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The governance of smart cities: A systematic literature review[☆]

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ABSTRACT

Research on smart cities lacks a systematic understanding of the different components of smart city governance, the metrics to measure these components, their envisaged outcomes and potential contextual factors influencing both components as well as outcomes. This study analyzes the relevant body of literature and proposes conceptual insights. A research scheme is generated and used for an extensive discussion of the literature. The systematic literature review indicates that various smart city governance definitions exist. Also, this study reveals substantial variances in contextual factors, measurement techniques and outcomes among the concepts of smart city governance.

1. Introduction

Various cities across the globe see a possibility to address challenges by adopting the ‘smart city’ (SC) concept (Allwinkle and Cruickshank, 2011). However, the label SC is a fuzzy concept (cf. Appendix 1 for a selection of various SC definitions) and the absence of a commonly accepted SC definition (e.g., Albino, Berardi, and Dangelico (2015); Alkandari, Alnasheet, and Alshekhly (2012), Chourabi et al. (2012), Gil-Garcia, Pardo, and Nam (2015)) makes implementing and governing SC programs difficult. For the purpose of this paper, the working definition of SC is as follows: smart cities are a multi-dimensional “mix of human (e.g., skilled labor), infrastructural (e.g., high-tech [...] facilities), social (e.g., [...] open network linkages) and entrepreneurial capital (e.g., creative [...] business activities)” (Kourtit and Nijkamp, 2012), that are “merged, coordinated and integrated [“into the fabrics of the city” (Kitchin, 2014)] using new technologies” (Batty et al., 2012), to “address social, economic and environmental problems” (Townsend, 2013), involving “multi-actor, multi-sector and multi-level perspectives” (Paskaleva, 2009). Such a holistic definition (Mora, Bolici, and Deakin, 2017) is in contrast to a solely techno-centric focused interpretation as used by Dirks and Keeling (2009), or as criticized in Söderström, Paasche, and Klausur (2014), Greenfield (2013) or McFarlane and Söderström (2017).

Despite the substantial potential of the SC concept, associated organizational, strategic and technical challenges have made it difficult for cities to capture the promising benefits. Therefore, both researchers and practitioners have argued that many of the challenges for cities to become or to be smart exceed the scope and capabilities of their current

organizations, institutional arrangements and governance structures (e.g., Bolívar (2016), Gil-Garcia et al. (2015), Caragliu and Del Bo (2012)). Consequently, much attention has rightly been paid, for example, on governance implications of SC investments. Partly, this focus can be seen as a direct consequence of “the perceived failures or lack of impact resulting from SC investments to date” (Barns, 2017).

Although several researchers highlight the importance of a structured, all-encompassing and practical governance framework for the realization of smart cities (e.g., Dameri and Benevolo (2016), Chourabi et al. (2012), Nam and Pardo (2011a), Hollands (2008), Giffinger et al. (2007)) there continues to be an open discussion regarding what smart city governance (SCG) entails and how it is to be defined (cf. Appendix 2 for a selection of broad SCG definitions). Therefore, the purpose of this systematic literature review is to collect, analyze and outline dimensions for SCG.

The lack of appropriate governance arrangements for the majority of cities appears to constitute the most serious obstacle for their effective transformation into being smart (e.g., Manville, Cochrane, Cave, Millard, Pederson, Thaarup, Liebe, Wissner, Massink, and Kotterink (2014), Praharaj, Han, and Hawken (2018)). Moreover, technology-driven developments (e.g., ICT) are affecting all cities across the globe, “irrespective of whether they choose to invest in or incorporate the SC concept into their governance agenda”, as highlighted by Cosgrave, Doody, and Walt (2014). Consequently, of all the possibilities, SCG and its comprehension, analysis and potential modification appears to be among the most beneficial levers at the cities’ disposal.

City governance is enormously complex with the multi-faceted and multi-level ecosystem of various agencies and stakeholder groups (e.g.,

Abbreviations: SC, smart city/ies; SG, smart governance; SCG, smart city governance

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local governments, citizens, urban planners) that are often driven by conflicting interests. As a result, (smart) cities require a proper governance system for connecting all forces at work, allowing knowledge transfers, facilitating decision-making in order to maximize their socio-economic and environmental performance. Therefore, the identification of the dimensions of SCG (as discussed in this study) could be of great value. Specifically, the inductively developed components (stakeholders, structures & organizations, processes, roles & responsibilities, technology & data, legislation & policies, exchange arrangements) of SCG can be considered as innovative (e.g., covers a wide range of SCG compositions, presents a superordinate structure allowing for different SCG archetypes) and significant (e.g., mitigates lack of clarity on definitions on SCG, accomplishes comprehensive taxonomy of the existing literature), potentially fueling the debate in the nascent area of SCG.

Although some attempts to review the literature on SCG have been made in the past, they did not consider contextual factors regarding SCG (Bolivar and Meijer, 2016), did not pursue a systematic review approach (Dameri and Benevolo, 2016), were focused specifically on a selected set of dimensions of SCG (Castelnuovo, Misuraca, and Savoldelli, 2016) or missed the opportunity to include measures of SCG in the analysis (Meijer and Bolivar, 2016). Therefore, by building on the past efforts of various scholars (notably Bolivar and Meijer (2016)) the author aims to add clarity and rigor to the ongoing debate by analyzing the defining components of SCG, compiling the various metrics used to measure SCG and the potential influencing contextual factors, thereby representing the perspectives on the outcomes of SCG.

This paper is structured as follows: firstly, the author describes the purpose of this study (Section 2) followed by the literature review methodology and the results of the search (Section 3). Secondly, the author employs a SCG research scheme, consisting of categories that have emerged during a preliminary analysis, which is used to analyze the relevant body of literature (Section 4). Thirdly and finally, the author discusses the conceptualizations and shortcomings of the literature (Section 5) as well as avenues for future governance research (Section 6), followed by final remarks (Section 7).

2. Purpose and review agenda

The purpose of this systematic literature review is to collect, analyze and outline dimensions for SCG by logically classifying the relevant body of literature. For this purpose, the author compiles a conceptual frame of reference. The frame serves the dual purpose of assessing the status quo of the research and disclosing future areas of investigation. Thus far, scholars have offered differing definitions and hypothesized about the various dimensions. The author aggregates the diverse conceptualizations and identifies any possible gaps or inconsistencies. To accomplish these objectives, the author's literature review is primarily guided by four sub-areas of interest: the determining of the components of SCG, the grouping of the types of indicators used to measure SCG, the identifying of relevant contextual factors, and the classifying of the envisaged outcomes of SCG.

The first (and main) area of interest that will steer the literature review is the search for a set of components that make up the current understanding of SCG. This appears fundamental since the basic prerequisite for understanding and potentially comparing SCG is, in a first step, to precisely define the pertinent components of SCG. Conventional organizational and institutional theory applied to the SC postulates that governance represents an important building block of a functioning SC construct. However, the majority of the relevant literature does not engage in sufficient breadth on which components SCG consists of, thereby mostly concentrating on specifically selected components. The author's objectives are to identify the full spectrum of the potential components in the literature, to clarify the various formulations of components and assess how, if at all, these components are distinct from or related to each other.

In addition to the mere identification of SCG components, several SC

researchers that study SCG are confronted with the task of measuring the occurrence or non-occurrence of sets of or individual components of SCG. The composition of any metric of SCG, as a whole or its relevant components, is affected by the underlying definitions used to delineate SCG. Therefore, the author's second sub-area of interest probes the different types of indicators used to measure SCG. Given the multifaceted nature of governance or related sub-dimensions, the focus of the second sub-area attempts only to consolidate the different measurement approaches and not evaluate appropriateness.

As a third area of interest, the author attempts to conceptually integrate the studies that discuss or at least mention the role of contextual factors in SCG. Although smart governance is assumed to be affected by many factors (e.g., Bolivar and Meijer (2016)), few papers mention, theorize or examine the potential role of contextual factors in SCG. Thereby, this review is not intended to provide the much-needed systematic analysis of the contextual phenomena related to SCG, but instead serves as an initial overview of the current state of the research.

Lastly, the author tries to identify the envisaged outcomes of SCG. Considerable efforts have been undertaken to distinguish not only among the different components of SCG, but also between their different outcomes (e.g., Meijer and Bolivar (2016), Dimelli (2016)). Only recently, for example, Bolivar and Meijer (2016) have chosen a classification in terms of 'first-, second- and third-order outcomes' to describe SCG results. First-order refers to "changes to the government organization", second-order is "changes in the position of government vis-à-vis other urban actors" and third-order is "improvements to the city". Therefore, the fourth sub-area of interest tries to provide clarification on what types of SCG outcomes are covered in the literature.

3. Search and literature review methodology

3.1. Methodology of literature search

In order to adhere to the systematic literature review standards presented in Webster and Watson (2002), among others (e.g., von Brocke, Simons, Niehaves, Riemer, Plattfaut, et al. (2009)), the author follows the guidelines through the creation of a reproducible search record. In addition, the author adopts the systematic research method described by Wolfswinkel, Furtmueller, and Wilderom (2013). In general, the systematic review methodology appears fundamentally different from the narrative approach, as it clearly specifies its "criterion-based selection" process (Cook, Mulrow, and Haynes, 1997). It, therefore, seeks to avoid any possibility of partiality or prejudice that may potentially emerge if unrevealed criteria are used for the selection of the literature. The methodology was initially established in the field of medicine, but has spread to various academic disciplines since.

A systematic literature review is defined through the usage of a comprehensive search that scans the relevant body of literature with clearly stated and comprehensible search choices and selection criteria (cf. Table 01). The development of the corresponding search record makes reproduction and "assess[ment] of the exhaustiveness" of the study possible such that "scholars in the field can more confidently (re) use the results in their own research" (von Brocke, Simons, Niehaves, Riemer, Plattfaut, et al., 2009). The usage of the systematic review appears to be appropriate and reasonable, particularly in a SC domain that requires "the connection of many academic disciplines" (Mora, Bolici, and Deakin, 2017). The stage-wise methodology, as illustrated in Fig. 01 and Appendix 3, was applied to select the literature sample.

The quest for published journal articles was limited to three major databases (Business Source Complete (EBSCO), Web of Science, ABI Inform Global) which are most relevant for SC research. Initial analyses have shown that the addition of further databases would have increased the number of obtained duplicates significantly. The search was restricted to journal articles that contained carefully selected keywords ("smart city" and "governance") in order to be left with only the most meaningful literature. The subsequent selection process stage narrowed

Table 01
Selection stages of literature search.

Stage	Procedure	Instructions and guidance	Targeted objective
01.	Select databases	Examine search to a selection of different databases	Narrow the search to the more relevant databases for the topic
02.	Choose keywords	Search for articles that include specific keywords in title or abstract	Single out the suitable literature for the research topic
03.	Specify filter type	Confine filtering to certain type(s) of journal articles (e.g. peer reviewed)	Safeguard the overall significance and appropriateness of the research
04.	Remove duplicates	Remove journal articles that emerge in multiple databases	Exclude articles since duplicates do not provide additional value
05.	Require keywords	Require that all keywords occur at least once in the full body of the article	Guarantee significant usefulness and pertinence
06.	Refine based on full text	Read abstract, introduction and conclusion of all articles to exclude potential false positives	Dismiss journal articles that lack a significant association or connection to overall review topic
07.	Add forward/backward citations	Add further relevant articles through forward and backward citation tracing	Include seminal literary works that have not been a part of the selected databases

Generated by author, mainly drawing from [Wolfswinkel, Furtmueller, and Wilderom \(2013\)](#).

down the search and excluded all published journal articles that have not undergone the peer-review process to ensure sufficient significance and appropriateness of the research. The author argues that given the enormous breadth of SC literature limiting the research to peer-reviewed journal articles helps restrict the focus of interest to a manageable and reputable search for literature. Articles that emerged in multiple databases were excluded. In order to ensure substantive relevance, both keywords were required to appear in the full body of the article. The abstracts, introductions, and conclusions of the remaining papers were analyzed to remove articles that did get through the stage-wise selection process but were not significantly meaningful for the author's review subject. Since the emphasis of this review is on SCG, studies with a purely technical focus or on different thematic topics were not considered. Lastly, the author included further relevant articles discovered through a forward and backward tracing of references in the citation index ([Webster and Watson, 2002](#)). Particularly because only a minority of studies directly zeroed in on SCG the author considered this step as imperative in order to include seminal literary works that were not covered by the selected databases.

The search was temporally bounded for all works between January 1997 and May 2017. The search query took place from May 19 to May

20 (2017) and was updated on June 13 (2017).

3.2. Selection sample of literature search

The remaining selection of journal articles comprises 62 articles (as illustrated in [Fig. 01](#) and [Appendix 4](#)). The articles selected span over 14 years, starting as early as 2003 and the latest having been issued in 2017. In this particular period, publication output regarding SCG, as measured by articles published per year has been inconsistent (with a median and average of 1 article and 4.4 articles per year, respectively). The year 2007, particularly through the publication of the influential and often cited report by [Giffinger et al. \(2007\)](#), reflects a turning point in the research of SCs and SCG. The publication smoothed the path for SCs becoming more part of the peer-reviewed branch of research, away from its previous mere niche existence in grey literature formats. The explicit mentioning of 'Smart Governance' as one of the key characteristics or factors of SCs brought more attention to the SCG research field. After the described turning point, almost every year (except 2009) had publications on this specific research theme. However, it can clearly be seen that particular in recent years the importance of SCG has seen an almost exponential growth.

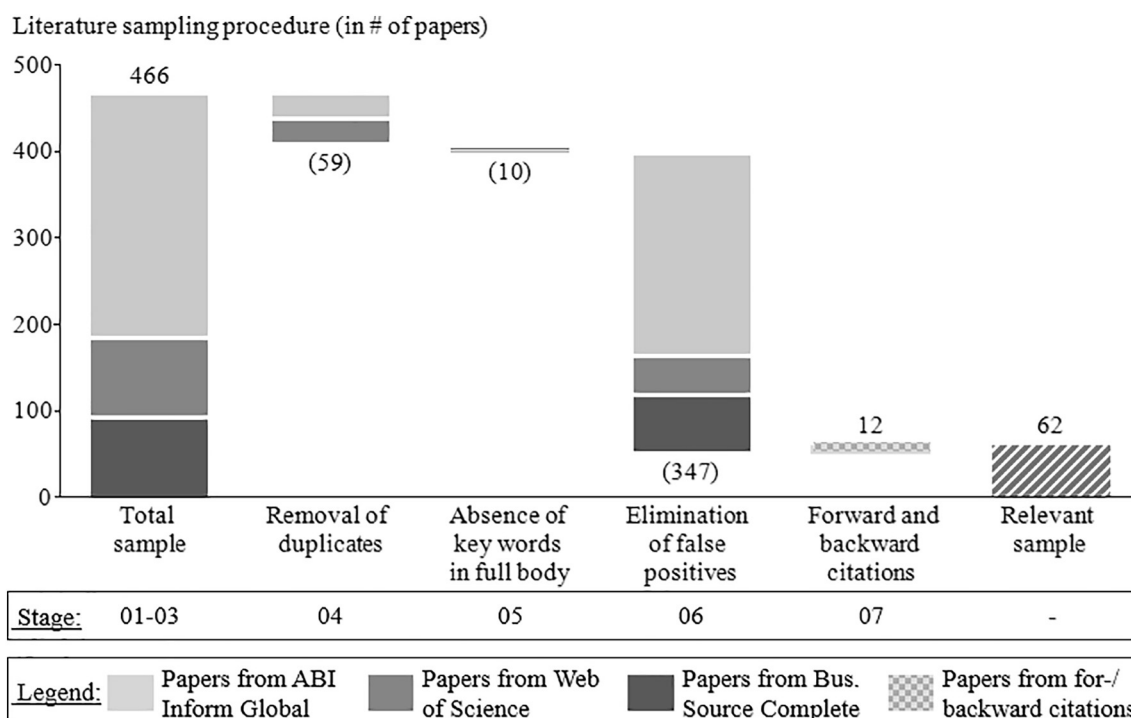


Fig. 01. Literature sampling procedure, separated by database origin.

The articles from our sample originated from the subsequent journals (top six results listed): *Social Science Computer Review* (~8%), *Innovation: The European Journal of Social Sciences* (~6%), *Journal of the Knowledge Economy* (~6%), *Information Polity: The International Journal of Government & Democracy in the Information Age* (~6%), *Cities* (~5%), and *Journal of Urban Technology* (~5%). The more or less even distribution of the most frequently used journals can be seen as a direct result of the multi-disciplinary character of the research subject.

3.3. Methodology of literature review

The articles selected were coded in the following manner: identification of the respective component(s), classification of the various metrics or measurement techniques, grouping of potentially influencing contextual factors, and categorization of the diverse envisaged results. The author would like to emphasize that the review agenda was solely utilized as a point of departure to help organize the reviewing process. The described coding scheme was specifically set up for changes, modifications and enlargements (Urquhart, Lehmann, and Myers, 2010). Throughout the analysis stage, various thematic codes were inductively derived, and articles were often coded in an iterative process to identify emerging themes. Consequently, the various reviewing cycles led to the emergence, and subsequent refinement, of various conceptual categories and sub-categories. The process described is informed by Wolfswinkel et al.'s iterative coding procedure and was adapted for the requirements of the author's review.

4. Smart city governance research scheme and reference clustering

The discovered diversity of the governance construct clearly demonstrated the need for a research scheme that could be used to analyze, examine and present the selected body of literature. An initial examination uncovered the following categories (also by building on the past efforts (“model of smart governance”) of Bolivar and Meijer (2016)) of broad research subjects: (1) components, (2) measurements, (3) contextual factors, and (4) outcomes. Categories and sub-groupings together generate the SCG research scheme (cf. Fig. 02) that was utilized to conduct the subsequent systematic literature review.

The author clustered the references, following Webster and Watson

(2002), with all 62 articles from the sample. Thereby, the author classified each article's SCG emphasis across the four categories within the scheme (cf. Table 02). The author specifically focused on SCG conceptualizations, references to SCG components, measurements, contextual factors, outcomes or direct applications of the SCG concept in different contexts. It is important to note that the author did not place a marker in those cases in which the article only cited other studies without building on the concept, providing an explanation, using the SCG concept in a specific context, validating the referenced SCG concept or making a new contribution to the adopted SCG definition or conceptualization.

The reference clustering provides various thought-provoking insights. In an initial analysis, the reference cluster seems rather consistent in its entirety, other than a few sporadic deviations. Upon closer examination, at the category and sub-category level, however, a number of changes and developments emerge (cf. Fig. 03).

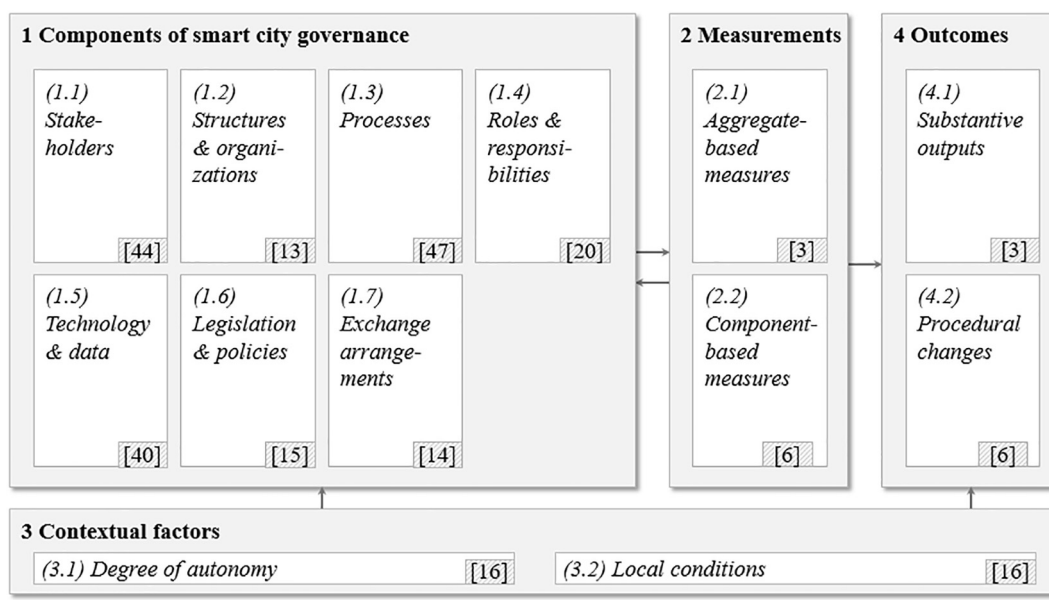
Regarding components, ‘stakeholders’, ‘processes’ and ‘technology & data’ have been extensively discussed throughout the sample period, while the other four sub-categories ‘structures & organizations’, ‘roles & responsibilities’, ‘legislation & policies’, ‘exchange arrangements’ have received less attention. More specifically, the less frequently mentioned sub-categories were present more towards the end of the sample period. The number of studies that address SCG measurements or SCG contextual factors is limited. With regard to the contextual factors, it appears that researchers have placed emphasis on the ‘degree of autonomy’ in the past, while recent studies also start to take into account ‘local conditions’. Concerning the outcomes of SCG, both types (‘substantive outputs’ and ‘procedural changes’), are distributed evenly with regards to the sample period. It is also worth noting that almost half of the studies that mention SCG outcomes examine both types, outputs and procedural changes.

5. Smart city governance research categories

5.1. Components of smart city governance

5.1.1. Conceptualization

In the following section, the seven inductively developed components will be described to obtain a more comprehensive understanding of SCG.



Legend: [#] Number of references per sub-category in the selected literature review sample

Fig. 02. Smart city governance research scheme.

Table 02

Reference cluster, sorted by year of publication.

References	1 Components						2 Measurements		3 Contextual factors		4 Outcomes		
	1.1	1.2	1.3	1.4	1.5	1.6	1.7	2.1	2.2	3.1	3.2	4.1	4.2
01 Odendaal (2003)*	x		x		x	x					x	x	x
02 Giffinger et al. (2007)*			x						x				
03 Hollands (2008)*	x			x	x								
04 Johnston (2010)	x		x	x	x	x							x
05 Bätägan (2011)	x	x	x									x	x
06 Caragliu, Del Bo, and Nijkamp (2011)*			x										
07 Nam and Pardo (2011a)*	x		x		x	x							
08 Batty et al. (2012)	x		x		x					x		x	
09 Chourabi et al. (2012)*	x		x	x	x	x	x						
10 Gil-Garcia (2012)*	x		x		x								
11 Kourtit, Nijkamp, and Arribas (2012)	x	x										x	
12 Lombardi, Giordano, Farouh, and Yousef (2012)	x		x					x	x				
13 Schuurman, Baccarne, De Marez, and Mechant (2012)					x								
14 Tranos and Gertner (2012)		x	x		x							x	
15 Walravens (2012)	x		x	x	x					x			
16 AlAwadhi and Scholl (2013)*	x		x	x			x						
17 Bakici, Almirall, and Wareham (2013)					x								
18 Komninos and Tsarchopoulos (2013)					x								
19 Zygiaris (2013)	x		x										
20 Angelidou (2014)			x		x								
21 Cano, Hernandez, and Ros (2014)	x		x		x								
22 Kitchin (2014)					x								
23 Kourtit, Nijkamp, Franklin, and Rodríguez-Pose (2014)	x	x							x			x	
24 Albino et al. (2015)*	x		x		x								x
25 Bolívar (2016)*	x	x	x	x			x						
26 Capdevila and Zarlena (2015)	x		x		x								
27 Dameri and Ricciardi (2015)	x	x	x				x						
28 Gil-Garcia et al. (2015)	x	x	x		x		x						
29 Kim (2015)	x		x				x						
30 Lin, Zhang, and Geertman (2015)	x		x		x	x						x	x
31 Popescu (2015)	x		x										
32 Shelton, Zook, and Wiig (2015)					x		x						
33 Almirall et al. (2016)	x		x	x	x	x	x						
34 Battarra, Gargiulo, Pappalardo, Boiano, and Oliva (2016)	x	x			x			x				x	
35 Van Den Bergh and Viaene (2016)		x	x				x						
36 Bifulco, Tregua, Amitrano, and D'Auria (2016)	x				x							x	
37 Bolívar (2016)*	x		x	x			x	x					
38 Bolivar and Meijer (2016)		x	x	x	x	x				x			x
39 Bull and Azenoud (2016)	x		x										
40 Castelnovo et al. (2016)	x		x		x			x	x			x	
41 Chatfield and Reddick (2016)	x		x	x								x	x
42 de Wijs, Witte, and Geertman (2016)	x		x	x	x								x
43 Dameri and Benevolo (2016)	x	x	x	x	x	x	x					x	
44 Dimelli (2016)	x		x		x			x					x
45 Fernández-Güell, Collado-Lara, Guzmán-Araña, and Fernández-Añez (2016)	x		x			x							x
46 Granier and Kudo (2016)	x		x	x	x								
47 Kitchin (2016)					x								
48 Klimovsky, Pinteric, and Saparniene (2016)			x										
49 Leszczynski (2016)					x								
50 Marsal-Llacuna (2016)	x								x			x	x
51 Meijer (2016)*	x		x	x	x		x		x		x	x	x
52 Meijer and Bolivar (2016)	x		x	x	x	x					x	x	x
53 Meijer, Gil-Garcia, and Bolivar (2016)	x	x	x	x	x	x					x	x	x
54 Paulin (2016)	x		x	x	x								x
55 Scholl and AlAwadhi (2016a)	x	x	x		x	x					x		
56 Scholl and AlAwadhi (2016b)			x	x	x	x					x		
57 Wiig (2016)					x								
58 Bifulco, Tregua, and Amitrano (2017)	x		x	x									
59 Kourtit, Nijkamp, and Steenbruggen (2017)			x	x	x	x							
60 Marek, Campbell, and Bui (2017)	x		x		x								x
61 Pereira, Macadar, Luciano, and Testa (2017)			x										
62 Taylor Buck and While (2017)	x						x			x			
Total	44	13	47	20	40	15	14	3	6	3	6	16	16

* Studies added to the review sample via forward/backward tracing (not restricted to peer-reviewed journals).

5.1.1.1. *Stakeholders*. Stakeholders are the second most frequently mentioned component of SCG. The term “stakeholders” is most often directly referenced (e.g., Gil-Garcia et al. (2015), Meijer and Bolivar (2016), Zygiaris (2013), Nam and Pardo (2011a), Kourtit et al. (2014)), but there are also similar terms such as “key actors” (e.g., Kourtit et al.

(2012)) or complete generalizations such as “everyone's access to [...] governance” (Hollands, 2008). Another approach is to describe the groups involved (e.g., Batty et al. (2012)) or their participation in processes and exchanges (e.g., Dimelli (2016)). In this context, the stakeholder term has been widely defined and refers to individuals,

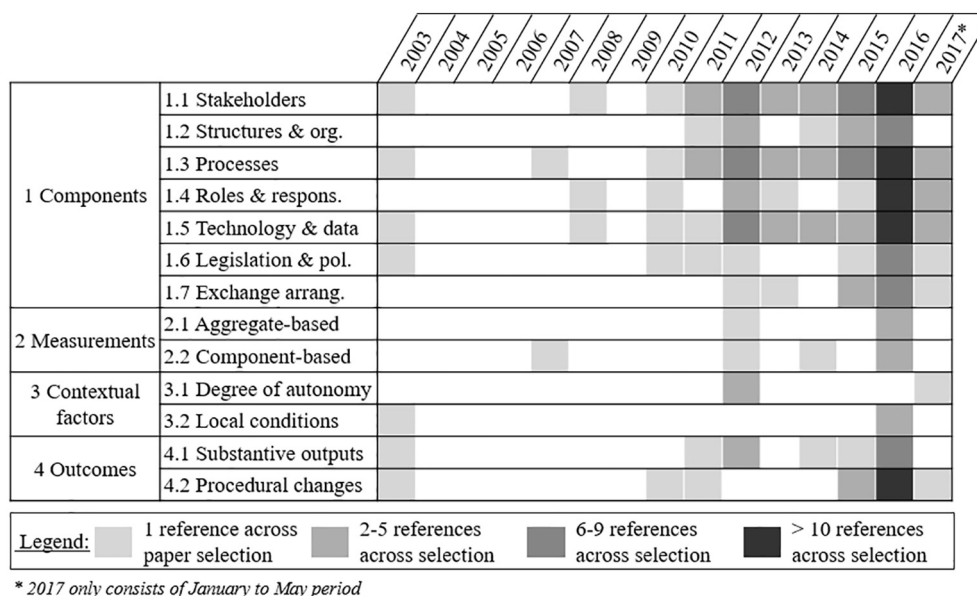


Fig. 03. Aggregated reference cluster, sorted by year of publication.

groups, agencies, parties or organizations that are involved in SCG in any way.

The author categorized the different types of stakeholders as public, private, academic or civic to best capture the range of stakeholders that relate to governance issues. Firstly, public stakeholders are oftentimes defined as “institutions” (Odendaal, 2003), “public subjects” (Battarra et al., 2016), “government agencies” (Castelnovo et al., 2016), “political leadership and administrative proponents” (Scholl & AlAwadhi, 2016a), “governing body” (Cano et al., 2014), or “public administration” (Bifulco et al., 2017). Secondly, private stakeholders are mostly defined as firms and private enterprises (e.g., Cano et al. (2014), Dameri and Benevolo (2016)), however some authors describe them more broadly as the “industry” (Lombardi et al., 2012) or even as the “market” (Lin et al., 2015). Thirdly, academic institutions are predominantly described as academic institutions such as “universities” (Lombardi et al., 2012) as well as “research bodies” (Dameri & Benevolo, 2016). Lastly, civic stakeholders, also often referred to as the civil society (e.g., Dameri and Benevolo (2016), Lombardi et al. (2012)), consist of a range of diverse actors and groups, including “citizens” (e.g., Marek et al. (2017)), “civic groups” (e.g., Gil-Garcia et al. (2015)), “community sector organizations” (e.g., Castelnovo et al. (2016)) or “communities” and “not-for-profit organizations” (e.g., Dameri and Benevolo (2016)). Several authors stress the importance of this stakeholder type; for example, Lombardi et al. (2012) sees them “as one of the main key actors” and for Bifulco et al. (2017) “citizens keep the most important role.”

While other categories do emerge in the literature (e.g., institutional vs. non-institutional actors (Dameri & Benevolo, 2016), internal vs. external stakeholders (Bifulco, Tregua, Amitrano, and D'Auria, 2016), national vs. international organizations (Dimelli, 2016)), the author focuses on the aforementioned distinction. It should also be noted that many stakeholder references in the review sample address the importance of diverse (e.g., Popescu (2015)), numerous (e.g., Fernández-Güell, Collado-Lara, Guzmán-Araña, and Fernández-Añez (2016)) or individual stakeholders (e.g., Gil-Garcia et al. (2015)) without providing a comprehensive definition of the respective stakeholders nor their characteristics. Others maintain a vaguer description of stakeholders, often only using the term without providing additional detail.

5.1.1.2. Structures & organizations. A subset of the literature directly references structures and organizations concerning SCG. In this context, this is seen as the structural or organizational formations that facilitate

the interaction among stakeholders or allow for certain processes. While some authors (e.g., Battarra et al. (2016)) highlight the general importance of organizational and coordination structures for smart governance, others place specific emphasis on the need to improve existing structures (e.g., Bătăgan (2011), Tranos and Gertner (2012)) to allow for smart governance. Scholl and AlAwadhi (2016a) describe the “dismantling of these old structures [departmental silos] [...] as a key element of any sustainable change” while focusing on a city-wide ICT program implementation. Gil-Garcia et al. (2015) shift the focus and accentuate the need for “intergovernmental, interagency, and also inter-sectoral networks” to allow for collaboration among multiple actors. Furthermore, Van Den Bergh and Viaene (2016) highlight that the organization can extend beyond a city’s administrative boundary.

Most of the aforementioned structural and organizational considerations are quite general. Dameri and Benevolo (2016) provide more specificity in their empirical examination of government structures implemented in smart cities. The researchers distinguish three types of structures – political, administrative, and external – and demonstrate that few cities possess all of them. Interestingly, Dameri and Benevolo (2016) highlight that “participation, collaboration, and partnership can be empowered [...] through dedicated nongovernment organizations, such as associations, foundations, and similar groups” composed of various stakeholders. Based on their empirical research, they add that the inadequate involvement of political and administrative actors is, at least in part, attributable to a lack of appropriate structural and organizational formations.

5.1.1.3. Processes. The various conceptualizations for SCG in the literature have produced an accompanying diversity of interpretations of how stakeholders interact using processes. Prior to examining the various processes, a conceptual delineation of the respective nomenclature seems useful. The literature review reflects a need for more well-defined terms in SCG research to address some of the ambiguity. The most frequently mentioned processes in the literature are delimited as follows:

- Information exchange/communication: refers to the direct dissemination of information or communication between stakeholders (e.g., Marek et al. (2017), Gil-Garcia et al. (2015), Kim (2015))
- Engagement/participation/collaboration/(co)-production: can be defined as a process characterized by active involvement of and collaboration between several stakeholders (e.g., Giffinger et al.

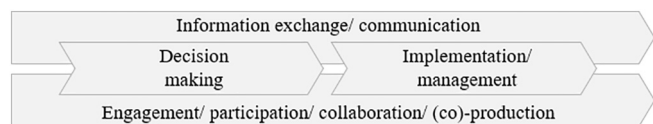


Fig. 04. Breakdown of the ‘processes’ construct in smart city governance literature.

(2007), Caragliu et al. (2011), Cano et al. (2014), Klimovsky et al. (2016))

- Decision-making: encompasses the process of the decision making itself (e.g., Dimelli (2016), Walravens (2012), de Wijs, Witte, and Geertman (2016), Batty et al. (2012), Bull and Azennoud (2016))
- Implementation/management can be described as the process dealing with the implementation of the decisions made as well as all other managerial aspects of SCG (e.g., Pereira et al. (2017)).

By placing the identified terms in a tentative temporal schematic, the author suggests a representation of the different process categories as depicted in Fig. 04.

The commonality among the defined process categories is that they all describe different forms of interactions among the various stakeholders within SCG. They may differ, if compared to each other in the type of activity (e.g., information exchange vs. decision making), in the number of stakeholders involved (e.g., few vs. many), and the individual level of activity per stakeholder involved (e.g., active vs. passive).

5.1.1.4. Roles & responsibilities. Based on the central role of stakeholders within SCG research, scholars have also given consideration to the stakeholders’ roles and responsibilities and enlarged upon individual dimensions of particular importance. This has led to an emphasis on the different distribution and transformation of stakeholder roles and responsibilities (e.g., Almirall et al. (2016), Kourtit et al. (2017), Dameri and Benevolo (2016)), and an increasing focus on several dimensions broadly falling in two categories: power distribution (e.g., Scholl and AlAwadhi (2016b)) and steering (e.g., Granier and Kudo (2016), Bolívar (2016)).

For example, Kourtit et al. (2017) suggest that city governments should “become more important players through their work with other urban stakeholders.” Bolívar (2016) also emphasizes the essential role played by governments in SCs and highlights three potential types (‘role of coordinator’, ‘role of funder’, ‘role of regulator’) of interventions. On the contrary, Dameri and Benevolo (2016), by investigating the role of several different stakeholders, describe the “shift in responsibility [as] stepping back of the municipality, [through] an increased involvement by different stakeholders”. Regarding power sharing, Bifulco et al. (2017) propose that “governance [in general] concerns all the activities that aim towards the sharing of power in decision making.” Paulin (2016) also puts an emphasis on the “empowerment and activities of authority (e.g., the many heterogeneous functions of the various levels of public administrations)” while defining the term governance. Concerning steering, Bolívar (2016) regards the steering mechanism as one of the “main dimension of governance” and describes the different types of steering that can be performed in SCs. Other researchers, for example Granier and Kudo (2016), describe a more specific intelligence-type of SCG where certain factors (e.g., technologies) can enable certain actors to steer others.

5.1.1.5. Technology & data. ‘Technology & data’ have long been used in the context of SCG, yet many scholars have not formally distinguished them in terms of technology- vs. data-related aspects. Most of the general SCG research deals with the usage of (new) technologies to support or enable particular activities, (for e.g., “better planning and decision making” (Dimelli, 2016), “enable central steering” (Granier & Kudo, 2016), “broaden and deepen participation” (Lin et al., 2015)),

focuses on data-related issues such as data collection, access or analysis (e.g., “open data” (Bakici et al., 2013), “open public data” (Angelidou, 2014), “data analysis” (Wiig, 2016), “data [...] enables real-time analysis of city life” (Kitchin, 2014)), or mixes both of them and related issues (e.g., “open data [...] is made public and put to use in SC applications and technologies” (Schoorman et al., 2012)). In this context, the author analyzes this construct by separating technology- vs. data-related issues to provide a more precise overview of the review sample.

According to Marek et al. (2017) “smart technologies drive effective governance” while, for example, “establish[ing] direct and two-sided links between the governance and citizenry serv[es] for optimization [and] communication.” The focus on activities (e.g., “strong element of public participation and public-private collaboration” (Cano et al., 2014), “technologically enhanced provision of [...] services” (Tranos & Gertner, 2012)) that can be improved by using new technologies as well as the special highlighting of information and communication technologies (ICTs) (e.g., de Wijs et al. (2016), Kourtit et al. (2017)) are common in the review sample. Accordingly, Kourtit et al. (2017) emphasize the key role of “digital technologies” especially in the transformation process, while Scholl and AlAwadhi (2016a) especially highlight ICTs’ role “in both the looking after and making decisions about [governance].” Other technologies that researchers allude to in the review sample are, for example, “geo-science tools and big data” (Kourtit et al., 2017), “data warehousing and monitoring tools” (Meijer, 2016), “sensors, virtualizations, geographic information technologies, social media applications” (Gil-Garcia, 2012) or ‘e-Technologies’ (“knowledge repository, exploitation eTools, online tech transfer”) (Komninos & Tsarchopoulos, 2013).

The data theme has been discussed and researched in the review sample in various ways. Shelton et al. (2015) highlight the impacts that new sources of data or new ways of understanding data may have on social and spatial processes of urban governance. The authors emphasize data’s “central place in urban governance, acting as a kind of master signifier or obligatory passage point through which all other functions must position themselves.” Several authors also mention in this context the concept of data-driven urban governance (e.g., Marek et al. (2017)), although the “concept [...] is not new and can be traced back throughout history.” Others, for example Dimelli (2016), Walravens (2012), Capdevila and Zarlenga (2015) or Angelidou (2014), focus more on the accessibility and general availability of (public) data. Leszczynski (2016) goes also into this direction but examines more broadly the overall relationship between “data, cities and governance” and their potential consequences, while Kitchin (2016) accentuates the potential negative consequences (technocratic forms of governance) of an excessive focusing on “big data systems, [...] city analytics and its instrumental rationality.”

5.1.1.6. Legislation & policies. This construct generally describes the legal framework and policies mentioned throughout the research. Kourtit et al. (2017) highlight that SCG “calls for modern and novel [...] policy instruments to address the emerging complex urban realities.” Scholl and AlAwadhi (2016a) add that it “also refers to changing norms, policies, and practices and their guiding principles and values.” In a prior study Scholl and AlAwadhi (2016b) found smart governance to “require revised norms [...] [and] sustainability and adaptability-oriented policies [...].” Dameri and Benevolo (2016) extend the concept to “political instruments, such [as] laws, rules, [and] municipal ordinances” while Johnston (2010) mentions rules in relation to “how to design SG systems [...].” In one of the few empirical research studies that covers the ‘legislation & policies’ component, Bolivar and Meijer (2016) indicate that “legislation is not a key strategy to promoting smart cities development.” However, unique policy and legal challenges emerge in SCG as they pertain to, for example, data access, social justice, and others. As such, the author has included it as one of the SCG components.

5.1.1.7. Exchange arrangements. Exchange arrangements play a crucial role because they constitute the relationships between the public (e.g., governments, political or administrative agencies) and the private sector (e.g., firms, companies, citizens) that are subject to change in SCG, as mentioned in the selected literature. Public-private exchanges are broadly classified into market-driven or contractual arrangements and more network-driven or relational arrangements, particularly between the private and public actors.

Dimelli (2016) highlights the general importance of “services and links between private and public [...] organizations, so that the city functions effectively as part of a whole [...].” This assessment is also shared by other authors (e.g., Van Den Bergh and Viaene (2016)). Almirall et al. (2016) adopt an ecosystem perspective to indicate the changing multifaceted role of local governments. These private providers to cities appear not only as pure service providers but also as enablers supporting independent actors, therefore actively engaging in networks and partnerships. AlAwadhi and Scholl (2013) also differentiate between the potential models of governance “used for and within smart initiatives, which might range from hierarchical to network approaches.” Taylor Buck and While (2017) point out that the public-private exchange may, at the same time, cause “tensions between collaboration and competition amongst different public and private interests” that need to be addressed. However, exchanges based on cooperation, networks and partnerships between public and private actors, as opposed to more market-driven exchange arrangements, appear to be more relevant to SCG (e.g., Dameri and Benevolo (2016), Gil-Garcia et al. (2015), Shelton et al. (2015)).

Gil-Garcia, Pardo and Nam (2015) highlight “the intergovernmental, interagency, and also inter-sectoral-networks and partnerships or collaboration among multiple actors, including government agencies”, and Shelton et al. (2015) describe the rise of the SC model and the associated emergence of “new inter-organizational partnerships and alliances.” Chourabi et al. (2012) also mention the “private/public partnerships” as an important characteristic of SG and SCs. For Dameri and Benevolo (2016), “governance includes [...] non-institutional mechanisms, such as public-private partnerships, subsidiaries, [and] negotiations.” Dameri and Ricciardi (2015) acknowledge the existence of “formal inter-organizational agreements or joint-ventures between the key SC actors” and emphasize the importance of relationships for SCG that “are fluid and managed informally.”

5.1.2. Discussion and shortcomings

Wide variations among the alleged building blocks of SCG exist and various researchers focus on different individual building blocks or subsets of them. The reviewed sample does not provide any usable findings about which component or combinations of components determine whether or how well a city possesses or pursues SCG, or offers a model of the underlying causal relationships. However, certain researchers claim to have at least identified certain dimensions or components that appear to be instrumental for SCG. For most of the identified components within this literature review the line of reasoning continues to be theoretical. Empirical proof is insufficient or completely absent. Claims about certain SCG components are meager; this includes, for example, ‘structures & organizations’ and ‘legislation & policies’. Each element has been mentioned in only ~21% and ~25% of the articles, respectively. Other components such as ‘stakeholders’, ‘processes’ and ‘technology & data’ seem to be at least pertinent for SCG researchers.

When investigating the components more deeply, the author notices that certain statements on components are particularly ambiguous. The configuration of the ‘processes’ component, for example, appears manifold and is, therefore, often used in rather vague ways. The same circumstance can be observed with the ‘exchange arrangements’ component concerning the various mechanisms of exchange that are possible. The respective nomenclature in such cases needs to be clarified, particularly for analytical purposes. Further research to develop consensus on the terms that form the ‘building blocks’ of SCG and causal

models of their impacts on SCG and SC outcomes would benefit the field greatly.

5.2. Measurements of smart city governance

5.2.1. Conceptualization

Only a few papers mention, theorize or examine the potential measurement techniques of SCG components. Several papers blend the measurement of SCG components and outcomes (e.g., Castelnovo et al. (2016), Marsal-Llacuna (2016)), thus adding to the overall confusion. With those studies that mention various SCG component measurements techniques, there exists little consistency between the different approaches. The author conceptually integrated the different measurement techniques into two sub-categories: aggregate-based measures and component-based measures.

Some researchers try to measure SCG as an aggregate concept, particularly when it is part of a larger study of smart cities. For example, Battarra et al. (2016) used the aggregate indicator of voter turnout (among others) to measure SCG. Alternatively, others try to measure the governance construct at the component level. Marsal-Llacuna (2016), for example, used indicators to measure the “citizen-centeredness” of city policies (‘legislation and policies’) and local governance to account for the social pillar of sustainability. Giffinger et al. (2007) used several indicators (e.g., “city representatives per resident”, “political activity of inhabitants”) to measure various aspects of SCG, e.g. “participation in decision-making”, while creating a SC ranking of European medium-sized cities.

Other researchers mix both, aggregate-based and component-based, perspectives in their measurement attempts. For example, Castelnovo et al. (2016) highlight the holistic character of their measurement concept to assess SCG and decision-making processes, however, their measurement techniques are based on an indicator system evaluating certain SCG components (e.g., “urban stakeholder engagement in SCG”). Lombardi et al. (2012) used the component of ‘stakeholders’ disaggregated into ‘university’, ‘government’, ‘civil society, and ‘industry’ to measure the SCG construct; however, the researchers aimed to investigate the relations between SCs components and, therefore, considered SCG more in its entirety than as the sum of its components.

5.2.2. Discussion and shortcomings

There is little conformity to be found among the small number of studies that theorize on measurement techniques. This problem is most often caused by a lack of focus on the variable to be measured. In addition, there is disagreement over the unit of analysis of measuring SCG (aggregate-based vs. component-based) as previously explained. In order to infer key components in SCG and, eventually, in achieving envisaged SCG outcomes, a components approach will be better suited to draw causal inference and test the impacts of the various components and their combinations on well operationalized metrics. Measuring SCG as an aggregate concept using certain indicators can be pertinent, but there are limitations particularly for isolating key components for applied research.

Other potential measurement techniques that have been neglected for the most part, such as ‘direct measures’, ‘taxonomy-based measures’ and ‘equipment/application-based measures’ may be particularly suitable for certain sub-sets of components and should therefore be investigated. For example, ‘direct measures’ based on the assessments of researchers or the perception of stakeholders involved via interviews and surveys (e.g., as discussed in Meijer (2016)) appear to offer a reasonable extension of the existing techniques, especially for sub-components (e.g., ‘roles & responsibilities’) that have proven to be difficult to measure. ‘Taxonomy-based measures’ may be able to assist in the measurement of sub-components which had hitherto tended not to follow a certain nomenclature (e.g., ‘processes’, ‘exchange arrangements’). The introduction of a conceptual delineation of their respective nomenclature and their either binary (in the case of ‘exchange

arrangements’) or multi-dimensional (in the case of ‘processes’) assessment could prove particularly helpful. ‘Equipment/application based measures’ (e.g., in the case of ‘technology & data’: amount of data stored and processed, etc.) can specifically target individual sub-components.

In addition, any combination of the above and other potential measurement techniques can potentially provide a much better picture of the component or sub-component to be measured than each techniques individually.

5.3. Contextual factors of smart city governance

5.3.1. Conceptualization

According to [Meijer, Gil-Garcia, and Bolivar \(2016\)](#), while many studies on smart cities already highlight the significance of the general context they do not provide a sufficient and systematic analysis of the phenomenon. More specifically, smart governance is assumed to be affected by many factors, e.g., “administrative cultures, political or demographic factors, technological factors [...]” ([Bolivar & Meijer, 2016](#)). However, only few papers mention, theorize or examine the potential role of contextual factors in SCG. With those studies that discuss or at least mention a potential positive or negative influence of contextual factors on SCG, empirical evidence has yet to be provided.

In the following section, the author conceptually integrates the potential factors into two sub-categories: degree of autonomy and local conditions.

5.3.1.1. Degree of autonomy. SCG is argued to be influenced by many factors, most notably by the degree of autonomy or sovereignty a city possesses (e.g., municipal-level, provincial-level, country-level, etc.). Accordingly, studies focused on autonomy, outsourcing and power characteristics mentioned their potential influence on SCG. For example, [Walravens \(2012\)](#) highlights “the impact of different levels of regulation (transnational, international, national, regional, local) [...]”, [Batty et al. \(2012\)](#) mentions “regulations that extra national government agencies may impose [...]”, while [Taylor Buck and While \(2017\)](#) describe “the difficulties facing UK cities in assembling the [...] governance powers” that “reflect the limited autonomy of municipal government and the effects of successive rounds of neoliberal hollowing out of the local state.” Therefore, among the potential contextual factors, the degree of autonomy appears to be a key influencer of SCG.

5.3.1.2. Local conditions. While exploring the relationship between ICT and local governance at an early stage of the SCG research, [Odendaal \(2003\)](#) mentioned various “less predictable elements such as social pressures, community activism and capacity within local governments’ areas of jurisdiction.” However, other researchers have mostly ignored the potential impact of local conditions on SCG.

More recently, scholars have started to hypothesize about the potential influence of local conditions on SCG. [Bolivar and Meijer \(2016\)](#) call for a closer examination of “administrative cultures, political or demographic factors.” Furthermore, [Scholl and AlAwadhi \(2016b\)](#) recognize the different municipalities’ structures within their case study, and the potential impact that such local differences might have. [Meijer \(2016\)](#) most clearly warns of the danger that a neglect or mistreatment of key contextual factors can entail and, consequently, develops a model for studying and assessing SCG in context. The researcher, thereby, underlines the importance of two contextual factors, ‘local cooperative knowledge potential’ and ‘the nature of the problem domain’. ‘Local cooperative knowledge potential’ refers, in this case, to the “availability of relevant knowledge among citizens and stakeholders, and the willingness to contribute this knowledge to collective problem-solving.” According to [Meijer \(2016\)](#), ‘the nature of the problem domain’ describes, situational characteristics, such as “political, institutional, societal, economic, and cultural” conditions that “interact with a series of political, administrative, and technological choices

regarding the use of new technologies for urban governance.”

5.3.2. Discussion and shortcomings

The influence of contextual factors on SCG remains unclear. Very few papers theorize about or measure the potential role of contextual factors. Contextual factors are sometimes claimed to impact SCG, at least in part, but empirical evidence of this connection is lacking. [Bolivar and Meijer \(2016\)](#) explicitly call for future research on “how smart governance is influenced by contextual factors” while [Meijer et al. \(2016\)](#) also highlight the “great need for more specific analyses of smart city governance in context.” To date certain contextual factors (e.g., “administrative cultures, political, or demographic factors, technological factors” ([Bolivar & Meijer, 2016](#)), “national regulations” ([Batty et al., 2012](#))) have been mentioned, but their impact on SCG has either not been clearly demonstrated or is completely absent. In addition, there is a risk that other contextual factors relating to SCG have not yet been identified and may be important, particularly since there is a geographic imbalance in the study of SCG thus far.

5.4. Outcomes of smart city governance

5.4.1. Conceptualization

Despite the small number of references, the overall spectrum of the specified outcomes appears to be varied and multifaceted. For example, while some authors mention potential outcomes at a broad level, such as “public value” ([Meijer et al., 2016](#)), others organize outcomes temporally (e.g., “short-term and long-term objectives” ([Lin et al., 2015](#))) or based on their potential economic, environmental and social impact (e.g., “maximize the socio-economic and ecological performance of cities” ([Kourtit et al., 2012](#))). In their literature review and empirical study [Bolivar and Meijer \(2016\)](#) choose another classification, in terms of ‘first-, second- and third-order outcomes’. First-order outcomes refer to “changes to the government organization”, second-order outcomes are “changes in the position of government vis-à-vis other urban actors” and third-order outcomes are “improvements to the city”.

In order to provide a concise overview, the author categorizes the envisaged outcomes (based on a similar classification utilized by [Meijer and Bolivar \(2016\)](#)) according to the substantive outputs (e.g., what is generated), and the procedural changes (e.g., how the output is generated).

5.4.1.1. Substantive outputs. A majority of the research studies that mention potential outcomes as a direct consequence of the implementation of SCG define SCG outcomes as an output that can be generated. In most instances, the studies conceptualize output-oriented SCG using economic, environmental or social metrics. For example, [Kourtit et al. \(2012\)](#) while calling for “pro-active and open-minded governance structures” describe the maximization of “the socio-economic and ecological performance of cities” as an envisaged outcome. [Castelnovo et al. \(2016\)](#) address “economic growth, employment, social inclusion [...]” while defining public value “which aims to measure the outcomes and/or the long-term impacts of the initiatives implemented.” The perspectives of [Tranos and Gertner \(2012\)](#) as well as [Lin et al. \(2015\)](#) are clearer regarding the third perspective and mention the “social inclusion of urban residents in public services” and “the engagement of marginal migrants and other social groups,” respectively. Other authors place particular importance on the combination of social and economic value creation (e.g., [Batty et al. \(2012\)](#); [Dameri and Benevolo \(2016\)](#)) or the solving of complex environmental sustainability problems at local levels (e.g., [Chatfield and Reddick \(2016\)](#)) as outcomes of interest.

5.4.1.2. Procedural changes. Other studies not only focus on the outputs, but also mention behavioral or procedural changes in the implementation of SCG. The author consolidates the various outcome predictions into the following key behavioral or procedural changes:

efficiency, innovation, transparency, and citizen-centricity.

First, [Dimelli \(2016\)](#) mentions “greater efficiency” while other authors, e.g. [Meijer \(2016\)](#), also highlight the potential savings in various dimensions such as time (e.g., “speed of decision-making process”). Second, the concept of an increased innovative attitude is highlighted in the review sample on several occasions. For example, [Marek et al. \(2017\)](#) speak of an “innovative environment” as an envisaged result while [Fernández-Güell et al. \(2016\)](#) focus more on individual actors, e.g. local administrations, that will become “more intelligent [and] innovative [...]”. In their empirical analysis [Bolivar and Meijer \(2016\)](#) also found that innovation “was frequently mentioned by practitioners.” However, in their model of smart governance, in contrast to this analysis, innovation capacity was added as a constitutive element of smart governance and not as an outcome. Thirdly, the tendency of being more transparent has been highlighted by [de Wijs et al. \(2016\)](#) (“sharing of concepts, vision, goals, [...]”), [Fernández-Güell et al. \(2016\)](#) as well as [Albino et al. \(2015\)](#) (“transparent”) among others. Lastly, several authors described a stronger citizen-centric focus in, for example, operations and services as a potential key outcome for SCG (e.g., [Bätägan \(2011\)](#), [Bolivar and Meijer \(2016\)](#)).

5.4.2. Discussion and shortcomings

Very few studies define or explicitly examine the envisaged outcomes of SCG. The majority of those studies that mention governance outcomes neither use a consistent taxonomy to describe the envisaged outcomes nor specifically delineate the outcomes driven by other constructs, such as the SC itself. Without more clarity, there is a risk of confusion if the stated outcomes are to be viewed as the direct result of the implementation of SCG or if the reasons for the outcomes lie somewhere else. The examination of the causal connection between the presence of certain SCG components and the achievement of SCG outcomes has been neglected and, therefore, additional research studies are needed.

5.5. General discussion and shortcomings

The non-uniform number of mentions and the highly inconsistent level of specificity on the research schemes' categories and sub-categories were to be expected, given that this review focuses on a niche aspect of the much broader SC area of research. Since only a small number of articles address the theme of SCG entirely (e.g., [Bolivar and Meijer \(2016\)](#), [Castelnovo et al. \(2016\)](#), [Dameri and Benevolo \(2016\)](#)), most of the cited studies devote limited attention to SCG or describe the general construct as a whole. More often, the articles delve into isolated components. One possible explanation might be that there is still disagreement on the underlying definition of SC itself and, subsequently, on the constructs (such as governance of SC) that complicate the emergence of a common theoretical basis. Current attempts have been rather heterogeneous and fragmented.

Therefore, the author proposes a more holistic perspective and defines SCG as the processual interplay among a diverse set of stakeholders, equipped with different roles and responsibilities, organized in various external and internal structures and organizations, driven and facilitated by technology and data, involving certain types of legislation, policies and exchange arrangements, for the purpose of achieving either substantive outputs for cities or procedural changes (or both). Thereby, the specified components and outcomes in this study can cover a wide range of forms and compositions and are (at least indirectly) affected by various contextual factors. Consequently, the author specifically refrains from a one-size fits all approach for SCG (similar to the rejection of the one-size fits all narrative for SC by [Kitchin \(2015\)](#)) and prefers to envision his SCG definition more as a superordinate structure (similar to the approach utilized by [Bolivar and Meijer \(2016\)](#) (“model of smart governance”)), explicitly allowing the existence of several different SCG archetypes (following the example of “smart governance configurations” by [Bolivar and Meijer \(2016\)](#)) (cf.

[Fig. 05](#)). The author thereby builds on the concept that different compositions of the proposed components – e.g., stakeholders could be composed of any combination of public, private, academic or civic types – exist for different contextual (e.g. regional) archetypes of SCG.

Closely related to an unclear definition of SCG is the prevalence of articles that use a descriptive rather than analytical approach. Therefore, the author argues that the current analytical constraints need refinement, along with finer-grained, empirical studies. Additionally, there is an imbalance with regard to the regional focus of the studies within this sample (~42% of studies have a focus on cities in Europe). In general, regional asymmetries should not be underestimated, given their potential to discredit the results generated so far if certain distinctive continental or national factors have a substantial impact on SCG. Nevertheless, this study has taken a more coherent and global perspective on SCG. The archetypes are meant to capture the widest range of SCG from various regions of the world. The potentially different compositions within the components should thereby reflect regional complexity as well as other contextual differences. For example, the European-focused literature in the sample differs slightly from the broader global sample under the component of technology & data – i.e. technology & data were more prominently mentioned in that sub-sample. That said, the components are designed to capture such variations, which may or may not be attributable to regional factors. The subcomponents (of, for example, technology & data) would represent the actual differences in the composition of the component and therefore different sub-components could form different archetypes. However, this level of analysis is not addressed in the paper, which is intended to provide the superordinate structure of SCG. The author expects that emerging sub-components and archetypes from future studies will help refine this proposed structure moving forward.

6. Avenues for future smart city governance research

This review stresses the need for further research to better comprehend what components constitute SCG, how to measure them, and their influence in achieving the intended outcomes of SCG. Therefore, the author advocates establishing SCG as a more distinct SC research area.

Furthermore, there are various methodological inadequacies that need to be addressed. One can argue that most of the deficiencies are a result of the significantly small number of empirical studies to date that have been focused on SCG, particularly when compared with the significant number (approximately a few hundred) of smart cities or smart city programs existing worldwide (e.g., [143 smart city projects worldwide] [Lee, Hancock, and Hu \(2014\)](#), [193 smart city pilot projects in China] [Liu and Peng \(2013\)](#), [240 smart cities in the EU] [Manville, Cochrane, Cave, Millard, Pederson, et al. \(2014\)](#), [250 smart city projects in more than 178 cities around the world] [Navigant Research \(2017\)](#), [100 smart cities development program in India] [Praharaaj, Han, and Hawken \(2017\)](#)). Although it is difficult to offer a conclusive number for the current number of smart cities or smart city programs (given the different SC definitions and national variations involved), the significant gap between smart cities (or SC programs) and SCG studies highlights both the lag and gap in the academic literature in understanding and informing the practice of SCG.

Nonetheless, it is not only seen as worthwhile to address the general shortage of empirical studies explicitly, but also to raise awareness of the limitations of the existing ones. Additional empirical research on SCG will require clear identification of both the independent and dependent variables and their appropriate measurement techniques. The current ambiguity of dependent variables, when they have been defined at all, as well as the lack of precision of the respective measurement techniques, demonstrate the need for additional empirical research on SCG. The factors mentioned contribute to the limited use of quantitative methods in analyzing SCG research thus far. The same factors impact the use of qualitative research in this specific field; comparatively,

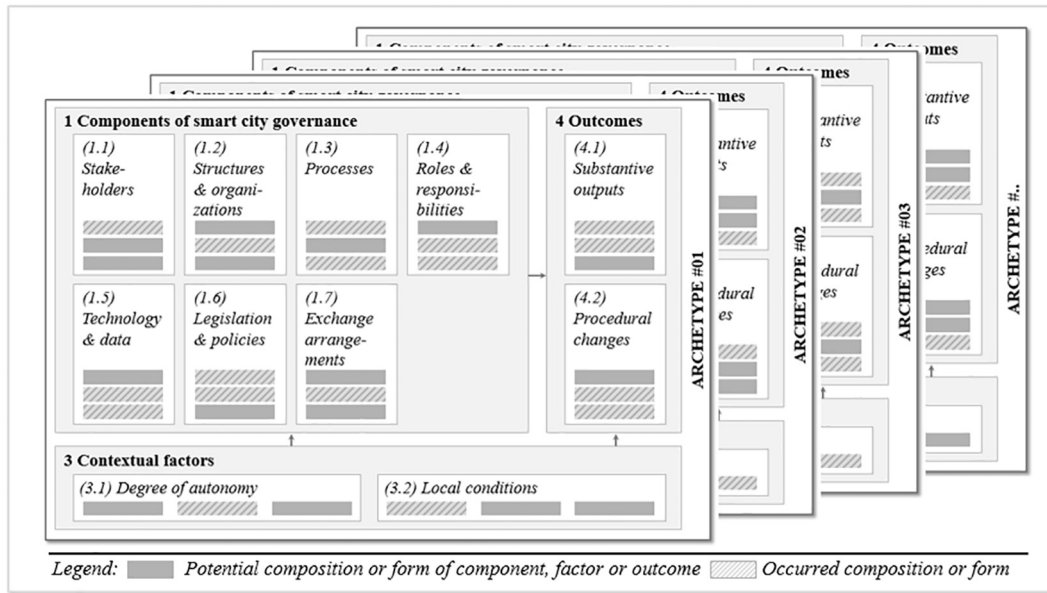


Fig. 05. Potential SCG archetypes.

qualitative methods have been used more frequently. Therefore, this field would benefit from more versatile and comprehensive studies and methods. As research into SCG advances and moves away from purely qualitative analyses (e.g., single-case studies), the author highlights the added value of more comparative studies. For example, employing set-based analysis tools like Qualitative Comparative Analysis (QCA) (Ragin, Shulman, Weinberg, and Gran, 2003), which have been underutilized in this field so far, may provide a valuable opportunity for SCG research. This method allows the examination of causal pathways that produce an outcome of interest, without the averaging of treatment effects. QCA allows for the integration of case-based and other substantive knowledge, and generates findings from a limited number of cases (e.g., Ragin (2005, 2008)). Given the nascent nature of this field, this topic might be well positioned for the use of such a tool. SCG research stands to benefit greatly from increased interdisciplinary research at the various levels of analysis. In general, the aforementioned approaches (e.g., QCA) can create more robust and deployable insights. This would not only contribute to the field of SCG but would also entail positive and far-reaching consequences for the applied side (e.g., for practitioners) of SCG.

More specifically, the author proposes the following research directions.

1. Multiple identified components stand to gain from additional data collection. One way forward for this explicit research initiative may be to deploy more case study research (Eisenhardt, 1989). The research method has the potential to examine currently marginalized themes and is particularly suitable for theory building. It is also worth mentioning that researchers may increase the generalizability of their results if cases are better distributed with regards to geography.
2. Research should specifically examine the connections of SCG components and their envisaged outcomes, which remain largely vague. Potential insights need to be tested against their causal connections. The few components and sub-components that demonstrate predominant similarities with regards to their generated insights can be further examined using confirmatory statistical research.
3. Future research should investigate empirically the role of contextual factors and their potential influence on SCG components and outcomes. Moreover, further research should focus not only on the contextual factors addressed within this review (e.g., degree of

autonomy, local conditions), but should broaden the analysis to include a variety of other potential factors. Although the above-mentioned contextual factors appear to be of specific significance for SCG, other factors should, at least, be considered and, if necessary, analyzed.

4. Once a more comprehensive body of literature exists with a more standardized ontology of terms and research approaches, further synthesis of the scattered extant case study data using a meta-analysis approach may support the effort to build a more sophisticated knowledge base in SCG.
5. Finally, longitudinal studies can provide valuable insights to sharpen causal models of components, interrelationships and dynamics related to the field of SCG. For example, longitudinal qualitative studies can advance the perception of SCG by recognizing the changing dynamics of such highly complex social-technical system. Furthermore, longitudinal research could offer further insights into the development stages of SCG where certain relationships may not be explainable or recognizable through other research designs.

7. Concluding remarks

Research on SCG appears to be even more ambiguous and disintegrated than that carried out on SC, more broadly. Therefore, this paper contributes to the SCG discourse by illuminating the thematic topic of SCG from the joint perspective of four inductively developed and distinct categories (components, measurement methods, contextual factors and envisaged outcomes) and, consequently, constitutes an important input for the designation and definition of SCG, with a wide intended application. Thereby, this paper presents an extended superordinate ontological structure (building on past efforts of Bolivar and Meijer (2016)) allowing for different SCG archetypes. While this study is not the first literature review with regards to SCG (e.g., Meijer and Bolivar (2016), Castelnovo et al. (2016)), it offers additional insights, especially given the recent surge in publications on SC (Dameri & Benevolo, 2016) and SCG, particularly in the last two years. However, the results of this study appear to underline the wide-ranging differences in perspectives on SCG. In spite of or rather because of that, this analysis highlights promising areas of potential research as well as offers methodological approaches to close some of the identified knowledge gaps.

The author recognizes the limitations of this review. Firstly, the three selected databases might not have been comprehensive for this kind of research, particularly given the interdisciplinary nature of the SC topic. Secondly, the applied search words might not have been all-encompassing for such a literature review. Lastly, the backward and forward tracing process used to find additional articles could open the way to speculation about researcher bias.

The author does not claim that his classification scheme is comprehensive. However, the author asserts that the wide-ranging conceptualization of SCG offers substantial advantages for both scholars and practitioners. For scholars, the developed research scheme allows for greater clarity and facilitates collaboration in this interdisciplinary field of research. For practitioners, it enables them to get a broad overview of the status quo of the research and allows them to begin putting useful scientific insights into practice. For example, the author expects that the results of this paper will be beneficial to local

government policy makers in comprehending the multi-faceted components of SCG, to design procedures for their SCG implementation, and to monitor and measure the SCG progress of their cities. Upon further refining the superordinate structure through additional case studies, the author envisions the use of this research to represent various SCG archetypes that could be utilized by SC practitioners and could frame a practical conversation around strategies for improving SCG at the sub-components level, via a pseudo-scorecard for SCG.

In summary, the research scheme and the conceptualization of SCG can serve two masters, researchers and practitioners, by creating a mutual understanding as well as a basis for discussion of a previously fuzzy construct. This appears crucial in a time where great significance is ascribed to the SC concept, and thus on SCG, to tackle and overcome the significant challenges and obstacles lying ahead.

Conflicts of interest: none.

Appendix 1

Table 03

Selection of broad smart city definitions, sorted by year of publication.

Study	Selected definitions of SC, sorted by year of publication
Hall, Bowerman, Braverman, Taylor, and Todosow (2000)	“A city that monitors and integrates conditions of all of its critical infrastructures, including roads, bridges, tunnels, rail/subways, airports, seaports, [...], even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens.” (p. 1)
Odendaal (2003)	“A smart city [...] is one that capitalizes on the opportunities presented by Information and Communication Technology (ICT) in promoting its prosperity and influence.” (p. 586)
Partridge (2004)	“A smart city that actively embraces new technologies [...] to be a more open society where technology makes easier for people to have their say, gain access to services and to stay in touch with what is happening around them, simply and cheaply” (p. 4)
Giffinger et al. (2007)	“[...] A Smart city is a city well performing in a forward-looking way in these six characteristics [economy, people, governance, mobility, environment, and living], built on the ‘smart’ combination of endowments and activities of self-decisive, independent and aware citizens” (p. 11)
Paskaleva (2009)	“In the context of the present study, the smart city is defined as one that takes advantages of the opportunities offered by ICT in increasing local prosperity and competitiveness – an approach that implies integrated urban development involving multi-actor, multi-sector and multi-level perspectives” (p. 407)
Harrison, Eckman, Hamilton, Hartswick, Kalagnanam, et al. (2010)	“Smarter cities are urban areas that exploit operational data, such as that arising from traffic congestion, power consumption statistics, and public safety events, to optimize operation of city services.” (p. 1); “One working definition of a Smarter City is connecting the physical infrastructure, and the business infrastructure to leverage the collective intelligence of the city.” (p. 2)
Caragliu et al. (2011)	“[...] the concept of the “smart city” has recently been introduced as a strategic device to encompass modern urban production factors in a common framework and, in particular, to highlight the importance of Information and Communication Technologies (ICT) in the last 20 years for enhancing the competitive profile of a city.” (p. 65)
Kourtit et al. (2012)	“[...] advanced business and socio-cultural attractiveness [...], presence of a broad (public and private) labor force and public facilities [...] and presence and use of sophisticated e-services [...]” (p. 234)
Nam and Pardo (2011b)	“A smart city is ICT-enabled public sector innovation made in urban settings. It supports long-standing practices for improving the operational and managerial efficiency and the quality of life by building on advances in ICTs and infrastructures.” (p. 186)
Batty et al. (2012)	“[...] rudiments of what constitutes a smart city which we define as a city in which ICT is merged with traditional infrastructures, coordinated and integrated using new digital technologies.” (p. 481)
Cretu (2012)	“[...] reveals two main streams of research ideas: 1) smart cities should do everything related to governance and economy using new thinking paradigms and 2) smart cities are all about networks of sensors, smart devices, real time data and ICT integration in every aspect of human life.” (p. 57)

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Table 03 (continued)

Study	Selected definitions of SC, sorted by year of publication
Kourtit and Nijkamp (2012)	“Such smart cities are based on a promising mix of human capital (e.g., skilled labor force), infrastructural capital (e.g., high-tech communication facilities), social capital (e.g., intense and open network linkages) and entrepreneurial capital (e.g., creative and risk-taking business activities).” (p. 93)
Lombardi et al. (2012)	“The identified clusters are: smart governance (related to participation); smart human capital (related to people); smart environment (related to national resources); smart living (related to the quality of life); and smart economy (related to competitiveness).” (p. 139)
Alkandari, Alnasheet, and Alshekhly (2012)	“A smart city is one that uses a smart system characterized by the interaction between infrastructure, capital, behaviors and cultures, achieved through their integration.” (p. 1)
Schaffers, Komninos, Pallot, Aguas, and Almirall (2012)	“The smart city concept is multi-dimensional. It is a future scenario [...], even more it is an urban development strategy (how to achieve it). It focuses on how (internet-related) technologies enhance the lives of citizens.” (p. 57)
Bakici et al. (2013)	“[...] Smart City implies a high-tech intensive and an advanced city that connects people, information and city elements using new technologies in order to create a sustainable, greener city, competitive and innovative commerce and a recuperating life quality with a straightforward administration [...]” (p. 139)
Townsend (2013)	“[...] define smart cities as places where information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems.” (p. 15)
Kitchin (2014)	“‘Smart cities’ is a term [...] to describe cities that, on the one hand, are increasingly composed of and monitored by pervasive and ubiquitous computing and, on the other, whose economy and governance is being driven by innovation, creativity and entrepreneurship, enacted by smart people.” (p. 1)
Scholl and AlAwadhi (2015)	“[...] smart city (definition) is a programmatic term that summarizes the creation, integration, combination, development, and effective leverage of resources and assets towards innovation, attractiveness, competitiveness, sustainability, and livability of an urban space facilitated and accelerated by the ubiquitous use of advanced information and communication technologies with local governments playing key investigating roles in this process.” (p. 2356)

Appendix 2

Table 04

Selection of smart city governance definitions, sorted by year of publication.

Study	Selected definitions of SCG, sorted by year of publication
Odendaal (2003)	“[Governance] refers in this context to the means by which local government manages its environment to achieve ongoing growth, delivery and effectively administer its affairs. “Governance” relates to the relationship between individual, interest groups, institutions and service providers in the ongoing business of government.” (p. 587)
Giffinger et al. (2007)	“Smart governance comprises aspects of political participation, services for citizens as well as the functioning of the administration.” (p. 11)
Caragliu et al. (2011)	“We believe a smart city to be smart when investments in human and social capital and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic growth and a high quality of life, with a wise management of natural resources, through participatory governance.” (p. 70)
Nam and Pardo (2011a)	“As urban planning based on governance with multiple stakeholders is pivotal to smart growth, smart city initiatives necessitate governance for their success.” (p. 286)
Lombardi et al. (2012)	“The identified clusters are: smart governance (related to participation); smart human capital (related to people); smart environment (related to natural resources); smart living (related to quality of life); and smart economy (related to competitiveness).” (p. 139)
Kourtit and Nijkamp (2012)	“Smart cities are supposed to be supported by appropriate and trustworthy governance structures and by open-minded, creative people, who through a joint effort are able to increase local productivity, [...]” (p. 93)
Kourtit et al. (2012)	“This calls for pro-active and open-minded governance structures, with all actors involved, in order to maximize the socio-economic and ecological performance of cities, and to cope with negative externalities and historically grown path dependencies.” (p. 232)
Schuurman et al. (2012)	“Six main areas can be identified in which these digital innovations should make a difference: smart living, smart governance, [...]. An important aspect within these innovative applications of ICTs for these six dimensions is the collection of all sorts of data and information by sensors and sensor networks.” (p. 51)

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Table 04 (continued)

Study	Selected definitions of SCG, sorted by year of publication
Chourabi et al. (2012)	“[...] we identify eight critical factors of smart city initiatives: management and organization, technology, governance, policy context, people and communities, economy, built infrastructure, and natural environment.” (p. 2289)
Batty et al. (2012)	“We have already argued that a much stronger intelligence function is required for coordinating the many different components that comprise the smart city. [...] Such governance reaches out to higher level NGOs [...]” (p. 497); “[...] and the organization that is developed will be part of new governance structures [...] that utilize much wider participation in decision-making as well as real time construction and use of a variety of simulations [...] relevant to decision support.” (p. 507)
Walravens (2012)	“Our approach is thus based in the idea of public governance as described in e.g. [Bovaird and Löffler (2009)] who refer to public governance as “how different organizations interact in order to achieve a higher level of desired results” and put a clear emphasis on the processes by which stakeholders interact.” (p. 125)
Barrionuevo, Berrone, and Ricart Costa (2012)	“To do that, cities need to develop smart governance systems that take all these factors [e.g. take a longer view, make greater use of innovation to improve the efficiency and sustainability of their services, improve communication and engage local residents in their projects] into account.” (p. 52)
Rodríguez Bolívar (2015)	“These models of governance can range from that in which smart cities may be governed completely by the organizations that comprise the network (self-governance model), to that in which local government acts as a highly centralized broker, or lead organization, and manages the development of the smart city (bureaucratic model).” (p. 4)
Gil-Garcia et al. (2015)	“Academic literature highlights governance-related elements of smart cities. It suggests particularly three elements: (1) e-governance, (2) engagement by stakeholders, citizens and communities, and (3) network-based relationships such as partnerships and collaborations.” (p. 76)
Scholl and AlAwadhi (2016a)	“[...] academic literatures on “smart government”, “smart city”, and “smart governance” [...] appear to converge on the suggestion that “smartness” in city government and governance stands for a progressive, future-ready, innovation, transformation, quality of life, and sustainability-oriented approaches to governing with modern information and communication technology (ICT) at its very core.” (p. 22)

Appendix 3

Table 05

Results of literature search.

Stage(s)	Description	Business Source Complete	Web of Science	ABI/ INFORM Global	Total
01–03.	Total sample	91	93	282	466
04.	Removal of duplicates	91	64	252	407
05.	Absence of keywords in the full body of the article	88	62	247	397
06.	Elimination of false positives	19	18	13	50
07.	Forward and backward citations	–	–	–	62

Appendix 4

Table 06

Detailed literature sampling procedure.

Total sample of Business Source Complete, Web of Science, ABI/ INFORM Global	466
Duplicates	(59)
Absence of key words in the full body of the article	(10)
Different scientific topic – thematic focus	(215)
Smart growth (e.g., urban regeneration)	(20)
Strategies (e.g., smart specialization approach)	(19)
Citizenry & civic behavior (e.g., senior citizens' habits)	(17)
Development & economy (e.g., national economic impacts)	(16)
Regional or territorial focus (e.g., urban sprawl)	(15)
Definition (e.g., conceptualizations of smart cities, regions or nations)	(14)
Privacy, safety & security (e.g., crime prevention)	(14)
Corporations (e.g., business models, management aspects)	(13)
Governance (e.g., governance referring to markets or supranational institutions)	(11)
e-Government (e.g., websites or social media concepts)	(11)

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Table 06 (continued)

Total sample of Business Source Complete, Web of Science, ABI/ INFORM Global	466
Services (e.g., focus on typology or provisions)	(10)
Innovation & entrepreneurship (e.g., role of universities or ecosystems)	(10)
Regulation (e.g., regulatory initiatives in the consumer industry)	(7)
Financing & funding (e.g., pricing systems or financial feasibility)	(5)
Other context of search items (e.g., ethics, civil rights, supply chain mgmt.)	(33)
Different scientific topic – technical focus	(55)
Technology & product (e.g., data visualization or sensing technology)	(26)
Application (e.g., interactional decision support applications)	(20)
Analytics & computation (e.g., social data mining or cloud computing tool)	(9)
Sector specific research (e.g., energy, transportation, healthcare, water)	(40)
No full article (e.g., introduction, book review, foreword, editorial)	(37)
Additional sources (forward and backward citations)	12
Relevant sample	62

Appendix 5

Table 07

Reviewed studies on smart city governance, sorted by year of publication.

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
01 Odendaal (2003)*	Qualitative	Australia & Oceania (AU), Africa (ZA)	Components, contextual factors, outcomes	<ol style="list-style-type: none"> 1) Compares SC initiatives in Brisbane (AU) with Durban (ZA). Provides conceptual landscape to determine extent of helpfulness of ICT in local government 2) Describes stakeholder, process, roles & responsibility aspects of governance with an emphasis on technology. Highlights potential contextual factors
02 Giffinger et al. (2007)*	Quantitative	Europe	Components, measurements	<ol style="list-style-type: none"> 1) Defines ‘smart city’ concept and ranks medium-sized European cities accordingly, considering a broad range of various factors and indicators 2) Delineates SG as political participation, services for citizens and functioning of the administration. Develops an indicator-based measurement system
03 Hollands (2008)*	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Discusses SC concept through an analysis of various examples with primary focus on the labeling process. Differentiates SC term from other concepts 2) Describes increasing stakeholder access to SCG, highlights developing link between technology and the changing role and function of governance in SCs
04 Johnston (2010)	Theoretical	–	Components, outcomes	<ol style="list-style-type: none"> 1) Discusses how to use the interaction of technology and society to design participation-based governance infrastructure in order to redistribute power authority 2) Defines governance infrastructures as interactive collection of technologies, systems, people, policies and relationships to support governance activities
05 Bătăgan (2011)	Theoretical	–	Components, outcomes	<ol style="list-style-type: none"> 1) Analyzes importance of smart systems on quality of life and sustainability. Identifies key elements of future SCs 2) Formulates general need to improve collaboration across departments as well as with communities. Describes potential results of a smarter government
06 Caragliu et al. (2011)*	Quantitative	Europe	Components	<ol style="list-style-type: none"> 1) Defines operational SC concept and uses statistical/graphical methods to analyze and state factors (e.g., education, ICTs) determining SC performance 2) Highlights participatory aspect of SC governance
07 Nam and Pardo (2011a)*	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Identifies multi-dimensional components under-lying SC concept (technology, people, institutions) and core factors for successful SC initiatives 2) Highlights stakeholder, technology (‘IT-mediated governance’), policy and participatory aspects of governance

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
08 Batty et al. (2012)	Theoretical	–	Components, contextual factors, outcomes	<ol style="list-style-type: none"> 1) Delineates SCs, sketches vision and describes research challenges. Defines SC scenarios, suggests further research areas and anticipates paradigm shifts 2) Views multi-stakeholder participation and ICT as key components of SCG and accentuates potential economic, social, privacy and security outcomes
09 Chourabi et al. (2012)*	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Proposes framework to understand the concept of SCs. Identifies eight critical factors of SC initiatives (e.g., mgmt. & organization, technology, governance) 2) Defines SG (ICT-based governance) as interactive collection of technology, people, policies, practices, resources, social norms and information
10 Gil-Garcia (2012)*	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Discusses challenges, trends and feasibility of inter-organizational collaboration and information technologies in government settings ('smart State') 2) Highlights SG's technology usage to interconnect information, processes, institutions and infrastructure as well as for the participation of various social actors
11 Kourtit et al. (2012)	Qualitative	Europe (UK)	Components, outcomes	<ol style="list-style-type: none"> 1) Compares SCs via selected 'smartness' performance indicators. Results show that most cities became more similar with the exception of a few outliers 2) Perceives SCs as geographical hubs of networked space-economy. Calls for pro-active governance structures, a prerequisite to achieve SC performance
12 Lombardi et al. (2012)	Theoretical	Europe	Components, measurements	<ol style="list-style-type: none"> 1) Investigates interrelations between SC components and triple helix model (TH). Uses analytic network process/TH to create SC performance measurement 2) Highlights participatory aspect of citizens in governance of cities. Defines SG measurement criteria and performance indicators (behavior- & results- oriented)
13 Schuurman et al. (2012)	Quantitative	Europe (BE)	Components	<ol style="list-style-type: none"> 1) Investigates crowdsourcing for idea generation and idea selection in an SC innovation context. Results prove crowdsourcing's usefulness in various situations 2) Highlights importance of data and information collection by sensors and sensor networks
14 Tranos and Gertner (2012)	Theoretical	–	Components, outcomes	<ol style="list-style-type: none"> 1) Assesses lack of global inter-urban perspective in SC policy framework. Argues that SC policy agenda should address structure of transnation. Urban networks 2) Characterizes governance as tool to improve structures, processes and practices, to fulfill social inclusion agenda and to provide government services
15 Walravens (2012)	Theoretical, qualitative	Americas (US)	Components, contextual factors	<ol style="list-style-type: none"> 1) Expands existing business model framework (FR) to allow analysis of value networks for mobile services. Analyzes FR with case study and examines usability 2) Describes governance elements that are related to the relationships between public and private entities (e.g., participation, decision-making process)
16 AlAwadhi and Scholl (2013)*	Qualitative	Americas (US)	Components	<ol style="list-style-type: none"> 1) Compares and finds differences of SC definition from literature with view of SC officials. Highlights that SC projects (Seattle) match practitioner definition 2) Considers governance as stakeholder involvement in SC initiatives. Argues that exchange arrangements might range from hierarchical to network approaches
17 Bakici et al. (2013)	Qualitative	Europe (ES)	Components	<ol style="list-style-type: none"> 1) Evaluates Barcelona's city transformation in SC management areas (drivers, bottlenecks, conditions, assets). Results indicate positive impact of SC strategy 2) Describes purpose of 'open data' SG initiative - to get better access to government information

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
18 Komninos and Tsarchopoulos (2013)	Qualitative	Europe (GR)	Components	<ol style="list-style-type: none"> 1) Examines case study's state of dev't. of technology infrastructure, strategy and bottlenecks. States need for new orientation of urban governance to address gaps 2) Highlights governance implications of technology infrastructure development
19 Zygiaris (2013)	Theoretical, qualitative	Europe	Components	<ol style="list-style-type: none"> 1) 1) Examines SCs 'smartness' aspects addressing mix of planning priorities into 'layer' reference model. Suggests holistic conception in building SC vision 2) Mentions soft governance in stakeholder processes
20 Angelidou (2014)	Qualitative	–	Components	<ol style="list-style-type: none"> 1) Identifies four strategic choices of policies with spatial reference for the development of SCs. Presents advantages and disadvantages and illustrates examples 2) Describes participatory aspects of SG with regards to citizens
21 Cano et al. (2014)	Qualitative	Europe (ES)	Components	<ol style="list-style-type: none"> 1) Discusses architectural modules based on dual citizen and government participation platforms. Suggests platforms as way to scale services/exchanges 2) Delineates SG as multiple stakeholder endeavor with strong ICT-based public participation and public-private collaboration
22 Kitchin (2014)	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Details instrumentation of cities with digital devices and infrastructure that produce 'big data'. Provides critical reflection on potential 'big data' implication 2) Highlights data implications on new adaptive modes of governance and management and sees potential for more efficient, sustainable and transparent cities
23 Kourtit et al. (2014)	Theoretical	–	Components, measurements, outcomes	<ol style="list-style-type: none"> 1) Proposes 'urban piazza' framework to establish identifiable quantitative benchmarks in order to address inefficiencies related to current urban analyses 2) Highlights stakeholder and structural features to create new governance blueprint. Describes socio-economic and ecological performance maximization
24 Albino et al. (2015)*	Theoretical	–	Components, outcomes	<ol style="list-style-type: none"> 1) Clarifies SC concept and identifies main dimensions and elements characterizing SCs. Reviews different metrics of urban smartness and performance measures 2) Defines SG as stakeholder engagement in decision making/public services. Highlights fundamental character of ICT-mediated governance for transparency
25 Bolívar (2016)*	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Discusses role of governments in SCs/SCG. Highlights importance of engagement of government and citizens, argues role of government not to be seen only as producing but also as SC organizing/managing 2) Describes unsatisfactory status quo of SCG in most cities. Highlights importance of relational networks of actors in order to constitute urban governance
26 Capdevila and Zarlenga (2015)	Qualitative	Europe (ES)	Components	<ol style="list-style-type: none"> 1) Analyzes top-down and bottom-up initiative dynamics in SCs. Suggests complementary of both types and indicates potential synergistic effects 2) Highlights importance of transparent SG that includes participation of various agents (e.g., citizens, firms, etc.) to communicate and connect effectively
27 Dameri and Ricciardi (2015)	Qualitative	Europe	Components	<ol style="list-style-type: none"> 1. Examines SC phenomenon with intellectual capital (IC) approach. Results suggest to extend IC framework by outcomes, resources, unit of analysis and challenges 2. Describes two types of organizational entities that govern SCs: <ol style="list-style-type: none"> 1) inter-organizational agreements/joint-ventures or 2) more fluid and informal relationships

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
28 Gil-Garcia et al. (2015)	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Conceptualizes main components and several specific elements of SCs. Provides policy implications 2) Defines governance as structures (collaboration, partnerships, networks) that include wide range of different stakeholders, involved in several activities
29 Kim (2015)	Qualitative	Asia (KR)	Components	<ol style="list-style-type: none"> 1) Investigates implementation process of SCs based on case study. Results show that poorly-managed conflicts during implementation diminish SC potential 2) Describes SCs positive impact on urban governance systems (e.g., interconnected, interactive) and high-lights transactional relationships between stakeholders
30 Lin et al. (2015)	Qualitative	Asia (China)	Components, outcomes	<ol style="list-style-type: none"> 1) Analyses modes of governance in the regeneration of Chinese migrant communities and develops framework on SG and social sustainability 2) Highlights lack of balanced relationship among three key actors: state, market, society. Describes importance of engagement methods for stakeholders
31 Popescu (2015)	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Discusses various concepts of SCs, factors related to SC interventions and altering forms of governance approaches of SCs 2) Describes how SG requires diverse set of stake-holders being involved in decision making and public services
32 Shelton et al. (2015)	Qualitative	Americas (US)	Components	<ol style="list-style-type: none"> 1) Examines material effects of SC policies in existing cities. Critiques SC rhetoric of companies but stresses possibilities opened up by data-driven governance 2) Emphasizes importance of data, inter-organizational partnerships/alliances and extra-territorial networks of key actors/institutions within data-driven governance
33 Almirall et al. (2016)	Qualitative	–	Components	<ol style="list-style-type: none"> 1) Summarizes insights from panel of experts on governance models, growth considerations and sharing economy regarding SCs 2) Describes emerging forms of mgmt. explored in SC context. Highlights importance of stakeholders and legal frameworks for urban transformations
34 Battarra et al. (2016)	Qualitative, quantitative	Europe (IT)	Components, measurements, outcomes	<ol style="list-style-type: none"> 1) Analyzes different uses of technologies for improving urban planning. Highlights necessity of citizen and institutional networks to improve smartness 2) Highlights certain elements (open data, sensors, connections) for proper system of governance to facilitate real urban change
35 Van Den Bergh and Viaene (2016)	Qualitative	Europe (BE)	Components	<ol style="list-style-type: none"> 1) Investigates city's ability to manage its internal organization to become smart. Describes key challenges for SC realization & need for mgmt. Leadership 2) Defines governance as the way cities organize internally and over the city admin. boundaries. High-lights citizen involvem. & public-private partnerships
36 Bifulco et al. (2016)	Qualitative	Europe	Components, outcomes	<ol style="list-style-type: none"> 1) Examines relation between SC features (Giffinger) with technologies as tools and sustainability as goal. Concludes that both can enable smartization process 2) Highlights technology (ICT) and stakeholder features as well as the social dimension of sustainability (as potential goal) in relation to governance
37 Bolívar (2016)*	Theoretical, qualitative	Europe	Components	<ol style="list-style-type: none"> 1) Analyzes relevance of mains dimensions of SC governance models. Results show that dimensions mainly drawn from empirical experience than theory 2) Stresses managerial feature of organizing collaboration among stakeholders, network characteristics and special role of government with regards to SG

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
38 Bolivar and Meijer (2016)	Theoretical, quantitative	Europe	Components, contextual factors, outcomes	<ol style="list-style-type: none"> 1) Develops research SCG model consisting of elements, outcomes and implementation strategies. Emphasizes importance of additional innovation capacity 2) Conceptualizes model of SG including strategies (ideas, actions), arrangement (org. processes, use of techn., innovation cap.) and outcomes (1st, 2nd, 3rd)
39 Bull and Azennoud (2016)	Qualitative	Europe (GB)	Components	<ol style="list-style-type: none"> 1) Highlights role of citizens and user engagement for co-creation of knowledge, collaboration and empowerment. Provides insights on how to engage citizens 2) Describes new governance style that enables integration of all stakeholders in the decision-making process
40 Castelnovo et al. (2016)	Theoretical	–	Components, measurements, outcomes	<ol style="list-style-type: none"> 1) Discusses importance of holistic approach for assessment of SCG. Develops performance assessment framework consisting of five dimensions 2) Provides guidance on how to assess SCG dimensions. Focuses on co-design and coproduction by stakeholders and social innovation processes
41 Chatfield and Reddick (2016)	Qualitative	Asia (JP)	Components, outcomes	<ol style="list-style-type: none"> 1) Identifies antecedent conditions for implementing SCs. Develops citizen-centric social governance framework. Highlights shared vision for sustainability 2) Conceptualizes citizen-centric social governance framework. Highlights importance of shared vision by stakeholders and use of informal govern. mechanisms
42 de Wijs et al. (2016)	Qualitative	Europe (NL)	Components, outcomes	<ol style="list-style-type: none"> 1) Analyzes conceptual congruence between theory and practice in SCs through case studies. Results show lack of practical implementation of SC concepts 2) Describes multi-faceted, diverging interests and varied responsibilities of the different stakeholders involved in SCG
43 Dameri and Benevolo (2016)	Quantitative	Europe (IT)	Components, outcomes	<ol style="list-style-type: none"> 1) Examines government roles/structures implemented in SCs. Observes limited political involvem. in SCs although engagement of institutions appears important 2) Maps involvement of political elements in governing SCs. Identifies SCG labels: actors, government, leadership, participatory govern., partnership
44 Dimelli (2016)	Qualitative	Europe (ES, IE, GR, Asia (JP))	Components, outcomes	<ol style="list-style-type: none"> 1) Examines possibilities of the adoption of global ICT practices in Greek cities through European and Asian case studies 2) Conceptualizes SG by means of processes, usages of technologies and service delivery. States behavior-related positive consequences
45 Fernández-Güell et al. (2016)	Qualitative	Europe (ES)	Components, outcomes	<ol style="list-style-type: none"> 1) Displays urban functional system to interpret SCs in holistic way. Incorporates foresight tools to formulate SC visions with the involvement of local stakeholders 2) Describes advanced govern. as critical for cities of the future. Highlights increasing involvement of stakeholders and innovative urban policies by political class
46 Granier and Kudo (2016)	Qualitative	Asia (JP)	Components	<ol style="list-style-type: none"> 1) Investigates citizen participation. Suggests that municipalities/utilities use concentrated intelligence type of SCG (technology usage to steer stakeholders) 2) Highlights participatory character of SCG. Shows two ideal-type models (technologies for concentrated and for distributed intelligence)
47 Kitchin (2016)	Theoretical	–	Components	<ol style="list-style-type: none"> 1) Examines forms, practices and ethics of SCs. Argues SC initiatives need to be recast (re-orientation how to conceive cities, reconfiguring of epistemology) 2) Describes potential new form of responsive urban govern. in which big data systems set urban agenda. Illustrates disadvantages of such data-driven urbanism

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
48 Klimovsky et al. (2016)	Qualitative	Europe (SK, SI)	Components	1) Analyzes citizens' willingness to introduce new form of relationship with SCs. Results show people's reluctance to use technology above level of their needs 2) Highlights participatory character of SCG
49 Leszczynski (2016)	Theoretical	–	Components	1) Examines relationships between data, cities, and governance in an urban algorithmic governance future-ing discourse 2) Describes increasing interwoven character of urban content (big data), algorithms, and governance in data-security 'assemblage'
50 Marsal-Llacuna (2016)	Theoretical	Europe (ES)	Components, measurements, outcomes	1) Proposes mechanism to account for social pillar of sustainability by measuring citizen-centeredness of govern./policies. Highlights potential positive impacts 2) Introduces city indicators on social sustainability as standardization technologies for smarter governance of cities
51 Meijer (2016)*	Theoretical	–	Components, measurements, contextual factors, outcomes	1) Presents 'local cooperative knowledge potential' and 'nature of the problem domain' as key contextual factors. Develops model to assess SCG in context 2) Argues that effectiveness of techno-governance arrangements depends on situational factors. High-lights non-existence of SCG one-size-fits-all approach
52 Meijer and Bolivar (2016)	Theoretical	–	Components, outcomes	1) Analyzes SCG publications and finds different em-phases (technology, people, collaboration), per-spectives on SCG changes, and outcome/process foci 2) Argues for comprehensive SCG perspective where SCG crafts new forms of human collaboration through use of ICTs to obtain better outcomes and processes
53 Meijer et al. (2016)	Theoretical	–	Components, contextual factors, outcomes	1) Discusses contextual conditions, governance models and assessment of public value in SC context. Highlights importance of customized SC approaches 2) Mentions various SCG components (e.g., technology) and raises questions regarding multilevel, socio-technical and public value aspects of SCG
54 Paulin (2016)	Theoretical	–	Components, outcomes	1) Discusses SCG 'atomic' factors with focus on infor-matability. Argues that factors cannot be directly infor-mated, but indication for indirect infor-matability exists 2) Highlights decision-making, dispute resolution, empowerment of authority in SCG. Sees utilization of technology to increase SCG quality, transparency, etc.
55 Scholl and AlAwadhi (2016a)	Qualitative	Europe (DE)	Components, contextual factors	1) Investigates overhaul of municipal government ICT infrastructure/governance model. Highlights impor-tance of top mgmt. support, PM's capabilities, etc. 2) Defines SG as the capacity of employing intelligent and adaptive acts and activities for monitoring and decision-making purposes
56 Scholl and AlAwadhi (2016b)	Qualitative	Americas (US)	Components, contextual factors	1) Investigates opportunities/pitfalls of an inter-city governance model. Concludes that example can serve as role model for multi-jurisdictional SC initiatives 2) Highlights power sharing, coordination and various pattern of decision-making features for governance model of multi-jurisdictional SC-initiative
57 Wiig (2016)	Qualitative	Americas (US)	Components	1) Explores how SC policies folds into entrepreneurial governance strategies. Argues change rhetoric pro-duces external perception rather than addresses issues 2) Defines SCG as integration of bldgs., neighbor-hoods, digital-urban infrastructures, city government, citizen activities with data analysis to solve issues

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Table 07 (continued)

Study	Research method	Geographical focus	Covered SCG categories	1) Content of study and 2) main statements/findings on SCG
58 Bifulco et al. (2017)	Qualitative	Europe (NL, ES, FI)	Components	<ol style="list-style-type: none"> Examines relevance of participative governance in areas implementing Living Labs (LL) initiatives. Results show increasing SC usefulness of LLs Defines SCG as set of principles to guide activities that emerge from multi-actor collaboration and as both connector and collector of actors and resources
59 Kourtiti et al. (2017)	Theoretical	–	Components	<ol style="list-style-type: none"> Highlights data/info. needs for strategic planning of cities, describes new decision support tools, and illustrates potential of digital data systems for urban mgmt. Depicts institutional/govern. aspects of big digital data mgmt. Stresses importance of citizen participation and role of city governments within urban network
60 Marek et al. (2017)	Qualitative	Australia & Oceania (AU)	Components, outcomes	<ol style="list-style-type: none"> Describes implementation experiences of new technologies in post-disaster environment. Examines problems arising from top-down technocratic solutions Defines SCs as urban center where smart technologies drive effective governance through the engagement of citizens
61 Pereira et al. (2017)	Qualitative	Americas (BR)	Components	<ol style="list-style-type: none"> Proposes conceptual model to analyze SC initiatives related to open data (OD). Results show that OD initiatives contribute to enhance delivery of public value Describes SG as mgmt. function contributing to SCs
62 Taylor Buck and While (2017)	Qualitative	Europe (UK)	Components, contextual factors	<ol style="list-style-type: none"> Analyzes initiatives to facilitate urban technological innovation. Findings show existing tensions about conjunctural nature of SC debate Highlights practical/conceptual challenges of translating smart urbanism into tangible govern. object. Stresses difficulties cities face reshaping urb. hardware

* Studies added to the review sample via forward/backward tracing (not restricted to peer-reviewed journals).

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