

E-Gov and Sustainability: a Literature Review

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Abstract

E-governance (e-gov) might provide the missing tools in order to move closer to the good governance ideal, often depicted as a key element for a sustainable future. But how is sustainability considered in the scientific debate around e-gov? The main objective of this paper is to review the current research at the intersection of e-gov and sustainability in order to provide insights on the identified challenges and opportunities arising from e-gov as well as the preconditions for sustainable e-gov. A systematic review of the existing body of scientific literature published since 2012 has been performed, and after several screenings - from the 180 documents initially identified - 30 articles were selected and analysed in-depth. The results of the analysis are structured based on the sustainability perspective and governance perspective respectively, with authors from developing countries rather looking into development opportunities while authors from developed countries focus on efficiency gains.

Keywords: *electronic; governance, digital, sustainable development, review, e-governance.*

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INTRODUCTION

Even though the concept of governance – let alone good governance – is still subject to a wide range of understandings (Fukuyama, 2013), the technological advances brought by the digital age are often perceived as a chance for governance systems to become more efficient, inclusive, representative, transparent, and accountable (OECD, 2003) in a quest for new and better forms of governance.

Starting from there, and acknowledging that our existing governance systems are humanly imperfect, highly complex, and dynamically changing, we think it is important to understand the challenges and opportunities we should expect as digital technologies become intrinsically part of these governance systems through what we call electronic governance.

Today, digitalisation is one of the most transformative forces shaping the way we interact as individuals and act as citizens, but also an increasingly important tool when it comes to informing and taking decisions, from individual purchase habits to running a state. In an age marked by the increasing urgency of solving the numerous social, environmental and economic problems of our times, this article seeks to understand the current state of the research and its contribution to better understanding the implications of the digital age for our governance systems from a sustainable development perspective. This article aims to start a conversation on whether or not and, most importantly through which mechanisms, digitally-supported forms of governance could directly or indirectly support or impeded our collective efforts towards better governance. This article does not try to conceptually redefine the concepts of sustainability and governance. These two concepts are still widely debated matters in the research community from a conceptual perspective (Baron, 2003; Giovannoni & Fabietti, 2013; Ruhanen, Scott, Ritchie, & Tkaczynski, 2010). Rather, this article seeks to provide a simple common understanding on what we mean through the terms sustainable development and e-governance, in order to present and analyse the current state of the research carried out by those whose work either clearly investigated or contributed to enriching our understanding of the mechanisms at stake at the intersection of these two concepts.

This article starts with a short section on the theoretical background of e-governance and sustainability, and proposes a brief conceptual framework which is here referred to as the digitalisation-governance-sustainability nexus, in order to set a common understanding of the subject at stake. It then proceeds with the actual review of a body of scientific literature produced on the subject since 2012 – first providing

methodological details on the analysis before systematically presenting the results. The article then provides a brief overview and discussion of the findings before ultimately identifying the potential shortcomings and research gaps of these studies and setting up an outlook for future research.

THEORETICAL BACKGROUND

E-governance

Governance is defined by UNESCO (n.d.) as the “structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and broad-based participation” – key characteristics of good governance - as well as “the norms, values and rules of the game through which public affairs are managed in a manner that is transparent, participatory, inclusive and responsive.” In a broader sense, UNESCAP (2009) defines governance as “the process of decision-making and the process by which decisions are implemented (or not implemented)”.

According to UNESCAP (2009) good governance is the ideal state of governance best described as being participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive, and following the rule of law.

Adding the digital dimension to the concept of governance, electronic governance is the process-oriented counterpart of the institution-oriented concept of electronic government. E-government is defined by OECD (2003) as being “the use of ICTs (Information and Communications Technologies), and particularly the Internet, as a tool to achieve better government” through increased efficiency, improved services, increased trusts, and overall enhanced possibilities to achieve specific as well as broad objectives. Both concepts are often indistinctly – albeit not necessarily correctly - grouped under the common label e-gov.

For the purpose of this article, we will define e-governance as being the use of information and communication technologies in the processes through which decisions are informed, taken and implemented, in the pursuit of good governance.

Sustainability

The concepts of sustainability and sustainable development are often referring to development pathways that meet the needs of the present without compromising the ability of future generations to meet their own needs (World Commission on

Environment, 1987). From a theoretical perspective, sustainability can be explained as a concept equally respecting its three main dimensions: environmental, social, and economic (Lozano, 2008). How sustainability is visually explained however varies according to scholars. The most common visualisation of the concept of sustainability is the Venn diagram which visualises sustainability at the intersection of the three dimensions but gives the misleading impression that the dimensions are independent from each other (Lozano, 2008), and the concentric circles which help visualise the continuous interrelatedness between all three dimension (a variation of the latter being the non-concentric nested-circles visualisation). However, none of these visualisations really show the complex inter-linkages that exist between each so-called dimension, nor do they show the multi-layered (Giddings, Hopwood, & O'Brien, 2002) and dynamically changing nature of sustainability with time (Lozano, 2008). Sustainability is not a spatially, contextually and temporally frozen concept. A practice or development pathway qualified as sustainable today in a given place and context can be regarded as unsustainable in the future as a result of e. g. a changing demographic context.

Conceptualising the sustainability-governancedigitalisation nexus

The technological progress of the last decades could help greatly by providing the missing tools to overcome the increased ineffectiveness of old governance models and respond to the need for new forms of governance that involve a much broader, inclusive and adaptively changing range of stakeholders (OECD, 2001). Yet, taking technology - something dually defined by Heidegger (1977) as being both and neither merely “a man-made means to an end established by man” and/or “a human activity” - for more than what it is, could easily lead to overestimating its potential benefits and underestimating its potential unintended negative impacts. This is why the benefits brought about by the digital age to governance systems should be analysed from a sustainability perspective in order to understand the potential benefits but also challenges that come with increasingly digital forms of governance. This analysis should take place at successive levels of analysis and in all three dimensions of sustainability.

Adding the sustainable development perspective to the topic, the field of study is at the intersection of digital technologies, governance systems, and sustainable development, which could be called the digitalisation-governance-sustainability (DSG) nexus.

METHODS

Operationalisation of the review

To assess the state of the research on the DSG nexus, we used a high-sensitivity search strategy to perform a systematic review of the existing body of scientific literature published since 2012 which would either investigate the implications of the digital age on sustainability through governance, or contribute to their better understanding. The choice of a high-sensitivity search strategy was made as a result of the large number of different understandings of what governance and sustainability are (Lenton, 2017), which would have made a high-precision search very difficult to perform comprehensively given the high number of relevant keywords that would need to be identified. Only peer-reviewed articles (both original research and reviews) published in scientific journals between 2012 and today and written in English were retained.

This means that some pertinent results may have naturally been omitted, either because they were not identified first hand, or because they were mistakenly perceived as irrelevant for this study. Studies older than 2012 were also excluded from this review, although the most pertinent ones were expected to be already presented in potential literature reviews published around 2012. The timeframe was limited to the last 5 years plus the running year, as the future of government can change dramatically within only a few years (Marche & McNiven, 2009). Secondary literature listed in the references of articles were also not explicitly analysed, however it turned out the most relevant ones had already been found through the primary search. Despite these shortcomings, we think this search strategy still provides a good overview of the state of research on this topic since 2012 to provide pertinent insights and recommendations for future research. The first step of our research consisted in building a generic search equation describing what we were looking for, namely scientific articles that would be relevant to the understanding of the digitalisation-governance-sustainability nexus. To do so, our generic search equation was built in two main parts, the first one dedicated to governance systems in the context of digitalisation, and the second one dedicated to sustainability. As e-governance and e-government are often, albeit not necessarily correctly, used interchangeably, it was decided in the first part of the search equation to search for both of these terms, which are sometimes gathered under the general umbrella of e-gov. We wanted through this choice to be able to understand what the digital age

means for governance systems at large – hence from the perspective of stakeholders, institutions, and activities.

Additionally, we also searched for combinations of the word government and, as not all stakeholders involved in governance activities are governments, of the word governance with any of the words ICT, IT, digital, electronic, or smart. In combination with the above, the second part of the search equation was looking at articles whose focus also look into “sustainability” or “sustainable”.

The final search equation was: (("e-government" OR "e-governance" OR egovernance OR egovernment OR "i-governance" OR "i-government" OR igovernance OR igovernment) OR ((ICT OR IT OR digital OR electronic OR smart) AND (governance OR government))) AND (sustainability OR sustainable).

The next step consisted in identifying the most relevant databases and adapting the generic search equation to each of them. Google Scholar, Scopus, Science Direct where identified as well-known libraries that should cover most of the pertinent results. For each of these databases, the search equations were adapted accordingly (list available in Annex 1).

A first search was then performed in these three databases by looking for articles whose title would respond to the search strings. This led to the identification of 95 documents in Google Scholar out of which 4 were immediately classified as irrelevant because of their nature (e.g. presentations and non-scientific publications). Similarly, 53 documents were found through Scopus, out of which 3 were immediately deemed irrelevant due to their nature. 11 articles were identified in Science Direct.

The 152 retained search hits were exported and referenced into an excel sheet through the .csv export features of Science Direct and Scopus, and with Harzing’s software “Publish Or Perish 6” for Google Scholar. This led to the identification of 104 unique documents. As all the documents found through the database Science Direct had already been found in Scopus or Google Scholar, it was decided at this stage to focus on these two databases only from now on.

As searching for the same terms in the text body of articles was not a realistic option given our limited analytical resources (Google Scholar provided more than 1.8 million search hits on these search terms, and Scopus still more than 67,000), it was decided to proceed to a second search this time looking for the same terms in the keywords and abstracts fields. Unfortunately, Google Scholar does not offer this option. It was therefore decided to perform this search in Scopus only. This enabled the identification of 87 documents, of which 77 had not yet been identified, leading to a

total of 180 unique documents out of the 246 search results obtained through this process.

A first screening was made in order to eliminate the most obvious non-relevant documents as per the aforementioned set of criteria. Only original research and review articles were retained (excluding: book and book chapters, conference papers, editorials, thesis, working papers, reports, and mainstream publications). After this first screening, 120 documents were retained (list available in Annex 2).

The abstracts of all 120 articles were read in order to filter out those obviously not relevant for our purpose. At this stage, only 49 articles were identified as potentially relevant. Subsequently, a second screening was performed, where the introduction and conclusions of each of these 49 articles were read entirely, and the remaining sections skimmed through when in doubt. When an article was deemed irrelevant for our purpose based on this method, it was filtered out. After this second screening, all remaining articles were read in full, and paragraphs where the authors clearly identified potential opportunities, challenges, or limits and preconditions for sustainable development resulting from the use of digital technologies in governance systems were highlighted for further analysis. At this stage, 32 articles were still retained, including one full article which could not be retrieved and one that would be later ruled out because of unusual similarities with another article, which was published earlier.

The 30 articles of this final selection were fully analysed in order to identify relevant findings contributing to either the identification of challenges and opportunities for sustainability arising from e-gov, preconditions for sustainable e-gov, or interesting insights on the state of research on the matter. The key statistics describing the documents found and filtered out at each step are in Table 1 below.

Table 1: Main statistics from the successive search and filtering steps

Item	number	% of initial results
Initial total number of search results exported	246	100%
Unique articles from initial search results	180	73%
<i>Of which are original research or review articles</i>	120	49%
<i>books, book chapters</i>	17	7%
<i>article in press and working papers</i>	3	1%

Item	number	% of initial results
<i>conference papers</i>	30	12%
<i>conference review</i>	2	1%
<i>editorial</i>	2	1%
<i>online news report</i>	1	0%
<i>report</i>	2	1%
<i>thesis</i>	3	1%
Keepers after reading abstracts (1 st filtering)	49	20%
Keepers after reading intro & conclusion (2 nd filtering) [†]	32	13%
Excluded after this stage [‡]	2	1%
Fully analysed	30	12%

Analysis strategy

For each of the 30 articles, the following information was noted:

- Overall thematic focus, including main dimension(s) of e-gov and of sustainability discussed in the article
- Keywords
- Dimensions of sustainability assed in the article (environmental, social, economic, governance)
- Research method(s) used in the study (empirical, conceptual, review, meta-analysis, other)
- Country where the author(s) are or were based at the time of submission
- Geographical focus of the study
- Opportunities for sustainable e-gov
- Challenges for sustainable e-gov
- Preconditions for sustainable e-gov
- Recommendations for future research

Some of the collected data was analysed with simple descriptive statistics in Excel. This includes:

- E-gov foci in each article and overall

[†] Except for the article that could not be retrieved, and had therefore not yet been eliminated from the shortlist

[‡] The un-retrieved article as well as an article deemed too similar to a previously published article were excluded

- Sustainability foci and number of sustainability dimensions assessed in each article and overall
- Type and number of research methods used in each article and overall
- Number of articles clearly identifying challenges, opportunities, preconditions, and suggestions for future research.

Additionally, each challenge, opportunity, precondition and suggestion for future research was analysed in order to identify recurrent themes and messages, as well as their respective shares in the overall number of identified paragraphs and in the overall number of articles analysed.

RESULTS

The list of the 30 articles analysed in details is available in Annex 3.

Statistical description

Categorizing these 30 papers with the help of the three commonly used sustainability dimensions (environmental, economic, social), 37% (n=11) of them discussed all three dimensions of sustainability, 27% (n=8) of them only discussed social and economic sustainability, 17% (n=5) of them only discussed social sustainability and another 7% (n=2) only environmental and social sustainability, 10% (n=3) only discussed environmental sustainability, 3% (n=1) discussed only environmental and economic sustainability, and none of them discussed economic sustainability only. When aggregating the percentage of papers covering per dimensions of sustainability, 97% (n=29) of the studies discussed social sustainability, 67% (n=20) of the studies discussed environmental sustainability and 67% (n= 20) of the studies discussed economic sustainability. A visual representation of this categorization is displayed in Table 2.

From an e-gov perspective, most articles (80%, n=24) had e-governance or e-government in general as their primary focus, although a significant portion (40%, n=12) were mostly focusing on smart cities. Among the 30 articles, 23% (n= 7) make an important focus on e-participation or e-democracy, 10% (n=3) on e-services, 7% (n=2) on geo-ICT, and 3% (n=1) on e-procurement.

57% (n=17) used empirical methods, 53% (n=16) contained a section discussing existing literature, 43% (n=13) presented a conceptual part, and 23% (n=7) presented either a structure or at least a significant part that would qualify them as position papers. 20% (n=6) used a meta-analytical approach.

Table 2: Dimension of sustainability covered by respective paper

# of dim	Environmental	Social	Economic
3	(Aichholzer, Cimander, & Kubicek, 2013; Anthopoulos, 2017; Chatfield & Reddick, 2016; Estevez & Janowski, 2013; Fathul, 2013; Ferro & Osella, 2017; Hayat, 2016; Ishkineeva, Ishkineeva, & Akhmetova, 2015; Larsson & Grönlund, 2014; Nica, 2015; Soma, Termeer, & Opdam, 2016)		
2	(Khansari, Finger, Mostashari, & Mansouri, 2016; Perillo, 2013)		
		(Al-Sudairy, 2012; Kim, Jung, & Choi, 2016; Larsson & Grönlund, 2016; Misra & Raju, 2014; D. D. Navarra, 2013; Ojo, 2014; R. Sharma, Fantin, Prabhu, Guan, & Dattakumar, 2014; Upadhyaya & Chugan, 2012)	
	(D. Navarra & van der Molen, 2014)		
1	(Corbett & Mellouli, 2017; Lee, 2017; D. Sharma & Singh, 2016)	(Bernhard & Wihlborg, 2015; Lin, Zhang, & Geertman, 2015; Marsal-Llacuna, 2016; Myeong, Kwon, & Seo, 2014; Trivellato, 2017)	-

Looking at geographical statistics, 37% (n=11) of the articles have a focus on developed countries only, 23% (n=7) on developing countries only, 7% (n=2) a focus on both developed and developing countries, and 33% (n=10) no particular geographical focus. The papers were written by 58 individual authors and co-authors based in 21 different countries. 70% (n=21) of the articles have authors exclusively based in developed countries, 3% (n=1) exclusively in an economy in transition, 23% (n=7) exclusively in developing countries, and 3% (n=1) result from a collaboration between co-authors based in developed and developing countries[§].

[§] These figures only add up to 99% because of rounding approximations. Rounding to two significant digits, they are respectively: 70, 3.33, 23.33 and 3.33 %.

Analysis

The main objective of this review is to identify the main challenges and opportunities relevant to the digitalisation-governance-sustainability nexus covered by the current research at the intersection of e-gov and sustainability.

To do so, each of the 30 articles has been analysed in order to identify the main challenges, opportunities, and preconditions for sustainable governance, as well as critics to existing research. Each paragraph containing such information was highlighted, and each statement analysed in terms of the information it contained. As such, a statement could comprise several sentences, and one sentence could contain several pieces of information, e.g. listing several sustainability benefits resulting from e-governance through one or several mechanisms. In this hypothetical example, each of the potential opportunities would have been counted as individual opportunities. When possible (e.g. on the condition that no new information was provided), repetitive statements from the same author were not picked.

Proceeding through the highlighted statements, a total of 243 individual identifications were made, of which:

- 64% (n=156) labelled as opportunities
- 14% (n=34) labelled as critics of the existing research
- 13% (n=32) labelled as challenges
- 9% (n=21) labelled as preconditions

Identified opportunities

Among the 156 opportunities identified by the authors of the reviewed articles, 49% (n=76) were not related to any of the environmental, economic or social sustainability dimensions, but to the possible improvements in the way governance systems work. 28% (n=43) of the opportunities were related to the environmental dimension of sustainability, 10% (n=16) to the social dimension, and 7% (n=11) to the economic dimension, while the remaining 10% did not fall in any of these categories.

From an environmental sustainability perspective:

- **Energy:** among the 43 environmental opportunities, 28% (n=12) of them were related to opportunities in the field of energy and were found in 7 papers. They included improved energy management (Hayat, 2016; D. Navarra & van der Molen, 2014), increased energy efficiency and reduced energy consumption (Aichholzer et

al., 2013; Fathul, 2013; Hayat, 2016; Lee, 2017), distributed energy generation (Hayat, 2016) and reduced energy dependency (Chatfield & Reddick, 2016). These benefits would be achieved indirectly through greater awareness and better integration of technology in management and governance activities, the increased efficiency of e-procurement, the use of technology-based policies and smarter urban management through geo-ICT, or even as a result of the e-government bringing services closer to remote populations.

▪ **Climate:** 19% (n=8) of the environmental opportunities were related to the field of climate and were identified across 7 different articles. This included generally improved climate change mitigation and adaptation capacities (Aichholzer et al., 2013; Chatfield & Reddick, 2016; Fathul, 2013; Lee, 2017; D. Navarra & van der Molen, 2014) and more climate-resilient cities through smarter disaster management (R. Sharma et al., 2014) and forward-looking governance (D. Sharma & Singh, 2016). Some of the climate change mitigation opportunities identified are a consequence of the increased energy efficiency expected by the same authors.

▪ **Overall environmental sustainability (unspecified):** 14% (n=6) of the environmental opportunities related to an increased environmental sustainability in general and were identified in 3 different articles. This was achieved through mechanisms such as the overall increased efficiency of e-gov compared to traditional forms of governance and government (Lee, 2017), the possibility to achieve slower, closer and more citizen-centric forms of governance – as an analogy to slowfood - (Bernhard & Wihlborg, 2015), and the better ability to use for example geo-ICT to understand and optimise the urban economic network (D. D. Navarra, 2013).

▪ **Other environmental opportunities** include increased resource efficiency through dematerialisation (Lee, 2017), resource efficient technologies and smart regulations and taxations (D. Sharma & Singh, 2016), smarter processes (Fathul, 2013) and lifestyles (Perillo, 2013). Better air quality is also mentioned on 3 occasions (7%) (Anthopoulos, 2017; Chatfield & Reddick, 2016; D. Sharma & Singh, 2016), through real time monitoring and management as well as technology-based policies. Other benefits include reduced environmental impacts from transportation and reduced environmental impacts in general (Lee, 2017), smarter water management and reduced waste production (D. Sharma & Singh, 2016), and better environmental disaster management (R. Sharma et al., 2014).

From a social sustainability perspective:

- **Employment:** 19% (n=3) of the social opportunities are related to improved employment opportunities through the development of the smart city industry (Kim et al., 2016), improved access to markets for poor populations (Upadhyaya & Chugan, 2012) or the development of public-private partnerships in the field of e-services (Upadhyaya & Chugan, 2012).
- **Social sustainability in general (unspecified):** 19% (n=3) of the social opportunities are related to increased social sustainability in general, resulting from the use of geo-ICT to optimise the spatial distribution of social activities (D. D. Navarra, 2013), the sustainable regeneration of migrant communities through interactive, inclusive, collaborative, transparent, and effective smart governance (Lin et al., 2015), or more citizen-centric forms of governance achieved globally through the use of social sustainability standards in the governance of cities (Marsal-Llacuna, 2016).
- **Education:** 13% (n=2) of the social opportunities are related to better education through increased access to education opportunities and improvement in the education system (Upadhyaya & Chugan, 2012).
- **Poverty:** 13% (n=2) of the social opportunities are related to poverty alleviation through increased opportunities for poor populations and increased access to micro finance services (Upadhyaya & Chugan, 2012).
- **Other social opportunities** include improved health and safety (6%, n=1) (Anthopoulos, 2017), reduced risks of social conflicts (6%, n=1) (Lin et al., 2015), increased success chances of emerging initiatives (6%, n=1) (Trivellato, 2017), reduced inequalities (6%, n=1) (Lee, 2017), stronger communities (6%, n=1) (Bernhard & Wihlborg, 2015), and increased quality of life (6%, n=1) (Trivellato, 2017).

From an economic sustainability perspective:

- **Economic growth:** 18% (n=2) of the economic opportunities are related to increased economic growth through the development of the smart city industry (Kim et al., 2016) and the use of ICT in developing economies (Upadhyaya & Chugan, 2012).
- **Overall economic sustainability (unspecified):** 18% (n=2) of the economic opportunities are related to overall economic sustainability through the use of geo-

ICT to optimise the spatial distribution of economic activities (D. D. Navarra, 2013) and the use of ICT in developing economies (Upadhyaya & Chugan, 2012).

- **Market and competitiveness:** 18% (n=2) of the economic opportunities are related to enhanced local markets and competitiveness, due to more citizen-centric local governance rather than local governments (Trivellato, 2017), and due to the use of ICT in developing economies (Upadhyaya & Chugan, 2012).
- **Public and private investments:** 18% (n=2) of the economic opportunities are related to increased public and private investments, achieved through the development of the smart city industry (Kim et al., 2016; D. Sharma & Singh, 2016).
- **Other economic opportunities** include an increased inclusion of small and medium sized enterprises through transparent e-procurement (Fathul, 2013), an increase in tax revenues due to a decrease in corruption (Upadhyaya & Chugan, 2012), and the increase role of the service industries through the development of smart cities (Kim et al., 2016).

From a governance perspective:

The analysed papers identify the most opportunities in governance systems themselves, representing 49% (n=76) of all identified opportunities.

Among them:

- 16% (n=12) point to increased governance efficiency (Corbett & Mellouli, 2017; Lee, 2017; Ojo, 2014; D. Sharma & Singh, 2016; Upadhyaya & Chugan, 2012), effectiveness (Khansari et al., 2016; Lee, 2017), or simplicity (Ojo, 2014)
- 13% (n=10) point to increased levels of citizens participation (Lee, 2017; Ojo, 2014; D. Sharma & Singh, 2016; Trivellato, 2017), engagement (Al-Sudairy, 2012; Chatfield & Reddick, 2016), or centrality (Nica, 2015)
- 9% (n=7) point to more accessible, efficient, effective, standardized (Ojo, 2014), or far-reaching public services (Upadhyaya & Chugan, 2012), and better overall quality of services (Upadhyaya & Chugan, 2012)
- 8% (n=6) point to cost reductions in governmental transactions (Ojo, 2014), infrastructure management (Lee, 2017), or governmental supplies (Fathul, 2013; Lee, 2017) and overall internal spending (Anthopoulos, 2017)
- 8% (n=6) point to improved information and communication management through easier access, more efficient communication (Ojo, 2014), better extraction and dissemination of information, more robust platforms, or improved information management (Corbett & Mellouli, 2017)

- 7% (n=5) point to better procurement practices, through more transparent procurement processes, increased energy and material efficiency as well as faster, more inclusive and cheaper e-procurement (Fathul, 2013)
- 7% (n=5) point to better policies and policy-making through increased policy effectiveness, transparency, accountability (Khansari et al., 2016), and stronger policy actors (Lee, 2017),
- 5% (n=4) point to enhanced risk management through increased participatory planning (D. Sharma & Singh, 2016), empowerment of poor populations through micro-finance (Upadhyaya & Chugan, 2012), and reduced risks of social conflict through citizen participation in decision-making processes (Lin et al., 2015)
- 5% (n=4) point to better data management through more cost effectiveness, more convenient data storage and access, and simplified data collection and analysis (Ojo, 2014)
- 4% (n=3) point to increased trust in government through transparency and tighter interactions (Bernhard & Wihlborg, 2015; Fathul, 2013; Myeong et al., 2014)
- 4% (n=3) point to reduced corruption (Fathul, 2013; Lee, 2017; Upadhyaya & Chugan, 2012)
- 3% (n=2) point to increased governmental accountability (Ojo, 2014)
- 3% (n=2) point to increased governmental transparency (Ojo, 2014)
- 3% (n=2) point to greater stakeholder engagement (Corbett & Mellouli, 2017; D. Sharma & Singh, 2016)
- 3% (n=2) point to improved compliance (Corbett & Mellouli, 2017)
- 3% (n=2) point to other governance benefits (Bernhard & Wihlborg, 2015; D. Sharma & Singh, 2016).
- 1% (n=1) points to greater institutional integration through smart cities (R. Sharma et al., 2014)

Identified challenges

Among the 32 challenges identified, 13% (n=4) were related to the environmental dimension of sustainability, 16% (n=5) to the social dimension, and 3% (n=1) to the economic dimension, while 50% (n=16) were challenges to governance itself, and another 19% (n=6) related to other challenges.

From an environmental sustainability perspective:

- 3% (n=1) related to the limits of climate change mitigation through e-participation as a result of the huge gap identified between individual CO₂ emissions reduction commitments and actual emissions in a case study (Aichholzer et al., 2013).
- 6% (n=2) related to environmental degradations as the maturity of e-government has not proven to directly affect – halt or mitigate - environmental degradation (Lee, 2017) while the development of ICT over the last decades is clearly pointed out as having helped achieve significant growth but at the cost of significant social and environmental costs (Lee, 2017).
- 3% (n=1) point to the higher vulnerability of smart cities to environmental risks as a result of the high demographic densities (Hayat, 2016)

From a social sustainability perspective:

- 3% (n=1) point to the lack of standardisation when it comes to social sustainability in e-governance (Marsal-Llacuna, 2016).
- 6% (n=2) point to lacking consideration of intangible aspects of social sustainability such as citizenship rights or the possible social implications of policies and programs in case of excessive enthusiasm for smart technologies (Lee, 2017; Marsal-Llacuna, 2016; Trivellato, 2017).
- 9% (n=3) point to the risk of not channelling individual aspirations well enough towards the creation of public value for society at large (Ferro & Osella, 2017).

From an economic sustainability perspective:

- 3% (n=1) point to the higher vulnerability of smart cities to risks as a result of the high concentration of economic activities (Hayat, 2016)

From a governance perspective:

- 3% (n=1) point to the risk of high administrative-centricity as many of the benefits of e-gov would primarily address issues faced in administrative spheres and not necessarily in the political and sustainability ones (Corbett & Mellouli, 2017)
- 13% (n=4) point to risks to citizens participation and engagement as a result of either overestimated potentials (Aichholzer et al., 2013), using instead of serving citizens (Marsal-Llacuna, 2016), uninformed public participation (Ojo, 2014), or exclusion of some parts of the population (Trivellato, 2017)

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- 6% (n=2) point to deficiencies in decision making processes that could result in serving the few rather than the many (Misra & Raju, 2014) and are simply not designed to handle the sustainability issues at stake (Larsson & Grönlund, 2016)
 - 19% (n=6) point to risk management deficiencies, as a result of the high dependency on sensors and automation could introduce serious vulnerabilities (Hayat, 2016) and overall need for mainstreamed resilience (D. Sharma & Singh, 2016)
 - 3% (n=1) point to the risk of rebound effect turning e-gov in an unsustainable model, making the analogy between a fast e-government and e.g., fast food (Bernhard & Wihlborg, 2015)
 - 9% (n=3) point to risks to trust, as a result of privacy and security issues (Myeong et al., 2014) as well as case studies that identified variance in the level of trust according to the type of digital divide (Myeong et al., 2014; Upadhyaya & Chugan, 2012).

Identified preconditions for sustainable e-gov

- **Urban cities:** when it comes to the specific case of urban development and management, several preconditions have been clearly identified in the articles. First, the use of resources should be optimised in cities to reach higher levels of efficiency. To do so, D. Sharma & Singh (2016) recommend to perform a benchmark of the services provided in cities in order to identify good practices and ensure appropriate coordination. A well-rounded context-specific risks analysis and well-informed strategies are also needed in order to enhance climate resilience. When it comes to the expansion of smart cities, Hayat (2016) recommends to start by analysing the future potential scenarios and their impact on e.g., city traffic congestion, in order to identify the best solutions. Hayat (2016) also points to the need for open-government in urban systems in order to achieve citizen-centric governance and emergency management.
- **Disaster management:** the topic of disaster management is also identified as particularly important by Hayat (2016) since taking a sustainability perspective could help improve risk management. In the context of disaster management, Hayat (2016) states that defining an adapted legal framework with clearly defined roles and responsibilities is key, in particular when it comes to actors whose role could be extended in the context of smart cities, e.g., the police. In addition, adapted means and capacity building are essential, as well as strong coordination in order to ensure

effective and efficient processes. Last but not least, resilience management should be embedded in all domains.

- **Overall governance efficiency:** in order to improve overall governance efficiency, several preconditions are required. First, governments need to set up adapted legal frameworks in order to ensure that network security, privacy and data protection remain intact (Myeong et al., 2014). Collaborative behaviours as well as the creation of work environments enabling efficient relationships is essential in order to work towards higher levels of trust – an essential condition to effective collaboration (Ferro & Osella, 2017). It is also important to ensure that municipalities, which are often the ones to implement and manage policies, have the necessary resources and capacities to achieve and successfully attain their objectives. Capacity building is, in this sense, an essential aspect, and should also familiarise the concerned actors with the available technologies (D. Sharma & Singh, 2016). More efficient overall governance coordination is also required. Better thought-of interactions could in the end help the public sector become more efficient (Larsson & Grönlund, 2016). The use of public-private-partnership could also help achieve higher levels of efficiency (Upadhyaya & Chugan, 2012), while the use of soft-law instruments such as standards could also help achieve more harmonised and sustainable practices in policy making and governance (Marsal-Llacuna, 2016). Finally, there are a few preconditions for the development and implementation of e-gov strategies as well. First, understanding the context in which governments are operating is essential in order to stay relevant. The understanding of this context includes grasping a global picture of the heterogeneous individual policy domains, initiatives and projects, as well as making sure that these individual initiatives keep a common goal and work together in the same direction. An overarching strategy is crucial in order to ensure the efficient and effective achievement of these goals (Perillo, 2013). It is also key to analyse and understand current existing problems from a sustainability perspective, as this could bring new ideas and innovative solutions (Larsson & Grönlund, 2016).
- **Networked forms of governance** that are not always focused on global and long-term goals but rather focused on small scale projects and limited sets of objectives are needed in order to improve the way in which information infrastructures are managed (Larsson & Grönlund, 2016).
- **Other preconditions:** In the specific case of e-procurement, Fathul (2013) recommends to take both technical and non-technical factors into account. When it comes to service industries, Kim et al. (2016) emphasize the importance to focus on actual demands in order to ensure their economic sustainability.

When it comes to the implementation of the SDGs within cities, Corbett & Mellouli (2017) state that a new type of information system that supports a multi- and transdisciplinary approach to sustainability is required in order to achieve an efficient implementation of the SDGs.

Critics of the existing research

Through this review, several limitations and critics of the current body of scientific literature were already identified by some of the authors of the reviewed articles.

Larsson & Grönlund (2014, 2016) identified that only a few papers discuss the concept of sustainability, and that there would often be a need for further description of the concept as well as a clear definition. The lack of depth in the discussion of sustainability is also pointed out too. Estevez & Janowski (2013) mention in their study that research papers at the intersection of e-gov and sustainable development are still rare. When it comes to the relationship between e-gov and social sustainability, Larsson & Grönlund (2014) reveal that the relationship between e-gov and social sustainability is often not discussed, while Lee (2017) identifies a lack of empirical studies regarding the relationship between e-gov and environmental sustainability, despite qualitative studies having been conducted. Additionally, Lee (2017) also found that studies investigating the impact of e-gov on environmental sustainability tend to only consider the direct impacts and mechanisms between the two topics. Lee (2017) and Soma et al. (2016) point to a lack of conclusive evidence as well as contradictory results when it comes to demonstrating the benefits of e-gov from a sustainability perspective. R. Sharma et al. (2014) also mention that some of the identified opportunities may result from overly simplistic approaches. Larsson & Grönlund (2016) identified a need to consider both positive and negative potential impacts, direct as well as indirect. Soma et al. (2016) mention that the cases studied do not always provide information on the potential sustainability implications at a larger scale. Estevez & Janowski (2013) and Larsson & Grönlund (2014) mention that current studies are not discussing the interlinkages existing between the different dimensions of sustainability. Additionally, Estevez & Janowski (2013) point to the fragmented character of existing studies, where all sustainability dimensions are treated separately and independently. Larsson & Grönlund (2014) say that in addition to the very studies talking about the interlinkages between sustainability dimensions, most papers focus on only one dimension of sustainability and in most cases this focus is made on the social dimension. Some studies are looking into the

other dimensions, but these studies are few. Larsson & Grönlund (2014) add that there is a lack of focus on the sense and meaning of e-gov in general as a large and complex phenomenon, and that there is little cumulative knowledge on this topic, with numerous research articles only addressing specific projects in the field of e-gov and sustainability.

DISCUSSION

After systematically reviewing the literature, several things can be pointed to.

Sustainability is not always assessed comprehensively, only about a third (37%) of the reviewed articles look at all three dimensions of sustainability. Although choices have to be made from an analytical perspective, it is indeed sometimes simplistic to try to dissociate the different dimensions of sustainability without investigating possible indirect impacts on the other dimensions one or two levels below. More studies should try to investigate indirect impacts as they seem not to be negligible according to Lee (2017). A deeper investigation of the mechanisms at stake could also reveal cascading impacts in several of the sustainability dimensions, including possible rebound effects or mitigating factors, which are important to understand before drawing conclusions. This lack of depth has already been identified by Larsson & Grönlund (2014). More studies that look at all three dimensions and their interlinkages are needed, and just as importantly, they need to analyse potential challenges and benefits in more depth.

In terms of thematic foci, smart cities seem to dominate from a governance perspective (a core focus in 40% of the reviewed articles), which is understandable given that urban areas gather most of the world's population and increasingly so (WHO, 2015). From a pure governance perspective, e-gov seems to offer increased possibilities to reach much higher levels of efficiency, effectiveness, transparency, and participation. Yet, it remains difficult to draw conclusions regarding the possible overall impacts of e-gov on sustainable development. Most opportunities identified by the authors of the reviewed articles relate to improvements in governance itself and not directly to sustainable development, and their indirect impacts on sustainable development.

From a methodological perspective, the reviewed sample provided a balanced number of articles using empirical and non-empirical methods, and while a conceptual part was present in 43% of the articles, it was often lacking in depth, which might explain

while few studies looked into the mechanisms through which e-governance could directly and indirectly impact sustainability.

From a sustainability perspective, 23% of the reviewed articles take a clear position, often describing e-governance very positively from a sustainability perspective, although the overall knowledge available on e-governance and in particular on the evaluation of potential drawbacks (e.g. digital gap) and rebound effects does not seem investigated enough to allow for general conclusions yet. It seems that an overly important focus has been given to the identification of opportunities (64% of the analysed statements), while developing a better understanding of the mitigating factors or preconditions (9% of the analysed statements) and drawbacks (13% of the analysed statements) did not seem to receive the same attention. Without necessarily implying that e-gov does not create more opportunities than challenges, analysing the link between e-gov and sustainability with a more neutral perspective and a more integrated approach is desirable. Such studies could help to identify the mechanisms through which more sustainability could be achieved as well as what could possibly go wrong in unexpected or undesired ways.

The problems e-gov is addressing differ based on the geopolitical and developmental context. There is for example a difference in terms of expectations between developed and developing countries, with developing countries rather looking into development opportunities while developed countries seem more interested in efficiency gains. Looking at the geographical areas studied, 37% (n=11) of the articles have a focus on developed countries exclusively, 23% (n=7) on developing countries exclusively, 7% (n=2) a focus on both developed and developing countries, and 33% (n=10) no particular geographical focus. While both developed and developing countries seem to be appropriately represented, more studies looking at a mix of developing and developed countries could help better identify and understand preconditions and limiting factors to sustainable development through e-governance.

Sustainable development is a spatially, temporarily and contextually defined concept, something well exemplified by the slightly different implications of e-gov on sustainability in developing countries as compared to developed countries (Saxena, 2005). Yet, most of the empirical studies are based on a limited number of cases, making conclusions difficult to generalise or compare. Only one of the studies included in the final reviewed sample came out of a partnership between authors based in developed and in developing countries. We think this is far too little and that more international collaborations should be pursued on the matter.

CONCLUSIONS AND OUTLOOK

Digitalisation trends are creating unprecedented changes in society, while changes in the political system are still happening at a much slower pace. With good governance being one of the most important preconditions for sustainable development, understanding this transformation of our governance systems and institutions from a sustainable development perspective seems very important in the context of the ambitious challenges and targets set by the 2030 Agenda for Sustainable Development and the Paris Agreements.

The main scientific contributions of this study are the systematically analysed and presented insights into the current state of research in the context of the digitalisation-governance-sustainability nexus providing findings addressing challenges and opportunities for sustainability arising from e-gov, as well as preconditions for sustainable e-gov. However, for future research, it could be promising to perform an even more extensive search with additional search terms, for instance by performing a detailed search on the key dimension of “governance for sustainability in the digital age” based on a semantic analysis of the SDGs as well as an analysis of the different dimensions and functions of a typical public governance system in the digital age. From an analytical perspective, it was sometimes difficult to label all statements precisely, e.g., when multiple interpretations were possible. The use of analytical tools (e.g. Maxqda) could maybe help do a more consistent and deeper analysis of the statements.

As a takeaway, we would like to emphasize the necessity to approach sustainable assessments of technology in general with more neutrality. Although studies looking into the possible opportunities or possible challenges of e-gov in solving a given problem are extremely useful, we think more attention has to be given to understanding the overall mechanisms at stake and direct as well as indirect impacts, which necessitates both a strong background in sustainability science and political sciences. So far, most studies have been looking into specific cases, or only direct implications of e-gov for sustainability, often from a limited sustainability perspective when it comes to the multiple dimensions at stake and the way in which the sustainability dimensions are intertwined. Strong interdisciplinary teams can make a difference in this context.

Comprehensively assessing the way in which the use of digital technologies could transform the governance paradigm towards sustainable development remains a difficult endeavour given the lack of universality of the concepts at stake and their dynamically changing nature.

Annex 1: search equations used in each database

Science Direct: pub-date > 2011 and TITLE (("e-government" OR "e-governance" OR egovernance OR egovernment OR "i-governance" OR "i-government" OR igovernance OR igovernment) OR ((ICT OR IT OR digital OR electronic OR smart) AND (governance OR government))) and TITLE ((sustainability OR sustainable))

Google Scholar: allintitle: (("e-government" OR "e-governance" OR egovernance OR egovernment OR "i-governance" OR "i-government" OR igovernance OR igovernment) OR ((ICT OR IT OR digital OR electronic OR smart) (governance OR government))) (sustainability OR sustainable)

Search limited to documents published in English after 2011, patents and citations excluded.

Scopus: TITLE (((("e-government" OR "e-governance" OR egovernance OR egovernment OR "igovernance" OR "i-government" OR igovernance OR igovernment) OR ((ict OR it OR digital OR electronic OR smart) AND (governance OR government))) AND (sustainability OR sustainable)) AND PUBYEAR > 2011 AND (LIMIT-TO (LANGUAGE, "English"))

Annex 2: keepers after 1st filtering

A critical reflection on smart governance in Italy: Definition and challenges for a sustainable urban regeneration (Garau, Balletto, & Mundula, 2017)
A dual channel, quality-based price competition model for the WEEE recycling market with government subsidy (Liu, Lei, Deng, Keong Leong, & Huang, 2016)
A game change in global health: The best is yet to come (Kickbusch, 2013)
A global perspective on cadastres & GEO-ICT for sustainable urban governance in view of climate change (D. Navarra & van der Molen, 2014)
Can information save energy? A three country comparison of words and actions in participatory local climate protection projects (Aichholzer et al., 2013)
A Green information technology governance framework for eco-environmental risk mitigation (Romli et al., 2017)
A survey of information technology governance capability in five jurisdictions using the ISO 38500:2008 framework (Mohamad & Toomey, 2016)
A survey on cloud-based sustainability governance systems (Truong, Phung, & Dustdar, 2012)
A sustainable information security framework for e-Government - case of Tanzania (Wangwe, Eloff, & Venter, 2012)
Smart utopia VS smart reality: Learning by experience from 10 smart city cases (Anthopoulos, 2017)
A tobacco-free world: A call to action to phase out the sale of tobacco products by 2040 (Beaglehole, Bonita, Yach, Mackay, & Reddy, 2015)
Access to Reliable Public Records as Evidence for Freedom of Information in Commonwealth Africa (Thurston, 2015)
Addressing sustainability in IT-governance frameworks (Stantcheva & Stantchev, 2014)
Municipal Contact Centres: A Slower Approach Towards Sustainable Local Development by E-government (Bernhard & Wihlborg, 2015)
ICT-enabled boundary spanning arrangements in collaborative sustainability governance (Termeer & Bruinsma, 2016)
Environmental nongovernmental organizations' digital media practices toward environmental sustainability and implications for informational governance (Nulman, Mözkula, & Özkula, 2016)

Global health governance in the sustainable development goals: Is it grounded in the right to health? (Van de Pas et al., 2017)
Sustainable IT Governance (SITG): Is COBIT 5 An Adequate Model? (Merhout & O'Toole, 2015b)
Assessing the side-effects of ICT development: E-waste production and management. A case study about cell phone end-of-life in Manado, Indonesia. (Panambunan-Ferse & Breiter, 2013)
Barriers and Solutions to Smart Water Grid Development (Cheong, Choi, & Lee, 2016)
Biofuels adoption in Nigeria: Attaining a balance in the food, fuel, feed and fibre objectives (Abila, 2014)
Comprehensive Knowledge Management Framework for Strengthening Sustainable e-Governance: Various Sectors of Rural India Productivity (Upadhyay & Kumbharana, 2012a)
Is China's e-governance sustainable? Testing Solow IT productivity paradox in China's context (Chen & Xie, 2015)
Enhancing the Control Objectives for Information and Related Technologies (COBIT 5) Framework for Sustainable IT Governance (Merhout & O'Toole, 2015a)
An empirical analysis of the relationship between environmental performance and sustainable e-governance in China (Yu, 2015)
Smart City Implementation Through Shared Vision of Social Innovation for Environmental Sustainability: A Case Study of Kitakyushu, Japan (Chatfield & Reddick, 2016)
Conceptualizing smartness in government: An integrative and multi-dimensional view (Gil-Garcia, Zhang, & Puron-Cid, 2016)
Cross-country comparison of voucher-based input schemes in sub-sahara Africa agricultural transformation: Lessons learned and policy implications (Obayelu, 2017)
Winning the SDG battle in cities: how an integrated information ecosystem can contribute to the achievement of the 2030 sustainable development goals (Corbett & Mellouli, 2017)
Determinants of the long term factors and effects of sustainability on usage of electronic government services: Evidence from the kingdom of Saudi Arabia (Al-Sammarraie, Rasheed, & Faieq, 2016)
Smart City Governance for Sustainable Public Value Generation (Ferro & Osella, 2017)
Sustainable development and citizen-centric e-government services (Nica, 2015)
E-Government ODA and Sustainability (Hong & Park, 2017)

Electronic Governance for Sustainable Development - Conceptual framework and state of research (Estevez & Janowski, 2013)
E-Governance services for sustainable livelihoods: MDGS based assessment (Misra & Raju, 2014)
Perceptual study of behavioural implications of usage of ICT for sustainable e-Governance in rural India (Upadhyay & Kumbharana, 2012b)
Enhancing the reach of public services through mobile governance: Sustainability of the Mobile Seva initiative in India (Kumar, 2016)
Environmental and economic life-cycle assessment of municipal water-storage options: Infrastructure refurbishment versus replacement (Eckelman, Altonji, Clark, Jenkins, & Lakin, 2014)
Evaluating the competitiveness of Indian metro cities: In smart city context (M. K. Singh, Gupta, & Kumar, 2017)
Smart cities: A global perspective (Hayat, 2016)
Understanding governance, ICT and organisation sustainability: Perspectives from donor funded small and medium enterprises (SMEs) in Uganda (Kokas Aupal & Ngaka, 2017)
Extended producer responsibility: The impact of organizational dimensions on WEEE collection from households (Corsini, Rizzi, & Frey, 2017)
Factors Influencing Electronic Government Social Sustainability (Abu-Shanab & Al-Quraan, 2015)
Major approaches towards understanding smart cities concept (Ishkineeva et al., 2015)
E-governance: An imperative for sustainable grass root development in Nigeria (Ojo, 2014)
Conceptual systemigram model: Impact of electronic governance on sustainable development (Khansari et al., 2016)
Impact of the smart city industry on the Korean national economy: Input-output analysis (Kim et al., 2016)
Generic services for cross domain use in e-government (Stasis, Kalogirou, & Tsiafoulis, 2014)
Get bill smart: A community-partnership approach to supporting low-income households to achieve home energy savings (Watson, Gabriel, & Rooney, 2015)
Going-Going-Green: Strategies for Fostering Sustainable New Federal Buildings (Patrick & Tolan, 2012)
Government IT Procurement Processes and Free Software (Iansiti, 2012)

Grassroots community participation as a key to e-governance sustainability in Africa (Ochara, 2012)
Use of Iodized Salt in Processed Foods in Select Countries Around the World and the Role of Food Processors (Ohlhorst, Slavin, Bhide, & Bugusu, 2012)
Hitching a ride towards sustainability: how sustainability is working its way into mainstream local government. A study in film/digital media (Blagg, 2014)
Enhancement of citizen's social life sustainability by ICT education and accessibility generating and distributing EGovernment content (Fatemeh, 2012)
ICT, public values and transformative government: A framework and programme for research (Bannister & Connolly, 2014)
Integration of proposed knowledge management framework with egovernance grid for sustainable egovernance in rural India (Upadhyay & Kumbharana, 2016)
Sustainable eGovernance? Practices, problems and beliefs about the future in Swedish eGov practice (Larsson & Grönlund, 2016)
Future-oriented eGovernance: The sustainability concept in eGov research, and ways forward (Larsson & Grönlund, 2014)
Exploring the relationship between e-government development and environmental sustainability: A study of small island developing states (Lee, 2017)
The 2010 Fifa World Cup as Sustainable Tourism: A Community Perspective (Paul Nkemngu, 2012)
The consequences of smart grids for the business model of electricity firms (Shomali & Pinkse, 2016)
Market-based biogas sector development in least developed countries -The case of Cambodia (Buysman & Mol, 2013)
Mitigating pollution of hazardous materials from WEEE of China: Portfolio selection for a sustainable future based on multi-criteria decision making (An et al., 2015)
Multicriteria decision analysis to develop effective sustainable development strategies for enhancing competitive advantages: Case of the TFT-LCD industry in Taiwan (Lu, Kuo, Lin, Tzeng, & Huang, 2016)
Smart cities in the new service economy: Building platforms for smart services (Anttiroiko, Valkama, & Bailey, 2014)
New hybrid web 2.0 adoption governance framework for public sector (Ramadan & Al-Qirim, 2015)

Toward smart governance and social sustainability for Chinese migrant communities (Lin et al., 2015)
Analysis of French generic medicines retail market: Why the use of generic medicines is limited (Dylst, Vulto, & Simoens, 2014)
OA policies and the sustainability of digital libraries of scholarly information (Chowdhury, 2014)
On IT governance structures and their effectiveness in collaborative organizational structures (Prasad, Green, & Heales, 2012)
Factors determining online sustainability reporting by local governments (Alcaraz-Quiles, Navarro-Galera, & Ortiz-Rodríguez, 2015)
PEPFAR, health system strengthening, and promoting sustainability and country ownership (Palen et al., 2012)
Five trends that matter: Challenges to 21st century electronic government (Scholl, 2012)
Assessing online consultation in participatory governance: Conceptual framework and a case study of a national sustainability-related consultation platform in Germany (Schulz & Newig, 2015)
Physician and patient willingness to pay for electronic cardiovascular disease management (Deal, Keshavjee, Troyan, Kyba, & Holbrook, 2014)
Assessment of legislation and practices for the sustainable management of waste electrical and electronic equipment in India (Pathak, Srivastava, & Ojasvi, 2017)
Powering China's sustainable development with renewable energies: Current status and future trend (Jia et al., 2015)
City Indicators on Social Sustainability as Standardization Technologies for Smarter (Citizen-centered) Governance of Cities (Marsal-Llacuna, 2016)
Fostering knowledge management and citizen participation via e-governance for achieving sustainable balanced development (Al-Sudairy, 2012)
The challenges of water, waste and climate change in cities (Koop & van Leeuwen, 2017)
Building electronic data infrastructure for comparative effectiveness research: Accomplishments, lessons learned and future steps (Randhawa, 2014)
Regional sustainability: National forest parks in Greece (Koliouka, Andreopoulou, Misso, & Borelli, 2017)
Relational power in the governance of a South African e-waste transition (Lawhon, 2012)
Risks and mitigation options for on-site storage of wastewater from shale gas and tight oil development (Kuwayama, Roeshot, Krupnick, Richardson, & Mares, 2017)

Rock caverns - Hong Kong's hidden land (Ng, Roberts, & Ho, 2016)
Role of project owner in e-government project sustainability (Anand, Seetharaman, & Vaidya, 2016)
Secondary resources and recycling in developing economies (Raghupathy & Chaturvedi, 2013)
Self-governance for sustainable global supply chains: Can it deliver the impacts needed? (Vermeulen, 2015)
Sustainable e-governance: The relationship among trust, digital divide, and E-government (Myeong et al., 2014)
Perspectives on the evaluation of geo-ICT for sustainable urban governance: Implications for e-government policy (D. D. Navarra, 2013)
Smart models for a new participatory and sustainable form of governance (Perillo, 2013)
Sustainable Rural Development Through ICT & E-Governance in India (Upadhyaya & Chugan, 2012)
Instituting environmental sustainability and climate resilience into the governance process: Exploring the potential of new urban development schemes in India (D. Sharma & Singh, 2016)
Social innovation for "smart" territories: fiction or reality? (Parada, 2017)
Spatially uneven development and low carbon transitions: Insights from urban and regional planning (Balta-Ozkan, Watson, & Mocca, 2015)
Sustainability of Public Debt in an AK Model with Complex Tax System (Kondo, Kondo, & Atsumasa, 2016)
Greening the economy: A review of urban sustainability measures for developing new cities (Addanki & Venkataraman, 2017)
Defining pace of urban development: E-governance in local bodies and public works departments (Emphasis on Indian Scenario) (Parishwad & Gupta, 2014)
Digital literacy and knowledge societies: A grounded theory investigation of sustainable development (R. Sharma et al., 2014)
Sustainable Rural Development through ICT & E-Governance in India (S. K. Singh, 2016)
Sustainable E-Waste Management in Asia: Analysis of Practices in Japan, Taiwan and Malaysia (Rasnan, Mohamed, Goh, & Watanabe, 2016)
Online dissemination of information on sustainability in regional governments. Effects of technological factors (NavarroGalera, Alcaraz-Quiles, & Ortiz-Rodríguez, 2016)

Promoting sustainability transparency in European local governments: An empirical analysis based on administrative cultures (Navarro-Galera, Ruiz-Lozano, Tirado-Valencia, & de los Rios-Berjillos, 2017)
Technological and organisational aspects of global research data infrastructures towards year 2020 (Karagiannis et al., 2013)
Real-time control water and wastewater network management. Optimizing and securing water distribution and preventing flood and pollution risks (Valentin et al., 2016)
Informational governance - A systematic literature review of governance for sustainability in the Information Age (Soma et al., 2016)
The Best-of-2-Worlds philosophy: Developing local dismantling and global infrastructure network for sustainable e-waste treatment in emerging economies (Wang et al., 2012)
The Public-Private Distinction in Global Governance: How Relevant is it in the Case of Voluntary Sustainability Standards? (Marx, 2017)
To realize better extended producer responsibility: Redesign of WEEE fund mode in China (Gu, Wu, Xu, Wang, & Zuo, 2017)
Tourism management and information and communication technologies (ICTs): The new smart destinations approach (Ivars Baidal, Solsona Monzonís, & Giner Sánchez, 2016)
How can 'smart' also be socially sustainable? Insights from the case of Milan (Trivellato, 2017)
Transformative Use of an Improved All-Payer Hospital Discharge Data Infrastructure for Community-Based Participatory Research: A Sustainability Pathway (Salemi, Salinas-Miranda, Wilson, & Salihu, 2015)
Uncovering the Recycling Potential of "new" WEEE in China (Zeng, Gong, Chen, & Li, 2016)
Understanding experts' views and risk perceptions on carbon capture and storage in three European countries (Karimi & Komendantova, 2017)
Urban policies and mobility trends in Italian smart cities (Pinna, Masala, & Garau, 2017)
Usage of European census data for sustainable land management – German case study (Klein & Müller, 2014)
Use of underground space for the development of cities in India (Goel, 2015)
What drives an environmental horticultural firm to start recycling plastics? Results of a Georgia survey (Meng, Klepacka, Florkowski, & Braman, 2015)
The antecedents and impacts of green eProcurement infrastructure: Evidence from the Indonesian public sector (Fathul, 2013)

Annex 3: final keepers after 2nd filtering

Can information save energy? A three country comparison of words and actions in participatory local climate protection projects. (Aichholzer et al., 2013)
Fostering Knowledge Management and Citizen Participation via E-Governance for Achieving Sustainable Balanced Development. (Al-Sudairy, 2012)
Smart utopia VS smart reality: Learning by experience from 10 smart city cases. (Anthopoulos, 2017)
Municipal Contact Centres: A Slower Approach Towards Sustainable Local Development by E-government. (Bernhard & Wihlborg, 2015)
Smart City Implementation Through Shared Vision of Social Innovation for Environmental Sustainability: A Case Study of Kitakyushu, Japan. (Chatfield & Reddick, 2016)
Winning the SDG battle in cities: how an integrated information ecosystem can contribute to the achievement of the 2030 sustainable development goals. (Corbett & Mellouli, 2017)
Electronic Governance for Sustainable Development - Conceptual framework and state of research. (Estevez & Janowski, 2013)
The antecedents and impacts of green eProcurement infrastructure: evidence from the Indonesian public sector. (Fathul, 2013)
Smart City Governance for Sustainable Public Value Generation. (Ferro & Osella, 2017)
Smart Cities: A Global Perspective. (Hayat, 2016)
Major approaches towards understanding smart cities concept. (Ishkineeva et al., 2015)
Conceptual systemigram model: Impact of electronic governance on sustainable development. (Khansari et al., 2016)
Impact of the smart city industry on the Korean national economy: Input-output analysis. (Kim et al., 2016)
Future-oriented eGovernance: The sustainability concept in eGov research, and ways forward. (Larsson & Grönlund, 2014)
Sustainable eGovernance? Practices, problems and beliefs about the future in Swedish eGov practice. (Larsson & Grönlund, 2016)
Exploring the relationship between e-government development and environmental sustainability: A study of small island developing states. (Lee, 2017)
Toward smart governance and social sustainability for Chinese migrant communities. (Lin et al., 2015)

City Indicators on Social Sustainability as Standardization Technologies for Smarter (Citizen-Centered) Governance of Cities. (Marsal-Llacuna, 2016)
E-governance services for sustainable livelihoods: MDGS based assessment. (Misra & Raju, 2014)
Sustainable e-governance: The relationship among trust, digital divide, and E-government. (Myeong et al., 2014)
Perspectives on the evaluation of geo-ict for sustainable urban governance: Implications for e-government policy. (D. D. Navarra, 2013)
A global perspective on cadastres & geo-ict for sustainable urban governance in view of climate change. (D. Navarra & van der Molen, 2014)
Sustainable development and citizen-centric e-government services. (Nica, 2015)
E-governance: An imperative for sustainable grass root development in Nigeria. (Ojo, 2014)
Smart models for a new participatory and sustainable form of governance. (Perillo, 2013)
Instituting environmental sustainability and climate resilience into the governance process: Exploring the potential of new urban development schemes in India. (D. Sharma & Singh, 2016)
Digital literacy and knowledge societies: A grounded theory investigation of sustainable development. (R. Sharma et al., 2014)
Informational governance – A systematic literature review of governance for sustainability in the Information Age. (Soma et al., 2016)
How can “smart” also be socially sustainable? Insights from the case of Milan. (Trivellato, 2017)
Sustainable rural development through ICT & e-governance in India. (Upadhyaya & Chugan, 2012)

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