IDENTIFYING THE DIFFERENT GENERATIONS OF EGOVERNMENT: AN ANALYSIS FRAMEWORK

Ongoing Research paper

New Directions for Digital Governance: Towards Government 3.0

Zoi Lachana, University of the Aegean, Samos, Greece, zoi@aegean.gr

Charalampos Alexopoulos, University of the Aegean, Athens, Greece, alexop@aegean.gr

Euripidis Loukis, University of the Aegean, Samos, Greece, eloukis@aegean.gr

Yannis Charalabidis, University of the Aegean, Samos, Greece, yannisx@aegean.gr

Abstract

For long time research and practice in the area of Electronic Government has been focusing on the use of information and communication technologies (ICT) for improving the efficiency and effectiveness of the internal operations of government agencies, as well as for providing electronic transaction services to citizens and firms. The increased needs and expectations of citizens, and the proliferation of 'participatory democracy' ideas, result in an increase of their direct participation in policy making processes, and the use of ICT seems to be an important facilitator of this. At the same time the multiple social problems and challenges to be addressed through policy-making, such as the increasing inequalities and poverty, the aging society, the environmental degradation, and the rising number of 'unpredictable' events, such as the financial and economic crises, necessitate the development of a new generation of eGovernment focusing on the design of effective responses - public policies for these challenges. Therefore evolutions in the needs of modern societies, in combination with technological evolutions in the ICTs, give rise to evolutions in e-Government, and the emergence of new generations of it. This paper aims at the identification and better understanding of the main characteristics of the different e-government generations, using an analytic framework based on two rounds of literature review. The results of the study provide insights on the main features of the three main e-Government generations, regarding their main goals, obstacles, key methods and tools, placing special emphasis on the new emerging generation of e-Government 3.0 and its basic characteristics.

Keywords: government 3.0, e-government 3.0, digital governance, eGovernment evolution

1 Introduction

The objective of Electronic Government research and practice has been the provision of ICT-based services to public servants, citizens and firms, aiming at efficiency and effectiveness improvements of the internal operations of government agencies, as well as enabling electronic transactions of citizens and firms with government (mainly through the Internet). As the expectations and needs of citizens and

societies in general are changing and growing, and also the capabilities offered by ICTs are evolving, it is inevitable to observe a shift in e-Government focus, and relevant ICT-based services provision. So there is an evolution of eGovernment, which is influenced on one hand by its wider external environment (such as the economic, political and social environment), and on the other hand its technological environment (emergence of new ICT). It is also subjected to emerging patterns of incremental improvements or more radical innovations that governments attempt to adopt, either by transforming the already existing services or by adopting new ones (Janowski T., 2015).

These evolutions have initiated several e-Government generations, which are driven by societies' problems and needs in combination with technological developments. The succession of different generations of e-government resulted in several definitions that have been formulated through years in order to describe e-government as the notion is evolving (Okot-Uma & London, 2000; El-Kiki et al., 2005; Chen et al., 2006). Numerous authors have been provided different definitions for these e-government generations, focusing on different characteristics of each generation (Basu, 2004; Maumbe et al., 2008; DiMaio, 2009; Baumgarten and Chui, 2009). Although there is an enormous frequency of use of the term "e-government", there is still not a clear and consistent understanding of the concept among practitioners and academia, and different meanings are assigned to it, with most of them focusing on the features of one of the e-Government generations that emerged in its evolution. Only a limited number of studies investigated and began to systematically consider questions related to the evolution of the domain (Karpchuk, 2017).

The current study aims to contribute to filling the above research gaps by making the following contributions: (i) it identifies the main characteristics and provides integrated definitions for the different e-Government generations; and (ii) it develops an analysis framework for this, setting up the analysis perspectives in the form of research questions towards the systematic investigation of e-government generations, which can be useful for relevant future research.

The rest of this paper is organized as follows. Section 2 provides background information on associated domains that illustrate similar evolution paths and should be considered in the analysis. Section 3 describes our methodological approach, while section 4 and 5 present the results of our research. Finally, section 6 includes conclusions and suggestions for further research steps.

2 Background

In many important economic and social activities, new ICTs, or new ways of exploitation of some existing ICTs, have caused important discontinuities and even disruptions of them (e.g. see literature on digital disruption, such as Christensen et al. (2015), leading to the emergence of new generations of them, with quite different goals and features from the previous ones. It is necessary to examine these ICT-induced new generations in all these activities, in order to identify similarities and differences, and also gain knowledge from them, which will enable us to be more prepared for the future generations in various activities that will be driven by various ICT. With the ICT constituting key enablers for the evolution and even the disruption of most sectors and activities, including the government one (through the development of e-Government), completely new opportunities for the societies, the private and the public sector, are being created for addressing complex problems and challenges, and for facilitating economic growth. So ICT has led in many economic and social activities to the emergence of new generations of them. The most widely debated and influential examples we can mention the areas of electronic content publishing (web) (O'Reilly, 2005; Choudhury, 2014; Rudman & Bruwer, 2016; Akhilesh Sharma, 2017), and also the industry (Lasi et al., 2014; Stock & Seliger, 2016; Roblek et al., 2016; Lu, 2017), where we can observe emergence of different generations: Web 1.0, Web 2.0 and Web 3.0 for the former, and also Industry "1.0", "2,0", "3.0" and occasionally "4.0" for the latter.

In, particular, in the area of electronic content publishing we can distinguish three generations of it, which have been driven mainly by ICT evolutions (O'Reilly, 2005; Choudhury, 2014; Rudman & Bruwer, 2016; Akhilesh Sharma, 2017). The first generation of the world wide web, the Web 1.0, also

called the 'Web of Documents', the published content has the form of interlinked through hypertext documents that contain text, images and videos, accessed via the Internet, which aim to be consumed and understood only by humans, who can only read this content, but have limited capabilities of interacting with if (for this reason this is also called the 'read-only' Web). Since 2004, Web 2.0 has been the term used to describe the new generation of it, which is called the 'social web', where social media and networking sites hold a prominent place, allowing users not only to consume (read) content developed by producers, but also to generate and publish their own content (for this reason it is called the 'read-write' web); also they allow the development of networks with other users for disseminating content and collaboration. These capabilities have profound consequences, as they give rise to new participatory, collaborative and distributed practices in many social and economic activities. The most recent generation, Web 3.0, is based on semantically structured documents, aiming to be consumed used not only by humans but also by machines (computers) as well. It is about a 'semantic' web of data, which through the semantic annotation of the data contained in a page, provide enhanced data search and link capabilities, allowing this web of data to interface better with itself, and also to feed data to other web applications being used by people around the internet. Web 3.0 technologies are the response to the ever-increasing amounts of data generated by the users and organizations, which have to be searched and exploited more efficiently. Furthermore, as no single platform will be able to handle such amounts of data, the necessity arises for the decentralization of the relevant services, which is reflected in the emergence of technologies like distributed computing or blockchain.

In the area of industrial manufacturing we can distinguish four generations of it, with the two most recent ones being driven also by ICT evolutions (Lasi et al., 2014; Stock & Seliger, 2016; Roblek et al., 2016; Lu, 2017). Its first generation, Industry 1.0, introduced the concept of mechanical mass production, by using water- and steam-powered machines, while Industry 2.0 utilized the power of electricity, while at the same time it developed new methods for increasing the efficiency and effectiveness of manufacturing facilities. Industry 3.0, also known as the 'third industrial revolution', was based on the development of electronic hardware and software, which was used for improving planning of industrial operations, as well as extending automation of previously manual production tasks; also these offered new services and capabilities based for optimizing warehouses management, which are completely beyond the realm of inventory control and shipping logistics. The most recent generation, Industry 4.0, refers to the advanced digitalization of both the production processes, and the products themselves as well (through the installation of sensors), and use of the 'Internet of Things' (IoT), big data, and analytics' technologies within factories, in order to generate new production-related information, which can be used for increasing further production efficiency.. Among the core characteristics of Industry 4.0 are: cyber-physical systems (physical systems with a variety of sensors transmitting wirelessly information about them to digital systems, which process this information, and then control through actuators the physical systems), smart products (with a variety sensors, which generate valuable information about their context, as well as their use, and transmit it to central digital systems, or to other objects, driving new forms of value creation for the consumer), and products/services extensive customization and personalization at mass production costs with the use of big data, which are an important factor driving Industry 4.0.

Furthermore, similar evolutions can be observed in many firm-level activities, which are highly important for firm's competitiveness and performance. A typical example is the customer knowledge management, in which we can distinguish four generations, KM 1.0 to KM 4.0 (Roblek et al., 2016) that have been driven also by evolutions in ICT. In this evolution in order to create knowledge about the needs and preferences of individual customers are used data initially from the Customer Relations Management (CRM) systems, and later from the social media in the subsequent generations. In the most recent generation KM 4.0 firms exploit data from sensors installed on products used by their customers, which are collected through the 'Internet of Things' (as the sensors are connected to it), and are processed through advanced big data analytics' techniques, and also used for providing to customers usage optimization services as well as condition-based and predictive maintenance services.

Since the ICT have such profound consequences on many important economic and social activities, leading to the emergence of new generations of them, it is important to investigate this in more detail

for the case of e-Government, exploiting the relevant knowledge obtained from the ICT-induced evolution and emerged generations in all these activities. It is important to understand better the different generations of e-Government, and the role that played for this evolution some disruptive ICT, which have driven, as mentioned above, important transformations and emergence of new generations in other economic and social activities, such as the social media (quite influential for the evolution of the electronic content publishing and the customer knowledge management) and the IoT as well as the big data analytics (quite influential for the evolution of the industrial manufacturing and the customer knowledge management).

3 Methodology

The research objective of this study is the identification and better understanding of the different generations of e-Government. In order to define to the necessary elements/perspectives of each generation to be examined and analysed we developed an analysis framework, based on Charalabidis et al. (2011) science base creation method, which has been used for the scientific foundation of the interoperability domain. This method has been adapted to the needs of this study. Each analysis element/perspective was converted into a research question. Table 1 presents the different analysis perspectives we used to investigate the major characteristics of each generation along with its detailed orientation.

As a second step, we proceeded with the identification of the main literature that contains the available definitions for the different generations of e-government. From a preliminary search we found that previous e-government literature distinguished three main generations of e-Government, referred to as "e-Government 1.0", "e-Government 2.0" and "e-Government 3.0", or even using terms such as "Government 1.0", "Government 2.0", and "Government 3.0". So this step aimed at answering the research questions of the analysis framework, by searching the EGRL (V. 13.5) and Google Scholar using the above terms as keywords, as well as "e-Government definition". So our intention was using these initially discovered keywords (without taking for granted any specific definitions or features of them) to find out the meaning assigned to them, and to above three e-Government generations, by relevant literature, and the existing definitions of them, as well as to understand the above seven important perspectives of them. We found 17 papers in total, which do not include sufficiently detailed information to provide all the necessary answers to the above seven research questions defined in our analysis framework (see above Table 1). However, they provided us more detailed keywords for conducting a second round of more extended literature search.

Table 1: Analysis framework and research questions

#	Main Perspective	Research Questions	Detailed Description
1	Main Goal	What is every generation aiming to achieve?	The result that each generation of eGovernment aims to achieve.
2	Main Method	How can their goal(s) be achieved?	An established, prescribed, or logical, practice or systematic process of achieving the main goal with accuracy and efficiency based on a credible approach.
3	Usual Application Level	Which is the targeted government level?	Related environment of offered services
4	Key Tool	Are there any factors in accomplishing their goal(s)?	A determining factor in accomplishing or achieving the main goal.
5	Key Obstacle/ Risk	Are there any obstacles?	A determining factor capable of preventing the main goal to be achieved. Could be a policy or the users' resistance to change.
6	Key ICT Area	Which technologies are being used?	Key enabling technologies allowing the deployment of the main method and the development of the key tool.
7	Most Needed Discipline, beyond ICT	Which are the important scientific discipline(s) to be leveraged?	Identification of the most important scientific discipline(s), beyond ICT, for the achievement of the major goal each generation, for the interdisciplinary field of e-government.

In Section 4 and in the Appendix we present the great diversity of definitions for each of the identified e-government generations, and also the combined keywords (e.g. "social media" AND "government") we used for each generation in the second round of extended literature search in order to answer the above seven more specific research questions. Scopus library was also included to this second round, in addition to the previously used EGRL (V. 13.5) and Google Scholar ones. We collected 126 papers,

from which initially were examined their abstracts, in order to select the most appropriate ones for answering the above research questions. Finally, 35 papers were selected as more relevant to be thoroughly analysed. It should be noted that in all the above papers we did not find a mention to any other generation of e-Government, and this confirms and validates the three generations identified from our preliminary search.

As a last step we proceeded to the description of the above mentioned seven main perspectives of each e-government generation, answering the defined relevant research questions, based exclusively on the analysis of these 35 gathered research papers (without taking anything for granted). Section 5 presents the different characteristics of each generation, along with a definition for each one of them, according to the analysis framework. This analysis allowed us to understand in-depth the different generations of e-government.

4 Definitions for e-government Generations

This section examines the different definitions of each e-government generation provided by the 17 papers found in the first round of literature search, which are shown in the Table of the Appendix. It also presents the combined keywords that were developed from each of them for the second round of the extended search. The examination of this Table results in the identification for all three e-Government generations of similarities and differences in the main focus of its definitions. It is observed that there is convergence about the main objective of Gov 1.0, to be the provision of information and services to citizens and business, as well as the development of government agencies' internal information systems for improving the efficiency and effectiveness of their internal operations and processes. There is also convergence regarding the major technology used in Gov 2.0, which is social media, used by Governments in order to increase the quantity and quality of its interactions with citizens and enterprises, and thus improve transparency and collaboration with them.

It also worth to mention that South Korea used the term "Government 3.0" first among all countries to describe its efforts mainly within its 'Open Government Partnership' (National Information Society Agency, 2013). It involves four main commitments: (i) to increase the availability of information about governmental activities; (ii) to support civic participation; (iii) to implement the highest standards of professional integrity throughout our administrations; and (iv) to increase access to new technologies for openness and accountability. We remark that the main elements of this South Korean definition for "Government 3.0" are actually the ones included in the existing definitions of "Government 2.0". As a conclusion, the use of "Government 3.0" in this country aimed mainly at political communication objectives, in order to enhance the image of government as promoter of technology and innovation.

5 Characteristics of the e-Government Generations

This section presents the different generations of e-government, along with their major characteristics as they are obtained from the papers found in both rounds of literature search. Table 2 briefly presents the key outcomes. Our study identifies the same obstacle for all of three generations of e-government, which is emphasized in all relevant papers: public sector mentality, which does not favour risk taking and innovation. Public servants and politicians seems to be reluctant to be early adopters of new technological advancements in order to achieve the main goal of each generation.

Except the similarities in each generation regarding the obstacles (research question 5), remarkable differences have been identified between the three generations in all the other examined perspective/research questions examined. For research question 1 about the main goal of each generation we can conclude there is a shift of the main goal/scope in e-Government through the years. While e-Government 1.0 pursues higher internal efficiency of government agencies and better transactional services by them,

for both the businesses and the citizens, e-Government 2.0 offers capabilities towards increasing citizens' participation, openness and accountability of governments, and thus enhancing democracy. Finally, e-Government 3.0 comes as the logical response to the deluge of data produced from the first and the second generation of e-Government (mainly large quantities of numerical data from complex internal information systems (IS), and also textual data from various social media sources), as well from new technologies (sensors, IoT, etc.); it is aiming to exploit these data for policy-making, societal problem solving, citizens' well-being (e.g. for citizen-level decision support services i.e. find the quickest route to your destination bypassing high traffic areas) and data-intensive decision making (policy informatics).

In order for these goals to be achieved, in e-Government 1.0 the most common method is interoperability between IS of government agencies, as well as towards central electronic 'one-stop shops' and national portals. In e-Government 2.0, social media and the capabilities offered by them play an important role for the development of new governance models, characterised by more participation of and collaboration with the society (individual citizens, communities, stakeholder groups, firms, professional and business associations), with the most advanced governments adopting this new way of communication with the citizens, as well as citizens' participation to governmental decisions. Moreover e-Government 2.0 emphasises on the opening and release of public data, by developing national and local open government data portals, towards greater transparency. In e-Government 3.0 the increased use of sensors and smart devices producing big data (e.g. concerning various infrastructures of cities), ranging from human text to sensor data, combined with advanced analytics and modelling, and possibly ubiquitous services (i.e. cloud), allowing the smart governance and data-intensive decision making.

The key ICT area of e-Government 1.0 emphasises on organizational infrastructures, while for e-Government 2.0 on social media, citizens' involvement, and open and big data, and for e-Government 3.0 focuses on analytics, modelling, artificial intelligence and Internet of Things. Finally, in order for all the above to be achieved the most needed 'complementary' discipline, beyond ICT, is management for e-Government 1.0, social and political sciences for e-Government 2.0, and a wide variety of disciplines for Government 3.0, concerning the multiple domains of government activity, such as economic, environmental and behavioural sciences.

Generally, it is clear that e-Government 1.0 focuses on informational and transactional services delivery, based on static ICTs and Web 1.0, while e-Government 2.0 uses the concepts of Web 2.0 in combination with various social media management tools and technologies, as well as textual data analysis techniques, for improving the transparency and openness in government, and at the same time for collecting useful information and knowledge from the citizens ('citizen-sourcing'). Following the obvious linkage of its predecessors, e-Government 3.0 is a connected concept with the Web 3.0 concept, utilising the web of data in such a way that permits societal problems solving and better informed policy making. E-Government 3.0 combines e-Government's 1.0 and e-Government's 2.0 capabilities, with the power of some emerging innovative technologies, such as AI and IoT, aiming at a substantial contribution towards better government decision support and policy making.

Summarizing the above-mentioned characteristics of these three e-Government generation, the definition of each of them can be formulated as follows:
- Government 1.0 (or e-Government 1.0) refers to the utilization of ICTs and other web-based technologies for improving or enhancing the efficiency and effectiveness of public service production and delivery to citizens and enterprises.

- Government 2.0 (or e-Government 2.0) refers to the use of the collaborative tools and approaches of Web 2.0, as well as to the opening of public information, in order to achieve more open, accountable and responsive government.

- Government 3.0 (or e-Government 3.0) refers to the use of new disruptive ICTs (such as blockchain, big data and artificial intelligence technologies), in combination with established ICTs (such as distributed technologies for data storage and service delivery), and taking advantage of the wisdom of crowd

(crowd/citizen-sourcing and value co-creation), towards data-driven and evidence-based decision and policy making.

Table 2: Generations of e-Government – main characteristics

#		e-GOV 1.0	e-GOV 2.0	e-GOV 3.0
1	Main Goal	Better Services (Millard, 2004; Silcock, 2001), internal efficiency (Lee et al., 2005; Von Haldenwang, 2004; Chen et al., 2006)	Openness (transparency) & Collaboration (Bonsón et al., 2012; Khan et al., 2014; Charalabidis & Koussouris; 2012).	Societal problem-solving (Hogan et al., 2017), citizen well-being (Bounabat, 2017), optimization of resources (Nam, 2013; Shin & Lee, 2015)
2	Main Method	Interoperability for Connected Governance (Gottschalk, 2009; Guijarro, 2007)	Open & Collaborative Governance (Bonsón et al., 2012; Charalabidis & Koussouris; 2012).	Smart Governance (Linders, et. al, 2015) & data-intensive decision making (Ojo & Millard, 2017; Nam, 2013)
3	Usual Application Level	National (Chadwick & May, 2003; Maumbe et al., 2008)	National & Local (Bonsón et al., 2012).	Local to International (Pereira et al., 2018; (Ojo & Millard, 2017; Nam, 2012; Nam 2015)
4	Key Tool	Portal (Ebrahim & Irani, 2005)	Social Media (Bonsón et al., 2012; Baumgarten & Chui, 2009; Boughzala et al., 2015)	Ubiquitous Sensors/Smart Devices/ Apps (Scholl, 2012)
5	Key Obstacle/ Risk	Public Sector Mentality (willingness to adopt; insufficient knowledge; lack of strategy) Business Mentality (siloed solutions; non-conformance to standards) Citizens Mentality (accessibility, digital divide) (Carter, & Bélanger, 2005; Carter & Bélanger, 2004; Choi, 2017)	Public Sector Mentality (willingness to adopt) Business Mentality (siloed solutions; non-conformance to standards) Citizens Mentality (trust, digital divide) (Bertot et al. 2010; Osimo, 2008; Picazo-Vela et al., 2012; Khan et al., 2014)	Public Sector Mentality (willingness to adopt) Business Mentality (non-conformance to standards) Citizens Mentality (digital divide) (Sang, 2014; Nam, 2015)
6	Key ICT Area	Organizational Infrastructures (Dittrich et al., 2003)	Social Media & Open, Linked and Big Data (Bonsón et al., 2012).	Artificial Intelligence & IoT (Pereira et al., 2018)
7	Most Needed Discipline, beyond ICT	Management (Ebrahim & Irani, 2005)	Social and Political Sciences (Nam, 2012; DiMaio , 2009; Taskforce, 2010)	A wide variety of disciplines concerning the domains of government activity, such as economic, environmental, behavioural sciences (Pereira et al., 2018)

Moreover, the first two generations of e-Government a considerable part of the reviewed relevant literature distinguishes two stages: the first is oriented towards the support of existing practices, processes and services of government agencies, while the second is oriented towards the ICT-based transformation of them (e.g. see Janowski (2015)). Also, it should be noted that despite the emergence of new generations of e-Government, there is continuing research interest in the previous ones as well, as they are extensively used by government agencies (absorbing bigger parts of their ICT budgets than the more recent ones), and pose important research questions that have to be investigated (for instance the IS for supporting the internal operations of government agencies, as well their electronic transactions with citizens and firms, of the first generation e-Government 1.0, are critical infrastructures for their everyday works and absorb most of their ICT budget, so it is highly important to conduct research for analyzing their performance, the problems they face, and propose improvements).

Finally, as e-Government 3.0 is the most recently emerged generation of e-Government, we have analysed in more detail the main characteristics of it identified by relevant literature:
- It has been motivated mainly by the need to respond to the challenge of exploiting the large amounts of useful data that has been collected by government agencies, for supporting their most demanding and critical tasks, which concerning decision-making and design of public policies, by using advanced technologies, such as machine learning, business analytics and Artificial Intelligence.
- Use of semantic web technologies for structuring the data, and enabling better search and exploitation of them; the use of the ontologies and tagged data allows the more efficient use of big data for decision-making and planning.
- Use of the Internet of Things (IoT): the use of a sensors, physical devices, home appliances networks, etc., allows the improvement of the collection and exchange of data for developing extremely efficient ICT solutions that provide valuable services to public servants, citizens and firms.
- Smart city integrated solutions: a large-scale use of the Internet of Things helps to address the challenges created by the continuing growth of cities, and to improve the citizens' quality of life.

- Citizens, gradually, move from a passive service beneficiary role, to a more active, engaged and co-creative one, contributing to public service innovation and problem-solving, and in general to public value 'co-creation'.
- Responsive and demand-driven government services: the use of new technologies not only allows for quicker response to the citizen concerns, but also allows the prediction of their future needs, for instance through predictive analytics machine learning algorithms.
- Availability of vast amounts of data leads to the use of AI and machine learning for data-driven decision-making based on policy modelling/analysis and game-based simulation techniques.
- Movement towards de-centralization: the necessity to deal with vast amounts of data efficiently (once only principle) and securely (principle of trustworthiness and security) warrant the use of distributed technologies like blockchain, which are expected to be widely used for government services (Ølnes, S. et al., 2017).
- A re-thinking of e-Gov 1.0 and e-Gov 2.0 infrastructures and services allows the optimization of resources usage.

6 Conclusion and Further Research

In the previous sections of this paper we have investigated the evolution of e-Government and identified three main generations of it. Our analysis has revealed that some ICTs, which have affected significantly the evolution of other important economic and social activities as well (see section 2), have affected critically the evolution of e-Government and have driven the emergence of new generations of it: a) the social media (which have been quite influential for the evolution of the electronic content publishing, as well as the customer knowledge management, were the main driver of e-Government 2.0); b) the IoT and the big data analytics (which have been quite influential for the evolution of the industrial manufacturing and the customer knowledge management, seem to be important for the emergence of Government 3.0). Based on relevant literature review, we analysed in-depth the three different generations that have emerged in the evolution e-Government, providing a better understanding of them.

In order for this to be achieved it was necessary to first develop an appropriate analysis framework: to properly identify their main analysis perspectives, i.e. their main characteristics of them to be examined. The basic perspectives and the characteristics we studied for these three generations of e-Government revealed the contribution and the usefulness of each generation to the public sector and society, as well as their main methods, tools and risks. Definitions for each generation were developed as a result of our research, and by comparing them, as well as the identified characteristics of them, their important differences were revealed in goals, orientations and means, and also their association with evolutions in needs and problems of societies, and in the ICT. As a last remark, this study divulges that even if a study, prototype or a service is conceptualised in the recent years, it could be categorised under or concern government 1.0 or 2.0. In other words, the 1.0 and 2.0 generations of e-government services have not stopped to produce solutions in European, national and local levels. The advent of Government 3.0 just refocus the target on the policy making.

Further research is required on one hand concerning the first two e-Government generations, in order to deepen our understanding of them: the use of the corresponding technologies, the transformations they have driven, their interplay with economic and social evolutions, and also possible growth stages they included. On the other hand, concerning the emerging e-Government 3.0 generation much more research is required, in order to address the fundamental questions it poses: How we can use these new disruptive ICTs (such as blockchain, big data and artificial intelligence technologies) in the public sector? – What major transformations they can drive in government agencies' operations and work practices, as well as in decision making, transaction and consultation with citizens and firms, and in general governance models? – How we can leverage knowledge from other scientific disciplines in the above directions?

References

Akhilesh Sharma Introducing The Concept Of Web 3.0 http://www.tweakandtrick.com/2012/05/web-30.html (accessed Dec 8, 2017)

Australian Government 2.0 Taskforce (AGT). (2009). Department of finance and deregulation: Engage: Getting on with Government 2.0. http://www.finance.gov.au/publications/gov20taskforcereport/. Accessed 9 Apr 2014.

Basu, S. (2004). E-government and developing countries: an overview. International Review of Law, Computers & Technology, 18(1), 109-132

Baumgarten, J., & Chui, M. (2009). E-government 2.0. McKinsey Quarterly, 4(2), 26-31.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. Government information quarterly, 27(3), 264-271.

Bonsón, E., Torres, L., Royo, S., & Flores, F. (2012). Local e-government 2.0: Social media and corporate transparency in municipalities. Government information quarterly, 29(2), 123-132.

Boughzala, I., Janssen, M., & Assar, S. (2015). E-Government 2.0: Back to Reality, a 2.0 Application to Vet. In Case Studies in e-Government 2.0 (pp. 1-14). Springer, Cham.

Bounabat, B. (2017). From e-Government to digital Government: Stakes and Evolution Models. www.revue-eti. net, 8.

Carter, L., & Bélanger, F. (2005). The utilization of e-government services: citizen trust, innovation and acceptance factors. Information Systems Journal, 15(1), 5-25.

Carter, L., & Belanger, F. (2004). The influence of perceived characteristics of innovating on e-government adoption. Electronic Journal of E-government, 2(1), 11-20.

Chadwick, A., & May, C. (2003). Interaction between States and Citizens in the Age of the Internet:"e-Government" in the United States, Britain, and the European Union. Governance, 16(2), 271-300.

Charalabidis, Y., Gonçalves, R. J., & Popplewell, K. (2011). Towards a Scientific Foundation for Interoperability. In (Y. Charalabidis ed.) Interoperability in Digital Public Services and Administration: Bridging E-Government and E-Business (pp. 355 - 373). Information Science Reference, Hershey New York.

Charalabidis, Y., & Koussouris, S. (Eds.). (2012). Empowering open and collaborative governance: Technologies and methods for online citizen engagement in public policy making. Springer Science & Business Media.

Chen, Y. N., Chen, H. M., Huang, W., & Ching, R. K. (2006). E-government strategies in developed and developing countries: An implementation framework and case study. Journal of Global Information Management, 14(1), 23-46.

Choi, Younghoon. (2017). Developing Governance: Back to the Future.

Choudhury, N. (2014). World Wide Web and Its Journey from Web 1.0 to Web 4.0. International Journal of Computer Science and Information Technologies, 5 (6), 8096 – 8100.Christensen, C. M., Raynor, M., and McDonald, R. (2015). What is Disruptive Innovation. Harvard Business Review, Dec., 44–53.

Di Maio, A. (2009). Government 2.0: Gartner Definition. Industry Research.

Dittrich, Y., Ekelin, A., Elovaara, P., Eriksén, S., & Hansson, C. (2003). Making e-Government Happen. Everyday co-development of services, citizenship and technology. In HICSS-36. IEEE Computer Society.

Ebrahim, Z., & Irani, Z. (2005). E-government adoption: architecture and barriers. Business process management journal, 11(5), 589-611

El-Kiki, T., Lawrence, E., & Steele, R. (2005). A management framework for mobile government services. Proceedings of CollECTeR, Sydney, Australia, 2009-4.

Gottschalk, P. (2009). Maturity levels for interoperability in digital government. Government Information Quarterly, 26(1), 75-81.

Guijarro, L. (2007). Interoperability frameworks and enterprise architectures in e-government initiatives in Europe and the United States. Government Information Quarterly, 24(1), 89-101.

Hogan, M., Ojo, A., Harney, O., Ruijer, E., Meijer, A., Andriessen, J., ... & Groff, J. (2017). Governance, transparency and the collaborative design of open data collaboration platforms: understanding barriers, options, and needs. In Government 3.0–Next Generation Government Technology Infrastructure and Services (pp. 299-332). Springer, Cham.

Janowski, T. (2015). Digital government evolution: From transformation to contextualization. Government Information Quarterly, 32, 221-236

Johannessen, M. R. (2010, August). Different theory, different result: Examining how different theories lead to different insights in government 2.0 research. In Proceedings of the 1st Scandinavian Conference of Information Systems and the 33rd Information Systems Research in Scandinavia (IRIS) Seminar(pp. 20-24).

Karpchuk, N. P. (2017). International Information: Guidelines.

Khan, G. F., Swar, B., & Lee, S. K. (2014). Social media risks and benefits: A public sector perspective. Social Science Computer Review, 32(5), 606-627.

Lasi, H., Fettke, P., Kemper, H. G., Feld, T. & Hoffmann, M. (2014). Industry 4.0. Business and Information Systems Engineering, 6, 239–242.

Lee, S. M., Tan, X., & Trimi, S. (2005). Current practices of leading e-government countries. Communications of the ACM, 48(10), 99-104.

Linders, D., Liao, C. Z. P., & Wang, C. M. (2015). Proactive e-Governance: Flipping the service delivery model from pull to push in Taiwan. Government Information Quarterly.

Lu, Y. (2017). Industry 4.0: A survey on technologies, applications and open research issues. Journal of Industrial Information Integration,, 6, 1–10.

Maumbe, B. M., Owei, V., & Alexander, H. (2008). Questioning the pace and pathway of e-government development in Africa: A case study of South Africa's Cape Gateway project. Government Information Quarterly, 25(4), 757-777.

Meijer, A., Koops, B., Pieterson, W., Overman, S. P., & Tije, S. T. (2012). Government 2.0: Key challenges to its realization.

Millard, J. (2004, August). Reorganisation of government back-offices for better electronic public services. In International Conference on Electronic Government (pp. 363-370). Springer, Berlin, Heidelberg.

Nam, T. (2012). Suggesting frameworks of citizen-sourcing via Government 2.0. Government Information Quarterly, 29(1), 12-20.

Nam, T. (2013, October). Government 3.0 in Korea: fad or fashion?. In Proceedings of the 7th International Conference on Theory and Practice of Electronic Governance (pp. 46-55). ACM.

Nam, T. (2015). Challenges and concerns of open government: A case of government 3.0 in Korea. Social Science Computer Review, 33(5), 556-570.

National Information Society Agency [NIA] (2013). Government 3.0: Dreaming New Korea. Available from http://www.gov30.kr. [Korean]

O'Reilly, T. What Is Web 2.0. Pattern Recognit. 2005, 30, 0–48.

Ojo, A., & Millard, J. (Eds.). (2017). Government 3.0–Next Generation Government Technology Infrastructure and Services: Roadmaps, Enabling Technologies & Challenges (Vol. 32). Springer.

Okot-Uma, R. W. O., & London, C. S. (2000). Electronic governance: re-inventing good governance. London: Commonwealth Secretariat.

Ølnes, S.; Ubacht, J.; Janssen, M. Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. Gov. Inf. Q. 2017, 34, 355–364.

Osimo, D. (2008). Web 2.0 in government: Why and how. Institute for Prospectice Technological Studies (IPTS), JRC, European Commission, EUR, 23358.

Pereira, G. V. et al., 2018. Scientific foundations training and entrepreneurship activities in the domain of ICT-enabled Governance. Delft, s.n.

Picazo-Vela, S., Gutiérrez-Martínez, I., & Luna-Reyes, L. F. (2012). Understanding risks, benefits, and strategic alternatives of social media applications in the public sector. Government information quarterly, 29(4), 504-511.

Roblek, V., Meško, M., Krapež, A. (). A Complex View of Industry 4.0. Sage Open April-June 2016.Rudman, R. and Bruwer, R. (2016). Defining Web 3.0: opportunities and challenges. The Electronic Library, 34(1), 132-154.Sandoval-Almazán, R., Gil-García, J. R., Luna-Reyes, L. F., Luna, D. E., & Díaz-Murillo, G. (2011). The use of Web 2.0 on Mexican state websites: A three-year assessment. Electronic Journal of E-government, 9(2), 107-121.

Sang Yun Lee·Myung ju Chung, "A Study on 'Platform' e-Government for Reducing the digital divide in a Multicultural Society of S. Korea", Journal of Digital Convergence, Vol. 12, No. 1, pp.1-12. 2014.

Scholl, H. J. (2012). Five trends that matter: Challenges to 21st century electronic government. Information Polity, 17(3, 4), 317-327.

Shin, K. H., & Lee, C. Y. (2015). A Study on Matters of Consideration in Building Cloud Environment through Analyses of Advanced Cases. International Journal of Applied Engineering Research, 10(21), 41753-41756.

Silcock, R. (2001). What is e-government. Parliamentary affairs, 54(1), 88-101.

Stock, G. & Seliger, G. (2016). Opportunities of Sustainable Manufacturing in Industry 4.0. Procedia CIRP, 40, 2016, 536-541.

Von Haldenwang, C. (2004). Electronic government (e-government) and development. The European Journal of Development Research, 16(2), 417-432.

Appendix: Definitions of e-Government Generations and Keywords

Definition	Reference	eGov Gen.	Extracted Keywords	Combined Keywords
Government 1.0 (or eGovernment) refers to the utilization of ICTs and other web-based telecommunication technologies for improving or enhancing on the efficiency and effectiveness of service delivery in the public services, towards citizens and enterprises.	Karpchuk NP, 2017	Gov 1.0	Internet, Information technologies, public sector, public services, quality of services, transformation ICT	Public sector internal information systems, Public sector transformation efficiency, transactional services information delivery with advanced maturity and functionality
Electronic government (e-government) aims to increase the convenience and accessibility of government services and information to citizens, businesses, and governmental units.	Carter and Belanger, 2005	Gov 1.0	Information, Accessibility, share, quality of services, services, society, public	
Electronic Government (eGovernment) refers to the processes and structures pertinent to the electronic delivery of government services to the public.	Okot-Uma, R. W. O., & London, C. S., 2000	Gov 1.0	Services, delivery of services, society	
E-government is the use of any information and communications technology (ICT) based initiative to improve government service delivery and internal processes.	Maumbe, B. M., et al., 2008	Gov 1.0	Transformation, reform Internet, delivery of services, quality of services, internal, ICT	
Electronic government (eGovernment) refers to the provision of government services through the use of information and communication technologies (ICTs).	El-Kiki, 2005	Gov 1.0	Transformation, reform, access, services, ICT	
eGovernment is a permanent commitment by government to improve the nature of the relationship between the private citizen and the public sector through enhanced, cost-effective, and efficient delivery of services, information, and knowledge.	Chen, Y. N., et al., 2006	Gov 1.0	Service delivery, Public sector efficiency	
eGovernment involves the automation or computerization of existing paper-based procedures in order to prompt new styles of leadership, new ways of debating and deciding strategies, new ways of transacting business, new ways of listening to citizens and communities and new ways of organizing and delivering information.	Basu, S., 2004	Gov 1.0	Transformation, accessibility, technologies, decision making, communication	
eGovernment involves using information technology, specifically the internet, to deliver government information, and in some cases, services, to citizens, businesses, and other government agencies.	Maumbe, B. M., et al., 2008	Gov 1.0	Internet, Information, service, Informational Delivery, Transactional, Advanced maturity, Functionality	
Government 2.0—the government's merger with Web 2.0 is a new notion for describing the current use of Web 2.0 technologies to socialize government services, processes, and data.	DiMaio A, 2009	Gov 2.0	Web 2.0, technologies, socialization, services, openness, political socialization	public sector transformation efficiency, emerged

The term e-government 2.0 points to the specific applications of social networks and Web 2.0 in the sphere of public services.	(Baumgarten and Chui, 2009).	Gov 2.0	Web 2.0, social media, public services, social network	web 2.0 technologies political socialization, user-generated content tools, openness and collaboration social network, social networks openness' and collaboration's
E-government 2.0 refers to the inclusions in government of features like social web, user-generated content, the delivery and use of open data, and network effects through more user engagement.	Boughzala, I., et al., 2015	Gov 2.0	Social media, open data, user-generated content, Web 2.0	
Government 2.0 refers to the use of the collaborative tools and approaches of Web 2.0 to offer an unprecedented opportunity to achieve more open, accountable, responsive and efficient government.	Taskforce, 2010	Gov 2.0	Web 2.0, openness, accountability, efficiency, collaboration, tools, technologies	
Government 2.0 refers to a government that uses interactive communication technologies to transform connections between government and citizens into increasingly open, social and user-centered relations.	Meijer, A., et al., 2012	Gov 2.0	Interaction, technologies, communication, openness, sociology, transformation	
The use Web 2.0 applications have the potential to generate greater interaction between different social actors, and as a consequence, greater citizen participation in government processes, have recently been termed 'Government 2.0'.	Sandoval-Almazán, R. et al., 2011	Gov 2.0	Web 2.0, applications, participation, services, transformation, reform	
Government 2.0 is an emerging area in both practice and research. The term emerged in blogs and technology news, and is related to the use of web 2.0 technologies in the public sector	Johannessen, M. R., 2010	Gov 2.0	Blogs, emerged technologies, web 2.0, public sector	
Government 3.0 refers to the use of disruptive ICTs (blockchain, big data and artificial intelligence technologies) in combination with established ICTs (distributed technologies for data storage and service delivery) and the wisdom of crowd (crowd-sourcing and co-creation) towards data-driven and evidence-based decision and policy making.	Pereira et al, 2018	Gov 3.0	Disruptive technologies, Blockchain, Big data, AI, Crowd, policy making, policy informatics, decision making, smart.	Smart services, government intelligent services, disruptive technologies, effectiveness of policy making, evidence-based policy making, policy driven electronic governance, dynamic decision support systems, AI in public sector
Government 3.0 can mean a Semantic Web-based government that personalizes all government services according to the conditions and preferences of each individual.	National Information Society Agency, 2013	Gov 3.0	Web 3.0, Semantic Web, personalized services	