	2.593		21.503	0.000		
TOTAL S-ECONOMY	−16.678	2.830	−0.649	−5.893	0.001	−0.876	−0.912
TOTAL S-ENVIRONMENT	−21.326	5.016	−0.468	−4.252	0.004	−0.783	−0.849

Also, the dimension of smart people seems also to be a good construct for increasing the citizen's perception of QoL (p-value close to 0.1). By contrast, the smart governance and the smart environment are not significant constructs for increasing the citizen's perceptions of QoL.

Regarding the NUMBEO QoL model, results show that only smart environment is the only significant attribute in the model (p-value under 0.05 and close to 0.01) and show a low and negative influence into the model.

As for the MERCER QoL model, results show that smart economy is a significant attribute of the model with a p-value under 0.01, whereas s-governance is close to be significant because its p-value is near 0.1. In any case, both of these attributes present a negative influence in the QoL ranking.

Finally, in the EIU QoL model, results indicate a high significant influence of both the smart economy and the smart environment in the QoL ranking, since the p-value in both cases is lower than 0.01. Also, both attributes show a negative influence in the analyzed QoL.

Discussions and Conclusion

The growth of SCs has sought the improvement of the QoL of their citizens through the intensive use of ICTs and the implementation of new governance models for improving citizen involvement in public decisions. Based on sample SCs and NSCs in the European context, this chapter provides insights into the existence of a link between SCs and higher QoL and the expected link between smart dimensions and citizen's QoL.

Findings indicate that only sample SCs are those ranked in the QoL rankings. NSCs do not appear in any of the QoL rankings used in this study, which makes one think that the promise of the advent of SCs for increasing the QoL is true. This finding is clearer and more consistent with the results obtained in the selected objective QoL rankings. Therefore, the main question here is: are there other different aspects in the city different from their intensive use of ICTs that could have the same impact on the citizen's perception of QoL in the city? So, future research could analyze this issue in a different context to obtain significant findings.

Regarding the influence of each smart dimension on the QoL, findings point out that smart economy and smart environment are the smart dimensions with a higher significant impact on the citizen's QoL across the different QoL rankings. Nonetheless, both of them seem to have a negative influence on it (see the results for participative rankings—EUROSTAT and NUMBEO—and for non-participative rankings—MERCER and EIU).

These findings seem to be different for particular national settings of European countries. A prior study in Spain (Centre of Innovation of the Public Service & IE Business School, 2015) indicates that the smart environment is relevant for public administrations and it could also be a factor that could have an impact on citizen's perception of QoL. However, in our research, the smart environment dimension is a

significant factor in the NUMBEO and EIU QoL rankings and both of them indicate a negative impact on the citizens' QoL.

In addition, road congestion has reached extreme levels in major cities in the world, and it seriously affects the QoL of the citizens (Pacheco et al., 2018). Indeed, the mobility problems into the cities are a relevant issue for smart cities (Centre of Innovation of the Public Service & IE Business School, 2015), which are forcing public agencies to adopt strategies to address city mobility problems (Chow, 2018). Nonetheless, citizens seem not to assign great relevance to smart mobility because it is only significant for the EUROSTAT QoL ranking. Perhaps this results indicates that smart mobility initiatives are not all about technology and ICT, except for the case in which the smart mobility initiative enhances the operations of other sectors of the city (then technology and ICT are central) (Peprah, Amponsah, & Oduro, 2019).

In brief, it is possible that our findings be context-dependent and more studies could help to gain a deeper knowledge on this issue. Therefore, future research could analyze the aim of this chapter in different national settings in identifying trends according to some variables like administrative culture, political settings, e-participation models, and so on.

In addition, prior and recent research have demonstrated that Spanish citizens and university students have a poor preoccupation of the municipality in the areas of smart economy and smart governance (Centre of Innovation of the Public Service & IE Business School, 2015; Vázquez, Lanero, Gutiérrez, & Sahelices, 2018). This negative perception could explain why the public policies of the city management in smart economy practices are not valued by citizens as a piece of their QoL. Perhaps higher government transparency could help to overcome this negative perception.

Also, although prior research and smart practitioners of SCs advocate new and collaborative governance models (Rodríguez Bolívar, 2018a, 2018b, 2018c; Yeh, 2017), our findings indicate that, in general, smart governance does not have an impact on the citizen's perception of QoL. In fact, findings only indicate a negative and significant impact of smart governance on the citizens' QoL in the MERCER QoL ranking (see Table 3). This finding confirms recent research in which, paradoxically, smart governance was the factor that university students less associated with QoL (Vázquez et al., 2018). In this regard, future research should investigate whether citizens are promoted and ready to participate in city management as well as the incentives they have to cooperate with local governments in the city management.

Also, city governments could allocate financial resources to improving a culture of open participation in the city and to making information and technological tools available to citizens for increasing their participation in public affairs. So, future research should focus its attention on the components that could help citizens to change their perception regarding smart governance and its link with the increase of the QoL in the city.

Finally, our findings indicate that smart living is the most significant dimension for influencing the citizen's perception of QoL. This finding is only presented in the EUROSTAT QoL ranking and it confirms recent research in which respondents to a questionnaire recognized smart living as one of the most valued dimensions for their QoL (Vázquez et al., 2018). As the smart living dimension is a very broad

concept, future research should analyze the components that have a higher impact on the citizen's perception of QoL (culture and leisure facilities, health conditions, housing quality, and so on).

In brief, SCs seem to fill the expectations of citizens to increase their QoL. Nonetheless, citizen's perceptions of higher QoL seem to be based on both the outcomes achieved in the city and their impact on their lives. In this regard, perhaps the knowledge that citizens have on the concept of SCs and their dimensions could be seriously questioned (Centre of Innovation of the Public Service & IE Business School, 2015). It could influence their perception regarding the smart dimensions and their contribution to increasing their QoL perception. This way, future research could also analyze this issue to understand better the components of the citizen's perceptions of QoL and how city governments in SCs can implement public policies to increase this perception.

Annex

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