

Understanding Electronic Government Research and Smart City:

A Framework and Empirical Evidence

Leonidas G. Anthopoulos¹

Associate Professor

Department of Business Administration

TEI of Thessaly, 41110 Larissa, Greece

lanthopo@teilar.gr

Christopher G. Reddick

Professor and Department Chair

Department of Public Administration

The University of Texas at San Antonio

San Antonio, Texas 78260, USA

chris.reddick@utsa.edu

Abstract

Smart cities have been evolving since their early appearance in late 1990s from metropolitan-wide Information and Communication Technology (ICT) based solutions to today's innovations –not necessarily based on ICT- that utilize city resources and improve local everyday life. This paper attempts to answer two research questions: (a) Does e-

¹ Corresponding author

government research provide the appropriate theoretical capacity consisting of terms and frameworks that define smart city? and (b) Is e-government research evolution able to provide the appropriate theoretical capacity to deal with smart city challenges? To answer these two research questions this paper follows a multi-methods approach comprising of (a) retrospective literature review (27 interdisciplinary journals, from 1997-2015 that publish smart city works are examined with regard to e-government and smart city) and define the key-areas of study (i.e., e-government in smart city etc.); and (b) prospective Delphi study (involving 16 experts in both e-government and smart city domains from prestigious universities, organizations, and cities across the globe), which identify action areas (i.e., livability and co-design) and measures for future e-government research contribution to the smart city. The results of this study shed light on existing gaps, interrelations, and reciprocities between e-government research and smart city and define an agenda for future research.

Keywords: smart city, e-government, information and communications technology (ICT); Delphi; urbanism

1. Introduction

The smart city originally appeared in late 1990s [54; 84] and has emerged radically since then, but it is still a confusing term with regard to its meaning and context [5]. More specifically, its definition ranges [6] from metropolitan-wide information and communications technology (ICT)-based environments; to various ICT adjectives that describe a city; to the “smartness footprint” of a city, which is measured with capacity

indexes (people, economy, living, environment, mobility and governance); and recently to innovative solutions –not limited to but mainly based on the ICT- that improve urban everyday life and enhance local sustainability.

National and international organizations (i.e., the European Union and its Standardization Institute (CEN-CENELEC); the United Nations (UN) with the UN Habitat and the International Telecommunications Union (ITU); United States Federal Government with National Institute of Standards and Technology (NIST); and British Government with British Institute of Standards (BSI)) are stressed to develop standards for smart sustainable cities and communities. On the other hand, big vendors from the ICT industry [6] (i.e., CISCO, IBM, and Alcatel); electronics (i.e., Hitachi and Fujitsu); energy (Siemens and Schneider); and construction industries (i.e., GALE, POSCO, and HGC Group) struggle to develop and deploy respective solutions -ranging from smart energy grids and smart buildings to end-to-end city intelligence systems- to conquer this emerging market. This novel smart city market is expected to exceed US\$3 trillion by 2020 according to UK Minister David Willetts keynote speech at Ovum Smart to Future Cities event that took place in London in April 2014.

This paper recognizes that smart city research is interdisciplinary. This paper more specifically focuses on the role of e-government in the smart city. Governance concerns one of the six smart city capacity indexes [51] (people, economy, living, environment, mobility and governance) and smart services comprise an important local e-government function. Smart cities can be considered as a means for governments to enhance public service delivery and democracy in urban spaces, as well as facilities to utilize energy, waste and resource management across the nation. Moreover, smart cities are mainly the outcome of government initiatives [6], for which the private sector develops solutions. As such, smart

cities appear to grow under the supervision of the state (municipalities and local governments) and they operate either as public organizations, state-owned-enterprises (SOE), public-private-partnerships (PPP) or project coalitions. According to the above reasons, e-government can be considered part of the innovative solutions that are being offered locally, but it is not clear whether it can deal with recent and future smart city challenges (i.e., urban sustainable growth). In this regard, this paper is inspired by [95], however, in this study we provide a connection between e-government and smart cities [4]. In order to provide connections between e-government and smart city, this paper aims to answer the following two retrospective and prospective research questions:

- a) **RQ1:** *Does e-government research provide the appropriate theoretical capacity consisting of terms and frameworks that define smart city? (Retrospective)*
- b) **RQ2:** *Is e-government research evolution able to provide the appropriate theoretical capacity to deal with smart city challenges? (Prospective)*

Answering the above two research questions is critical, since smart city is still an ill-defined concept, while its challenges are evolving and to this end the contribution of the appropriate theoretical capacity by e-government research is important to know.

In an attempt to answer the above questions, this paper follows a multi-methods approach comprising of (a) retrospective literature review (publications in 6 e-government journals and 21 interdisciplinary journals between 1997-2015) with regard to e-government and smart city and define the key-areas of study (i.e., e-government in smart city etc.) and (b) prospective Delphi study involving 16 experts in both e-government and smart city domains from important smart city stakeholders, which identifies action areas (i.e., livability and co-design etc.) and measures for future e-government research contributions to the smart city.

This literature review provides the framework establishing the connection between e-government and smart cities answering RQ1. From this framework, data is generated and tested with experts using Delphi study answering RQ2.

The remainder of this paper is organized as follows: section 2 examines the relevant literature on e-government and smart cities; this section provides the theoretical framework and answers retrospective RQ1. Section 3 contains the research methodology that answers the prospective research question RQ2. Section 4 discusses our major findings from both literature review and Delphi study. Finally, section 5 presents our conclusions and future research suggestions are discussed.

2. Literature Review

The first research method that was followed in this paper is a literature review. This is used to identify the existing theoretical capacity that e-government provides for smart city in order to answer RQ1. This process was complicated, since the smart city domain is broad, evolving and complex, while existing literature review research on smart city and e-government were not found. More specifically, smart city initially appeared in the literature in 1997 [54] and many attempts at understanding it can be located since then (i.e., [5; 24; 93]). Moreover, various scholars give alternative definitions of smart city, ranging from ICT attributes in the city (i.e., digital, broadband, wireless, etc.) that describe various ICT solutions in the urban space and prioritized differently across the globe [5]; to the “smartness footprint” in an agglomeration area, which is measured with various indexes [51]; to information flows across the urban space [120]; and to large-scale living labs. With this respect, the smart city can be viewed broadly and concerns interdisciplinary studies [4; 5] such as, ICT; urban planning and growth; living labs as large-scale testing beds; city and

corresponding ecological aspects; and creative industry in a city. All the above scientific areas appear to overlap in a smart city and result in a broad and complex domain of research.

Taking into account the above complexities, the literature search strategy was defined carefully. This literature study requires defining (a) the *domain* (the disciplinary field(s) in which the literature search is conducted), (b) the *sources* (publication outlets from that domain to be included in the search), and (c) the *search strategy* (search terms applied in order to extract relevant articles).

a) *Domain*: This paper's objective is to examine e-government research with regard to smart city. In this respect, e-government can be defined as the utilization of ICT by governments in order to improve public service delivery, simplifying citizens' access to government and transforming itself to become more accountable and transparent. On the other hand, a smart city has been defined with alternative approaches and means, which can be summarized as innovative (not necessarily but mainly ICT-based) solutions, which enhance urban living. There were no preconceived expectations concerning the outcomes from the literature review method used. The authors wanted to explore existing frameworks and theories of e-government with regard to smart city and confirm these findings with experts' opinions using a Delphi study. This would also enable experts to propose additional theoretical ideas. This process was long and incremental. It started in January 2012 and the outcomes were updated before each interview with experts until January 2015. Moreover, most interviews during the first Delphi round were performed during 2014, when almost all literature review findings were collected. The second Delphi round requested from all participants that they express their opinions on all past findings.

b) *Sources*: Following the above definitions, as primary sources for this literature review, the following classes of publication outlets were selected: first, major e-government journals [95]; and second, journals that have been identified to publish smart city research [4]. In order to reflect on the smart city evolution and corresponding e-government literature, authors focused on the time period from smart city's initial appearance in the literature, which goes back to 1997 until 2015. Journal selection was based on editorial policy conformity with e-government and smart city, as well as the criteria that they publish currently (2015) and have a high level of scholarly recognition [95]. To this end, the first class of top ranked six e-Government journals contains *Government Information Quarterly* (GIQ); the *International Journal of Electronic Government Research* (IJEGR); *Information Polity* (IP); *Public Administration Review* (PAR); *Transforming Government: People, Process, Policy, e-Government: An International Journal* (TG), and the *Electronic Journal of e-Government* (eJEG). This list of e-government journals was located earlier to the publication of [108], which confirmed the importance of the above 5 journals. Only the *Journal of Technology and Politics* (JITP) (or *Journal of e-Government* until 2007) and *Electronic Government, an International Journal* (EGIJ) were left out from this study. However, examining these journals early in 2015 for smart city articles –with the same search strategy as it is described below- returned only one relevant article, which was written by the authors of this paper in 2006.

The second class, of top ranked journals that publish ICT-related smart city articles contain 21 journals selected from [4] according to the same above criteria, which are called for the purposes of this article “smart city journals”. However, these journals publish interdisciplinary works, covering research in urban technologies, ICT and management, as

well as general ICT issues. This class contains *Communications of the ACM; Cities; Pervasive and Mobile Computing; Journal of Urban Technology; Environment and Planning; City; Environment and urbanization; Applied Geography; Information and Management; Expert Systems with Applications; Sustainable Cities and Society; IEEE Internet Computing; Behaviour and Information Technology; Journal of The Association For Information Science and Technology; Technological Forecasting & Social Change; Future Generation Computer Systems; Environmental Modelling & Software; Applied Energy; and Habitat International*. Due to the publications' timeline's length (1997 to 2015), the large size of the examined journals (26) and of the screened articles' number, authors did not examine research from conference proceedings and book chapters. Although these highly ranked conferences and chapters would provide good quality research, we wanted to limit our scope to just academic journal articles as prior research has done. The overall literature review process is outlined in (Fig. 1).

[FIGURE 1 GOES ABOUT HERE]

c) *Search Strategy*: As for the smart city articles published in specific e-government journals, their title, abstract, keywords, and, where possible, full text were scanned for "smart city" related search terms and more specifically for the eight smart city classification groups identified by [6]: "Smart city", "Digital city", "Virtual city", "information city", "Knowledge based city", "Broadband City", "Broadband Metropolis", "Wireless city", "Mobile City", "ubiquitous city", and "Eco-city". This literature review process started in January 2012 (before the first interview with experts) and it was updated before each interview until January 2015. The final search period for the journal articles confirmed the results and was

done between December 2014 and January 2015. From the resulting batch of articles, duplicates and papers irrelevant to this study were excluded manually.

[TABLE 1 GOES ABOUT HERE]

Articles, which focus on smart government, [52] in terms of innovation in public administration, as well as on e-government practices, which were tested in cities were excluded from the analysis. Results illustrate that the interest by e-government research in smart city grows slowly and expands rapidly in 2014 (Fig. 2).

A set of 20 articles was discovered, with GIQ and IJEGR leading the “race” and IP without returning any relevant result. From the analysis, we identified the following five areas of study regarding smart city:

- a) **E-Government role in smart city:** scholars conclude that e-government is part of a broader smart city context and concerns local government transformation to a modern ICT-based one [52; 77; 93], as well as the improvement of local government efficiency [9; 21; 99].
- b) **Local government policy-making:** articles demonstrate smart city tools, which enable urban governance and city management [9; 21; 65].

[FIGURE 2 GOES ABOUT HERE]

- c) **Government ICT and smart city:** researchers discuss the role of government ICT investments contribution to smart city development [63], which in return result to smart governance systems. Moreover, the role of government in developing new city forms such as wireless cities is demonstrated [48; 107; 121].

- d) Government challenges in smart cities:** novel and unexplored government challenges are questioned by scholars and concern big data, open data and crowd-sourcing [83], as well as “city smart-competition” [5; 6] and “climate change impact in urban spaces” [114; 115; 119] that has to be handled by local governments.
- e) Engaging local community:** issues such as digital citizenship [88; 91; 104] and social capital engagement in policy and decision making at local level are identified [90], because cities are considered the forefront of e-government adoption.

[FIGURE 3 GOES ABOUT HERE]

As for the articles published in the second class of journals, their title, abstract and keywords were scanned for “government” as well as “public sector” combined with the term “smart city” and then underwent the same analytical procedure mentioned above. From the resulting set of articles, screening excluded papers irrelevant to the ICT.

Tables 2 and 3 contain an overview of the literature search results. The set of articles retrieved from the e-government journals was unexpectedly short, compared to the fact that the term smart city appears in almost all e-government calls for papers in prestigious e-government conferences (with special tracks and workshops) and the emerging size of corresponding journal special issues. On the contrary, the search in smart city journals returned 109 articles as e-Government research, which matches the previously defined emerging topics and issues (Table 3). Findings from this research illustrate that interest in smart city with journals of class 2 over time have expanded (Fig. 3).

Table 3 data shows matches between the research in these two domains, however, some differences appear. For instance, an unexpected finding demonstrates that journals from class 2 define more issues about e-government in smart city than the corresponding articles

from class 1. Furthermore, some of the same issues appear to have different topics between the two domains. E-government adoption for instance is examined in topic 1 from class 2 (e-government in smart city) and in topic 5 from class 1 (engaging local community), which is to be expected, since citizen engagement in smart city addresses various urban issues instead of adoption alone.

- a) **E-government role in smart city:** scholars identify the potential of e-government to enhance local administration in terms of bureaucratic elimination, paperwork reduction, efficiency and transparency, [2; 41; 42; 72; 80; 94; 126]; standardized and interoperable services supporting crime protection, safety and security initiatives of socially-inclusive and participatory urban regeneration programs; digital services with regard to natural resources and energy, transport and mobility, buildings, living, government, economy, and people [23; 30; 36; 45; 54; 89; 92; 113; 117; 123]; e-government adoption [29; 47; 64]; e-government for value creation [76], service quality [35; 73; 101] and viability [103].
- b) **Local government policy making:** articles demonstrate the contribution of ICT to enhance local government policy making regarding local challenges such as city retrofitting, local economic development, urban planning and sprawl management. ICT solutions in this spectrum include Geographic Information Systems (GIS), urban informatics, and knowledge utilization for urban management [3; 11; 12; 32; 34; 37; 39; 43; 49; 56; 57; 74; 81; 84; 97; 112; 116; 118; 129].

[TABLE 2 GOES ABOUT HERE]

[TABLE 3 GOES ABOUT HERE]

- c) **Government ICT and the smart city:** corresponding works illustrate the role of government ICT and of public ICT investments for enabling a smart city [18; 79; 118] enhancing urban characteristics, improve livability and city competition [1; 58; 59; 60; 85; 87; 98; 105; 109; 111; 114; 115; 127; 128]. Moreover, means that increase smart city management [10; 125] and the formulation of information, intelligent and wireless cities is analyzed [40; 44; 50; 27; 119; 132] as well as the transformation of a city to a product for export [70; 107; 111].
- d) **Government challenges in smart cities:** scholars argue about the role of government in smart cities and the corresponding ICT solutions used to deal with these challenges. The recognized challenges include the city's future in terms of resilience, sustainability and response to climate change [7; 16; 17; 25; 31; 46; 66; 67; 68; 75; 78; 82; 100; 107; 112; 122; 124; 131; 132; 133; 134]; new ICT trends such as government big data [38; 55; 62; 69; 86]; crowd sourcing [14]; open data [8; 61]; and Internet-of-Things (IoT) [19].
- e) **Engaging local community:** corresponding articles in this area focus on government ICT solutions that support citizenship empowerment and engagement in smart cities, as well as enhancing local human capital and people knowledge [2; 22; 20; 28; 53; 96; 130] issues such as privacy [26; 102], security, and trust [13;15].

3. Research Methods

The literature review presented in the previous section was used to provide answers to the first research question (RQ1). In order to answer the second research question of this paper

(RQ2), regarding the potential of e-government research to deal with the emerging smart city topic, the Delphi method was applied as a prospective tool [95]. The research methods used in this paper have been successfully employed in past research [95; 106]. For instance, the literature review was broad and systematic, it lasted a long time and it explored diverse number of sources. Moreover, the sample of the smart city experts was not large (a fact that makes Delphi an optimal choice when having a small sample size) due to the complexity in locating experts and getting them to participate.

The potential of smart cities is seen through the framework developed from literature review and the five topics identified in Table 3. These five topics illustrate the interrelationship between e-government and smart city domains, which was explored by scholars between 1997 and 2015. The required prospective analysis aims to identify the potential of e-government theory to deal with future smart city challenges.

The underlying principle of the Delphi method is that group-based forecasts are considered to be more accurate compared to individual forecasts [95; 106]. The questions used in the interviews were taken from the previously discussed literature review. Topics of the literature review framework suggested areas of interest for the interviews, however, when themes were left out from the literature they were still investigated in the interviews (Fig. 4).

[FIGURE 4 GOES ABOUT HERE]

To this end, a group of experts was assembled early in 2012 for the purposes of the *Enterprise Architecture for Digital Cities (EADIC)* research project in Greece. All of the experts were approached during the first Delphi round with physical meetings over 3 years and interviewed with a structured questionnaire. The expert's names and affiliations were

kept confidential in order to get more candidate responses to the questions. This group consisted of 16 smart city experts, coming from universities, local governments, international organizations, standardization institutes and smart city industry. The identification process used the following criteria:

- a. Representing or being involved in important and highly ranked smart city projects that appeared somewhere in the literature review or in smart city networks (e.g., the European Smart Cities Innovation Network).
- b. Involved all potential smart city stakeholders in this process. To this end, local and national governments; international organizations; academia; industry; standard bodies; city facility providers; and smart city service providers [4] were investigated and identified. Citizens were not directly involved due to the need to interview smart city experts, as well as to the increased complexity that such involvement would add to the methodology (i.e., sufficient and homogenous samples from all the examined cases to be collected and studied). However, the representatives from the case of the City of Melbourne in Australia had performed an open and long-running consultation with the local community (design thinking process) and the outcomes from this process were utilized during the interview.
- c. In order to secure a positive response not all of the invited participants accepted the invitation from the beginning, while alternatives were invited. In some cases because of scheduling conflicts some meetings had to be arranged 12 months before the interview.

- d. In order to secure smart city experts' relevance with e-government the discussion agenda was communicated to the experts before each interview and various terms were explained before and during the interview.
- e. There was a collection of experiences and perspectives from all continents around the globe and from all types of cities (new and existing as well as big and small cities) and smart cities [5].

Each first round interview lasted about one hour and contained an open discussion, where experts expressed their opinions on the questions on a structure questionnaire. Questions were codified in order to collect as much information as possible against each topic and issue. The answers were decoded after the completion of the interview. Experts were generally familiar with important smart city cases and solutions around the world, or work on smart city disciplines for international organizations and companies (Table 4). The first interview contained a traditional Delphi round. When all interviews were completed, the second Delphi round was processed (early February 2015), and the same experts were invited and confirmed the first round's results, as Delphi suggests (Fig. 5). As a value for the process stop for this study we considered 66% agreement as the cutoff.

[TABLE 4 GOES ABOUT HERE]

[FIGURE 5 GOES ABOUT HERE]

3.1 Round 1

In order to define the future perspective of e-government and smart city, emerging outcomes in both disciplines were defined according to the findings from Table 3 and Fig. 4 and provided to the interview experts, who were asked to present their opinions on smart cities and e-government. Emerging issues in urban studies, which are addressed by smart

city were discussed in the literature review. These demonstrate increased interest in *livability; urban sustainability; resilience* in terms of resource availability and disaster response; *city management; city competitiveness* and *investment attractiveness*; and *urban planning and development* in terms of local government's efficiency and structure [33; 36; 71; 109].

[TABLE 5 GOES ABOUT HERE]

On the other hand, trends for e-government in the urban space emerged as well [36; 120]: *citizen participation and engagement with data utilization; co-design* in terms of collaborative efforts between citizens and public agencies; *digital neighborhood* in terms of citizen urban associations via social media; *third wave e-government*, which demonstrates the role of city demographics to e-government; *online information landscape of local events* and their roles in community participation and neighborhood activities.

These issues about smart city and e-government were utilized to structure a set of questions in a paper-based questionnaire and discussed with the experts (Table 5). Participants used a Likert scale (1: absolute disagreement to 5: total agreement), which describes the proportion of their agreement regarding the presented issue, while they could also propose additional topics or issues. Agreement to the questions among the experts was considered if they exceeded the trim mean value for each answer.

The introduced issues were grouped in two topics and emerged from the literature review framework (Fig. 4): *a) the role of government transformation in smart city; and b) the role of e-government trends in smart city challenges*. Smart city challenges during the interviewing period (2012-2015) were discovered and examined with previously illustrated literature findings (i.e., enhancement of city resilience, livability, management, competition). On the

other hand, e-government trends for the examined period were extracted from corresponding literature and authors' empirical findings. A few participants (6 out of 16) requested the discussion of the role of standardization for smart city (smart city standards) and e-government (interoperability and open data ontologies), due to the attention that standards institutes and international organizations play. These issues were incorporated for testing in issue B.6 for the topic B (Table 6).

3.2 Round 2

After compiling the results from round 1 (Table 6), a second structured questionnaire was administered using the same Likert scale (1: absolute disagreement to 5: total agreement). This was the final round of interviews since the stop value of 66% agreement was achieved for all the discussed issues [95].

[TABLE 6 GOES ABOUT HERE]

For the issues A.6 (Urban planning and development in terms of government efficiency), B.4 (Third wave e-government regarding urban demographics impact on e-government) and B.5 (Online information landscape of local events), these were all ranked as non-important by the experts. Moreover, as introduced by the experts the B.6 theme about standardization was ranked to be important. The range of agreement varied from the lowest at 69% (A.5, B.1, B.3 and B.5) to highest at 81% (A.2, A.4 and A.6). Excluding A.6 theme, both A.2 (Urban Sustainability) and A.4 (City Management) were found to be broadly discussed in literature review.

Upon completion of the written results from the expert panelists, a group comparative Chi-square test was computed for each statement which enables the identification of potential response differences (Table 6). The statistical analysis did not return significant differences

between the responses; this can be regarded as an indicator of a non-biased selection of panelists.

4. Discussion

Both the literature review and the Delphi study demonstrate that research on e-government effectively address challenges related to smart city during its initial appearance in late 1990s. This research found that primary studies (i.e., the ones that attempt to perform definitions and differentiations to urban innovation) could be considered a necessary precondition for further progress in this field. Additionally, future challenges need to be addressed, such as that of integrating e-government with smart city understanding and around the role of government ICT for urban challenges. There is the importance of theories, concepts, and models of e-government, urban studies and ICT research which could be applied through public adoption and engagement (see Fig. 6).

With regard to RQ1 and the existing theoretical capacity of e-government to define smart city, an extensive literature review in both domains between 1997 and early 2015 returned important references, which define a five-topic theoretical framework (Table 3). An important finding is that smart city research has developed more publications about e-government in smart city, compared to the number of articles from e-government journals. More specifically, existing research focuses on local administration enhancement and corresponding policy making; on the role of public ICT investments regarding urban challenges; recent e-government trends in the smart city (i.e., big and open data); and the ability to engage local communities in decision making for urban challenges. Findings also demonstrated that scholars have heightened interest in smart city mainly in 2014, which

generates expectations about the forthcoming period and the ability of e-government to deal with the rapidly evolved smart city industry.

[FIGURE 6 GOES ABOUT HERE]

Through the Delphi method, authors attempted to answer the prospective RQ2: *Is e-government research evolution able to provide the appropriate theoretical capacity to deal with smart city challenges?* The findings from the experts indicated strong agreement in the discussed topics and in most of the introduced issues. More specifically, only three issues were excluded as less important by the experts, who emphasized emerging urban trends (i.e., sustainability, resilience etc.) and the role of government and e-government (i.e., collaborative planning and standardization efforts). In general, a research agenda for e-government and smart city has been shown in this study (Fig. 6), where urbanism and corresponding challenges, accompanied by the emerging smart city industry offers important potential for e-Government research for the next decade and beyond.

5. Conclusions and Future Research

This paper addressed the interrelation between e-government and smart city. More specifically, it followed both a retrospective and prospective approach in an attempt to answer two research questions: *RQ1* regarding the e-government theoretical capacity to define smart city; and *RQ2* concerning e-government research and its ability to deal with emerging smart city challenges.

The retrospective literature review from late 1990s to 2015 provided answers to *RQ1* and confirmed that smart city is a radically emerging domain since its initial appearance in 1997. Many different sciences (such as ICT, construction, and electronics) study the smart city domain from different perspectives, while a much promising smart city industry emerges.

Literature review resulted in a five-topic theoretical framework, with which e-government defines and addresses past and current smart city challenges quite effectively, according to the 128 journal articles analyzed that ground this framework. Each of the framework's topic's analyzed in a set of issues (Table 3) and sufficient matches appeared between e-government and smart city research.

The prospective Delphi method questioned a panel of 16 smart city experts around the world in order to answer RQ2. Questions were grouped into two categories (Fig. 4), which define e-government evolution and its ability to deal with emerging smart city challenges. Participants' replies included and excluded themes from the introduced topics, and validated the ability of e-government to deal with smart city challenges and defined a future research agenda (Fig. 6).

Some limitations of this study should be mentioned. First, this paper's literature study focused only on journal articles, while important smart city research has been presented at top conferences such as [24], which have been identified by [108]. However, this paper was able to identify major areas of smart city-related research inside e-government research. While the literature missing from these important conferences might have added to the identified framework, the preliminary framework already reveals important relationships. Future research should try to investigate this potential gap further and close it if necessary. Second, the expert panelists mainly came from developed countries, while smart city challenges in developing countries could be represented by experts from international organizations (International Telecommunications Union (ITU), World Bank and United Nations (UN) Habitat), but were not included. Future research could involve experts from developing countries in order to test the framework developed here. Second, other

industries are directly involved in smart city domain as well, but they were not included in this study, since they did not directly involve e-government (i.e., biomedicine, smart materials, etc.). Therefore, future research could perhaps examine smart city and other academic disciplines to look more closely at this important issue.

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TABLES

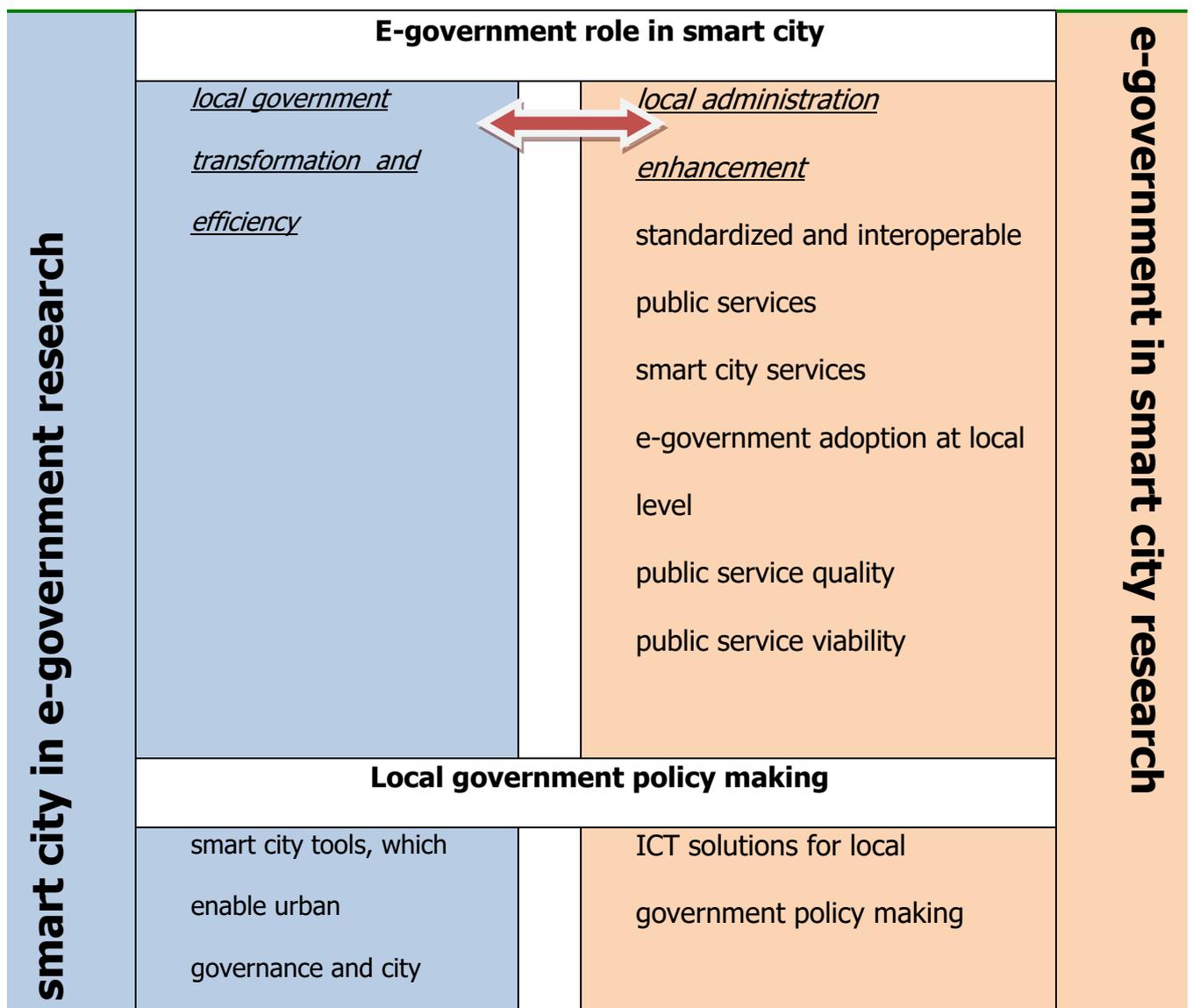
Term	GIQ	IJEGR	IP	PAR	TG	eJEG	JITP	EGIJ
Smart city	12	12	0	3	3	8	0	0
Digital city	14	15	0	1	1	40	1	0
Virtual city / information city	6	0	0	0	0	13	0	0
Knowledge based city	0	1	0	0	0	3	0	0
Broadband City / Broadband Metropolis	1	1	0	0	0	6	0	0
Wireless city / Mobile City	4	1	0	1	0	7	0	0
Ubiquitous city	1	0	0	0	1	6	0	0
Eco-city	1	1	0	0	0	1	0	0
Number of articles after screening	6	5	0	2	2	4	1	0

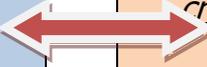
Table 1: Terms for search in e-government research and corresponding article results

Journal	Results returned on search terms		
	*government and smart city	Public sector and smart city	Number of articles after screening
1. Communications of the ACM	26	8	4
2. Cities	16	11	20
3. Pervasive and Mobile Computing	44	11	2
4. Journal of Urban Technology	28	64	16
5. Environment and Planning B	74	8	4
6. City	1	66	5
7. Environment and urbanization	5	1	3
8. Applied Geography	13	2	3
9. Information and Management	61	11	5
10. Information Systems Management	23	41	7
11. Expert Systems with Applications	70	13	3
12. Sustainable Cities and Society	28	15	5
13. IEEE Internet Computing	82	3	4

14.	Behaviour and Information Technology	125	31	2
15.	Journal of The Association For Information Science And Technology	79	124	4
16.	Technological Forecasting & Social Change	113	34	11
17.	Future Generation Computer Systems	5	0	3
18.	Environmental Modelling & Software	1	2	1
19.	Applied Energy	2	3	1
20.	Habitat International	5	4	3
21.	Urban Studies	6	2	3
			Total:	109

Table 2: Terms for search in smart city research and corresponding article results



management		
Government ICT and the smart city		
<p><i>government ICT investments for enabling a smart city</i></p> <p><i>the role of government in developing solutions like wireless cities</i></p>	 	<p><i>government ICT and of public ICT investments for enabling a smart city</i></p> <p>enhancing urban characteristics, improve livability and city competition</p> <p>means that increase smart city management</p> <p><i>the formulation of information, intelligent and wireless cities</i></p> <p>the transformation of a city to a product for export</p>
Government challenges in smart cities		
<p><i>government big data, open data at local level crowd-sourcing</i></p> <p>city smart-competition</p> <p>climate change impact in urban spaces</p>		<p><i>government big data crowd sourcing open data at local level</i></p> <p>the role of government in smart cities</p> <p>government ICT solutions for resilience, sustainability and climate change</p> <p>Internet-of-Things (IoT) in cities</p>

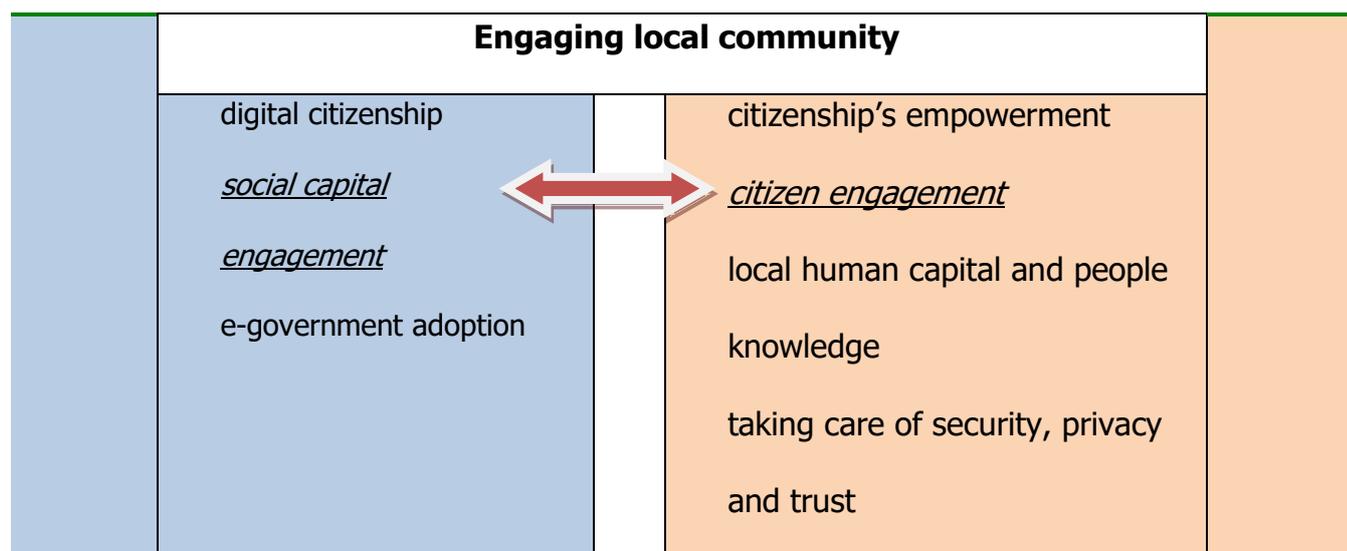


Table 3: Identified matches on topics and issues (underlined the exact matches)

Id	Case/Organization	Date of interview (round 1)
1.	City of Tampere (Finland)	25/4/2012
2.	Geneva (Switzerland) - Services Industriels De Geneve (SIG)	30/8/2013
3.	Zurich - Elektrizitätswerk der Stadt Zürich (EWZ)	2/9/2013
4.	New Songdo (South Korea): Gale International	16/2/2014
5.	Vienna (Austria): Smart Vienna	5/4/2014
6.	London: Business School, Brunel University	29/4/2014
7.	World Bank - Middleware Engineering and Rapid App Development	29/9/2014
8.	UN Habitat – Liaison Office NYC	2/10/2014
9, 10.	New York City	1-3/10/2014
	1. Department of Electrical Engineering, Columbia University	
	2. Department of Information Technology and Telecommunications (DoITT)	
11.	UN ITU – Smart Sustainable City Focus Group	9/10/2014
12.	City of Trikala (Greece)	10/10/2014
13.	Hong Kong - Office of the Government Chief Information Officer	4/12/2014
14, 15	Melbourne	9-10/12/2014
	1. City of Melbourne	
	2. Department of Computer Science, RMIT University	

Table 4: Interviewed cases and international organizations

Code	Issue	Description
A	<i>Government and Smart City</i>	<i>The role of government transformation in emerging smart city issues: government transformation is the outcome of e-government activities. How this transformation affects smart city?</i>
A.1	Livability	The contribution government ICT in city well-being conditions, which make a city attractive for residents
A.2	Urban Sustainability	Government ICT role in local resource use, with respect to local future generations.
A.3	Resilient City	The role of government ICT for resource availability, disaster response and recovery planning.
A.4	City management	Government ICT for information retrieval and urban intelligence.
A.5	City competition	Government ICT role in enhancing city competitive advantages in the international smart city arena.
A.6	Urban planning and development	In terms of local government's efficiency and structure
B	<i>E-government and smart city</i>	<i>The role of e-government emerging issues in smart city: how do e-government trends affect smart city evolution?</i>
B.1	Citizen participation and engagement	Data utilization (open and big data) for social engagement in decision and policy making
B.2	Co-design	Collaborative efforts via social media and e-government platforms between citizens and public agencies
B.3	Digital neighborhood	Citizen urban associations via social media and e-government platforms
B.4	Third wave e-government	The role of city demographics to e-government
B.5	Online information landscape of	Online information role in community participation and

	local events	neighboring activities
B.6	Standardization	E-government interoperability and open data ontologies in smart city standardization

Table 5: The proposed topics and issues for the Delphi process

Round 1 Findings			Round 2 Findings		Differences
	# Agree (out of 16)	Percentage	# Agree (out of 16)	Percentage	Chi ² 0.95
A.1	11	69%	12	75%	Not significant
A.2	13	81%	13	81%	Not significant
A.3	11	69%	12	75%	Not significant
A.4	11	69%	13	81%	Not significant
A.5	11	69%	11	69%	Not significant
A.6	9	56%	13	81%	Not significant
B.1	11	69%	11	69%	Not significant
B.2	12	75%	12	75%	Not significant
B.3	11	69%	11	69%	Not significant
B.4	8	50%	12	75%	Not significant
B.5	9	56%	11	69%	Not significant
B.6	11	69%	12	75%	Not significant

Table 6: The results from the Delphi process execution

FIGURE CAPTIONS

Fig. 1: Search Method for Research

Fig. 2: citations' appearance in e-government journals

Fig. 3: Frequency of journal articles per year

Fig. 4: Assignment of literature review framework to Delphi processed topics

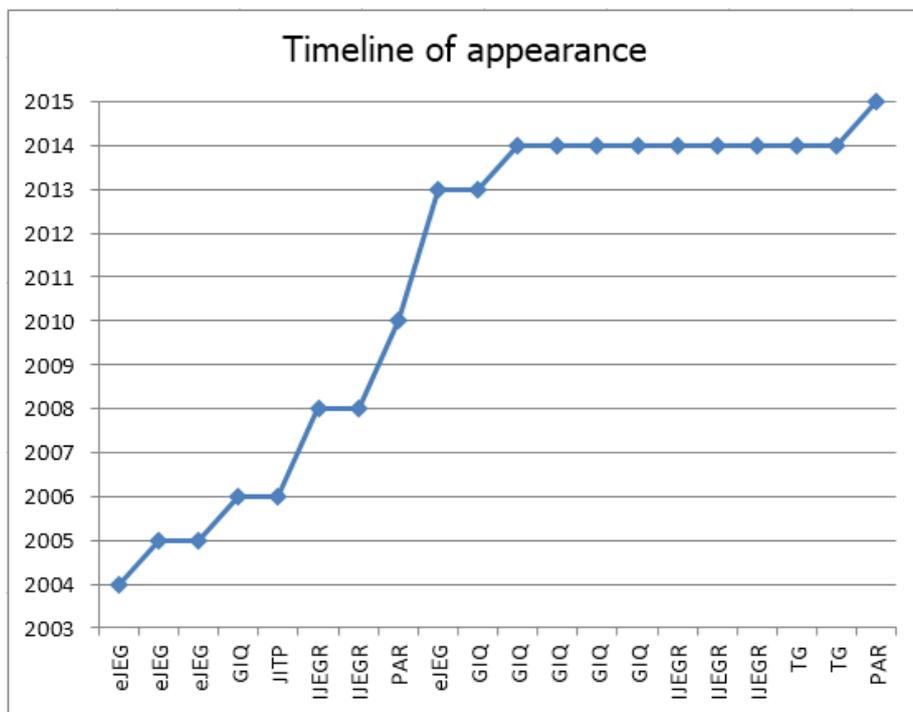
Fig. 5: Summary of the followed Delphi process

Fig. 6: Concluded research agenda

FIGURES



Fig. 1: Search Method for Research



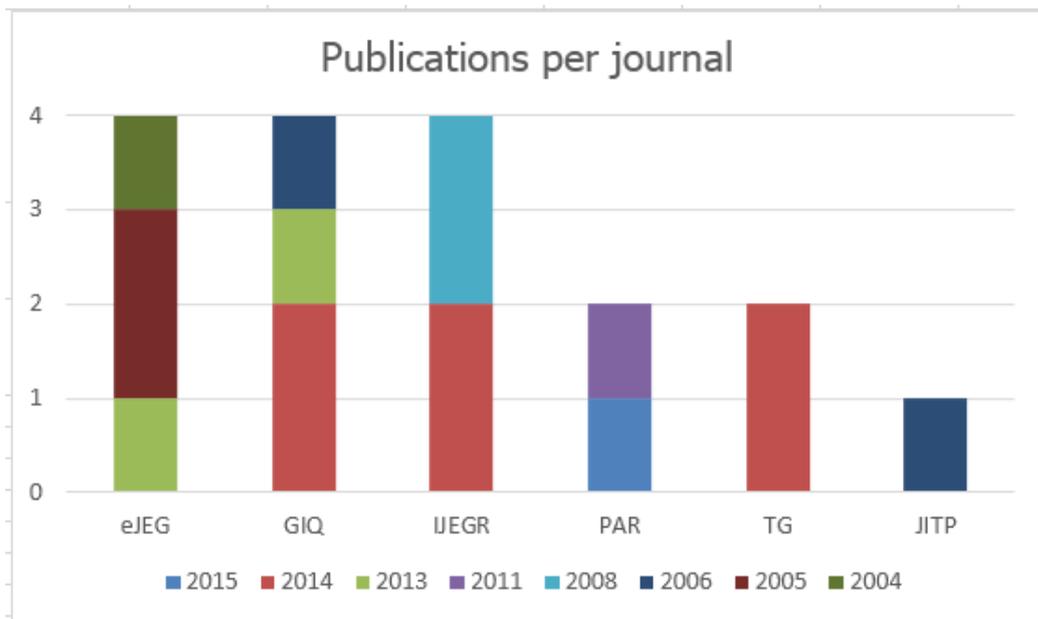
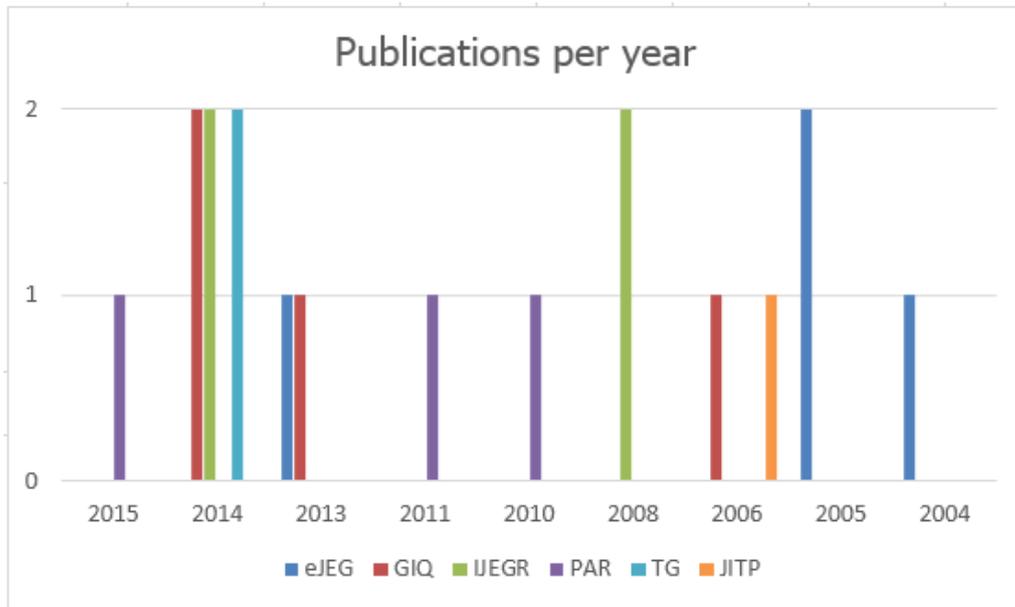


Fig. 2: citations' appearance in e-government journals

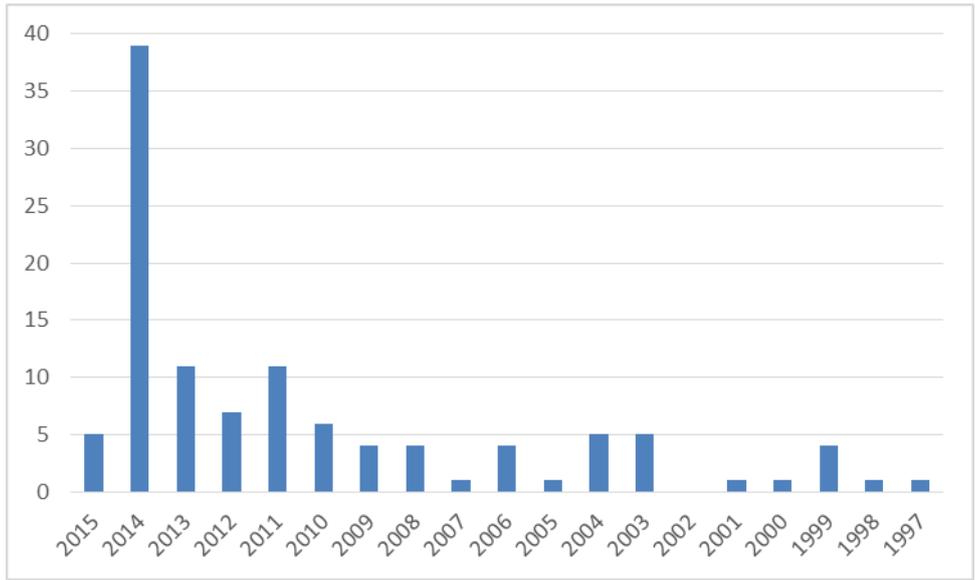


Fig. 3: Frequency of journal articles per year

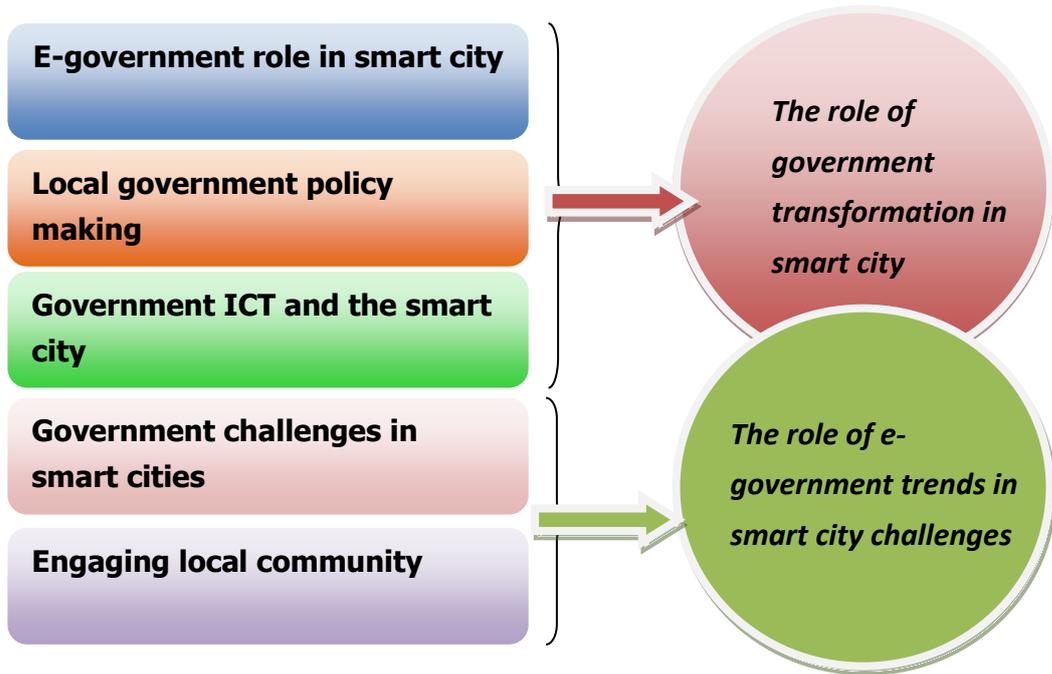


Fig. 4: Assignment of literature review framework to Delphi processed topics

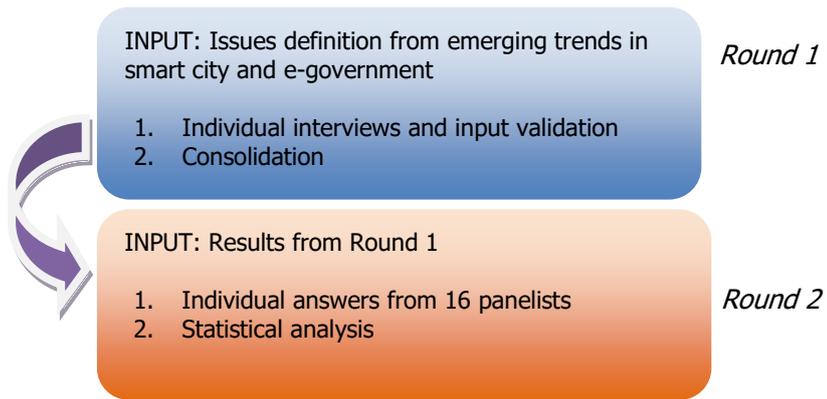


Fig. 5: Summary of the followed Delphi process

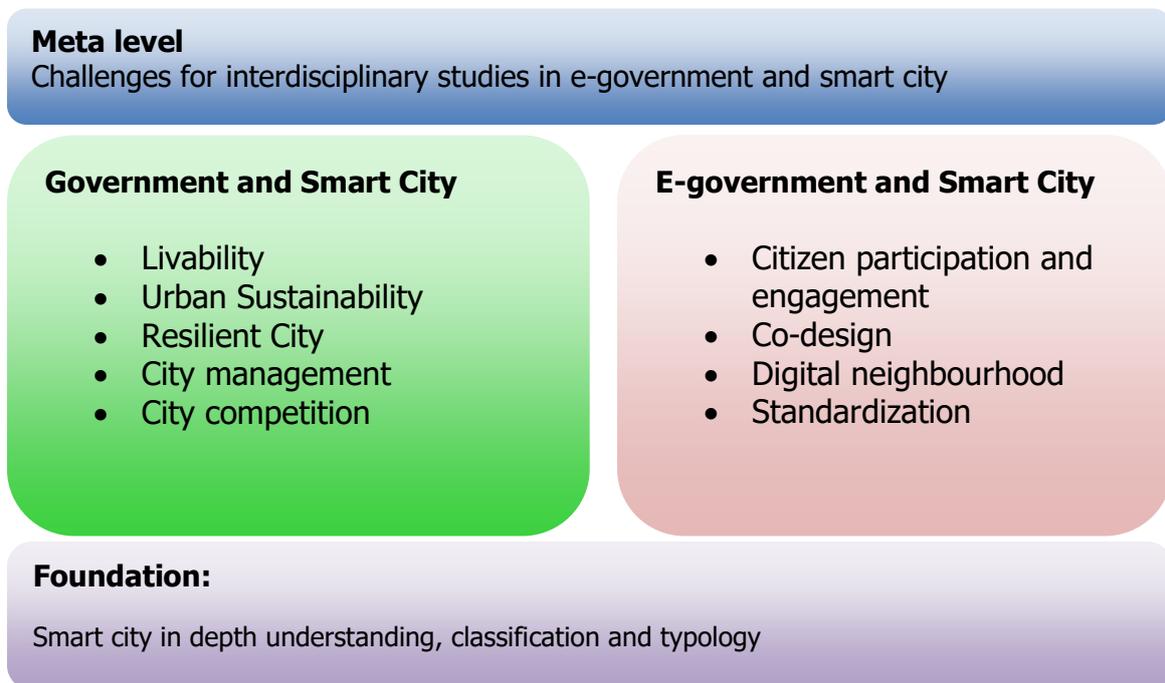


Fig. 6: Concluded research agenda