

An Ontology of eGovernment

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Abstract. Amidst this rapid explosion of interest in eGovernment there is absent a clear definition of the concept and its domain. We review the extant definitions of the term and present an ontology of eGovernment to articulate its combinatorial complexity. The ontology parsimoniously encapsulates the logic of eGovernment. It moves away from technology-based conceptualizations to a systemic one. It makes the ‘elephant’ visible. It can be used to articulate the components and fragments which constitute eGovernment using structured natural English sentences and phrases. It serves as a multi-disciplinary lens to study the topic drawing upon concepts from information systems, knowledge management, public administration, and information technology. The ontology can be used to systematically map the state-of-the-research and the state-of-the-practice in eGovernment, discover the gaps in research and between research and practice, and formulate a strategy to bridge the gaps.

Keywords: eGovernment · Ontology · Gap analysis · Roadmap

1 Introduction

Advancements in information technology over the past twenty years have motivated many governments around the world to use it to improve their services. This initiative by the governments to electronify their services has been termed eGovernment or e-Government. The use of the term eGovernment has become common among researchers in the field; at least twenty three journals publish research on eGovernment [1].

Despite the widespread use of the term and an intuitive understanding of the same, there is a lack of agreement among researchers on the connotation of eGovernment. Yildiz [2] named this difficulty “definitional vagueness” of the eGovernment concept. The difficulties are associated with the complexity of the construct, not only because it is multidimensional but also because the dimensions are highly interconnected. Its complexity is combinatorial.

The focus of the literature to date has been mostly on the type of electronic medium used, the type of government for whom it functions, the target of its services, the types of services provided, and the overall purpose of its existence [2–4]. eGovernment

perspectives in the literature can be divided into those related to its availability (infrastructure and policies) and to its use (citizens, businesses, NGOs, government employees) [5]. Additional elements pointed out by Ndou [3] are the components of eGovernment which include the use of information technology to transform government in three critical areas (internal, external, and relational applications), the targets of the government actions (citizens, businesses, government organizations, and employees), and the domains of their applications (e-services, e-democracy, and e-administration).

Researchers and practitioners have focused selectively on different parts of the whole, neglecting the “big picture” – a theme analogous to the story of the five blind men and the elephant [6, 7]. This selectivity results in fragmentation of the research and development agenda; the sum of the parts simply falls short of making the whole. There is a need to articulate and make the combinatorial complexity of eGovernment visible to facilitate both the effective design and evaluation of eGovernment systems [8].

The eGovernment concept is a challenge many researchers have tried to tackle; but there are significant gaps in the research due to their selective focus. To discover and address these gaps systematically and systemically we propose an ontology. The main goal of this ontology is to provide a synoptic perspective to assess and guide eGovernment research and practice.

We will first review some of the key definitions of eGovernment and then logically deconstruct the concept using an ontology. We will then describe how the ontology can be used to define the domain of eGovernment, and how it can be extended, reduced, refined, and coarsened to adapt to the evolving technology and environment for eGovernment. Last, we will delineate how the ontology can be used to map the state-of-the-research and the state-of-the-practice in eGovernment, discover the gaps in research and between research and practice, and formulate a strategy to bridge those gaps and generate synergy – all with the goal of making the whole greater than the sum of its parts.

The problem with the definition of eGovernment arises from the “vagueness of the e-government concept” and the concept is limited for many reasons [2]. First, the eGovernment concept is guided by the objective of the activity instead of the technology used. Second, each definition emphasizes a particular set of pet issues of government, for example: accountability, transparency, interactivity, participation, and cost-effectiveness. Third, the term eGovernment has something of a hype and promotion in it. Fourth, the level of change needed for an eGovernment project is ambiguous. Although many researchers attempt to define eGovernment in an all-encompassing manner, there is still a need for a more complete understanding of it [1].

2 Definitions of eGovernment

The initial work on the use of information technology (IT) in public administration can be found in Garson [9]. It proposes four frameworks to conceptualize the relationship among public concern, policy development, and the potential of IT. These frameworks conceptualize: (a) eGovernment as the potential of IT in decentralization and democratization, (b) limitations and contradictions of technology, (c) interaction between the

technology and organizational-institutional environment, and (d) position of eGovernment within of global integration theories. The term eGovernment as such can be traced back to a model proposed by Layne and Lee [10] to assess the stages of eGovernment development. Their view of eGovernment focuses on the importance of the interaction between citizens, businesses, and government, and the need to assess the level of eGovernment development to identify the current state of development and to understand how to work towards the implementation of a more efficient government.

2.1 Frameworks and Models of eGovernment Development

The development of eGovernment research lags that of practice. This gap gives rise to many frameworks and models that assess the states of eGovernment research and practice from varying perspectives. On the one hand, the initial frameworks proposed by Layne and Lee [10] are based on advances in practice. On the other hand, there are many conceptual models and frameworks that assess the advances in research.

Models that assess the development of eGovernment in practice vary in the number of stages and the description of each one of them. Most of the stages contain different levels of technological sophistication, administrative integration, and citizen orientation [11].

The Gartner 2000 model [12] segregates the development of eGovernment into four stages: web presence, interaction, transaction, and transformation. Many of the subsequent models preserve the essence of those stages with semantic variations [10, 13–19]. Some models incorporate a fifth stage, usually called e-democracy, which refers to the involvement of citizens in online political processes [15, 16, 18, 20]. This fifth stage is necessary because it is used by governments to increase political participation, citizen involvement, and politics transparencies using online services such as online voting, polling, and surveys [18]. Most models locate the e-democracy as a fifth stage though some researchers [21] consider it an integral part of the earlier interaction stages instead of a standalone process.

Many researchers have proposed frameworks to assess the development of eGovernment research in the literature. Snead and Wright [22] analyzed 100 journals articles between 2007 and 2011 and proposed a framework that includes the government level (federal, state, local, tribal, and multiple levels), four research perspective categories (policy, governance, technology, and websites), and ten governance topics and sub-topics. They characterized the methodology of the papers based on research orientation (outputs, outcomes, processes, models, and theory), research purpose (exploratory, descriptive, and explanatory), data sources (primary and secondary), and research methods [22]. Results obtained using this framework, with the sample of journal articles, revealed various gaps in research efforts not only on important areas but also throughout different levels of government. The authors found that eGovernment research occurred at federal level (37 %), state level (19 %), local level (28 %), multiple levels (15 %), and tribal level (1 %). They also found that most attention were devoted to output studies (58 %) and outcomes studies (24 %). However, very little attention was given to the process as a research orientation, only 6 % of the sample.

Almarabeh and AbuAli [23] also proposed an eGovernment framework by answering three main questions, “What, Why and How E-government?” They also

addressed the ten questions proposed by the Working Group on eGovernment in the Developing World [24]. “Why are we pursuing E-government? Do we have a clear vision and priorities for E-government? What kind of E-government are we ready for? Is there enough political will to lead the E-government effort? Are we selecting E-government projects in the best way? How should we plan and manage E-government projects? How will we overcome resistance from within the government? How will we measure and communicate progress? How will we know if we are failing? What should our relationship be with the private sector? How can E-government improve citizen participation in public affairs?” [24, p. 8]. Finally, through the answers to these questions these researchers proposed some definitions and assessed the maturity of eGovernment addressing the challenges and opportunities for developing a successful eGovernment.

Many frameworks and models in eGovernment can be found in the literature. However their focus varies based on the researchers’ perspective. The main perspectives of analysis in eGovernment frameworks are the assessment of the advancement of a particular government – at local, provincial, central levels, the level of the technology used, the target and type of the eGovernment services, and the overall purpose of its existence. The other group of eGovernment frameworks is focused on the assessment of the research and scholarly literature that has been published on the topic. Among these the focus is divided between the availability of eGovernment (infrastructure and policies) and its use (citizens, businesses, NGOs, government employees) [2–5]. Additional elements are presented by Ndou [3] as mentioned earlier.

3 An Ontology of eGovernment

In this section we present a simple ontology of eGovernment as a systemic framework to systematically study the topic. More than a decade ago Kaylor et al. [25] bemoaned the lack of research “into the specific functions and services as they emerge on municipality websites.” [p. 293] To correct the situation they proposed a very broad definition of eGovernment as “the ability for anyone visiting the city website to communicate and/or interact with the city via the Internet in any way more sophisticated than a simple email letter to the generic city (or webmaster) email address provided at the site.” [25] They wanted to draw attention to the functions of an eGovernment articulated through the government’s website.

While local eGovernment research and implementation continue to be popular and important, there has not emerged a systemic framework to conceptualize it. Researchers and practitioners focus on different parts of the whole but not on the whole – analogous to the story of the five blind men and the elephant [6, 7]. There is a need to make the combinatorial complexity of eGovernment visible to facilitate their effective design and evaluation [8]. We use an ontology to represent the complexity of eGovernment and make it visible.

An ontology represents the conceptualization of a domain [26]; it organizes the terminologies and taxonomies of the domain. It is an “explicit specification of a conceptualization,” [27, p. 908] and can be used to systematize the description of a complex system [28]. “Our acceptance of an ontology is... similar in principle to our acceptance

of a scientific theory, say a system of physics; we adopt, at least insofar as we are reasonable, the simplest conceptual scheme into which the disordered fragments of raw experience can be fitted and arranged.” [29, p. 16].

We deconstruct eGovernment into four dimensions, each represented by a taxonomy (Fig. 1). They are, from left to right, Medium, Entity, Service, and Outcome. The dimensions and elements of the taxonomies are defined in the glossary below the ontology and described below. Four illustrative components of eGovernment derived from the ontology are listed below the ontology with examples. The ontology is applicable to eGovernments in general; however, we will focus on local/municipal eGovernments’ perspective only in this paper. The method can be generalized to the study of other eGovernments.

3.1 Medium

The ‘e’ in eGovernment indicates a fundamental shift in the media used by a government in its operation due to the revolution in information technology. The historical media for government operations were first people and then paper. The new medium is electronic. In the early stages of the information technology revolution personal computers were emblematic of the ‘e’, now in addition there are the smart phones and social media.

The government portals such as FirstGov.gov are an important step toward the use of electronic medium at the government level and the implementation of some critical legislation regarding the government’s use of IT – for example, Paperwork Reduction Act (PRA), Electronic Freedom of Information Act (EFOIA), Personal Responsibility and Work Opportunity Reconciliation Act (PRWORA), the Information Technology Management Reform Act (the Clinger–Cohen Act), and the E-government act. They also support the increased use of electronic means in government [2]. “Until the introduction of the Internet and widespread use of personal computers, the main objectives of technology use in government were enhancing the managerial effectiveness of public administrators while increasing government productivity. Until then, the main use of technology in government organizations was the automation of mass transactions such as financial transactions using mainframe computers” [30, p. 121]. Norris and Reddick [31] analyzed the level of eGovernment development and found that at least two thirds of the municipalities in their sample (1,326) had adopted at least one social medium.

The induction of new media – first paper and then electronic – has not eliminated the use of old media, but simply changed their role. People and paper continue to be important in the operation of even the most advanced eGovernment. The importance of people, for example, is illustrated by the emergence of contact centers [32] for providing service. Similarly, paper will continue to play a role in managing the long-term continuity of records from the past to the future [33].

Thus, we articulate the Medium dimension as a two-level taxonomy. At the first level are People, Paper and Electronics; and at the second level there are three subcategories of Electronics, namely: PC/Web, Smart phone, and Social media. (Note: Words which refer to the dimensions, categories, and subcategories in the ontology are capitalized to distinguish them from common usage of the same).

<u>Medium</u>	<u>Entity</u>	<u>Service</u>	<u>Outcomes</u>
People	Governments	Information	eGovernment
Paper	Local/Municipal	Transaction	eGovernance
Electronics (E-)	Provincial/State	Interaction	eDemocracy
PC/Web	Central/Federal		
Smart phone	Intermediaries		
Social media	Citizens		
	Businesses		
	NGOs		

[based system for]

[to provide/obtain]

[services for]

[functions]

Illustrative Components:

1. People based system for governments to provide/obtain information services for eGovernment functions. For example, visiting the municipal office to obtain information on parking zones and restrictions from the clerk.
2. Paper based system for citizens to provide/obtain transaction services for eDemocracy functions. For example, voting with paper ballot.
3. Electronics based system for businesses to provide/obtain interaction services for eGovernance functions. For example, online discussion on new city tax policies.
4. Electronics ^{social media} based systems for citizens to provide/obtain information services for eGovernment services. For example, posting city office closure messages on Facebook. (A subcategory is shown as a subscript.)

Glossary:

Medium: The medium for providing government services
 People: People based services
 Paper: Paper forms, document services
 Electronics (E-): Information technology based services
 PC/Web: Personal computer, worldwide web, internet based services
 Smart phone: iPhone, Android, and other smart phone based services
 Social media: Facebook, Twitter, Yelp, and other social media based services
 Entity: The entity providing or receiving the government services
 Governments: The different levels of government
 Local/Municipal: The lowest level of government
 Provincial/State: The government of a province or state, above the local/municipal government
 Central/Federal: The government of the country
 Intermediaries: Organizations aiding the relationship with the government
 Citizens: The citizens of the community governed by the local government
 Businesses: Businesses within the community and having relationship with it at its government
 NGOs: Non Government Organizations working with the community
 Service: The types of services provided and received by the entities
 Information: Providing and receiving information
 Transaction: Exchange of funds, material, services, and information
 Interaction: Continuing exchange of funds, material, services, and information
 Outcomes: The outcome of government
 eGovernment: Electronification of administrative functions
 eGovernance: Electronification of government decision and policy making
 eDemocracy: Electronification of political participation

Fig. 1. Ontology of eGovernment

3.2 Entity

Entities are the stakeholders in the eGovernment. The municipal/local government and the citizens are the central entities by definition in a democracy – the government is of the citizens, by the citizens, and for the citizens. Any local government has to operate in cooperation and collaboration with other local governments, the provincial or state

government, and the central or federal government. These other government entities can play a significant role in the effectiveness of the eGovernment.

Between the local government and citizens there may be intermediaries. On the one hand, eGovernment is intended to eliminate many traditional intermediaries (middlemen) to increase transparency in services like issuing licenses and permits [34]. On the other hand, there appears to be emerging a new type of intermediary such as a contact center [32] to help citizens with the new technology and processes. In the same vein public libraries too could be intermediaries [31].

Businesses drive the local economy and are driven by it. In addition, local and external businesses supply products and services to the local government and the local businesses. In performing their activities the businesses may need to interact with the local government to obtain information, provide information, obtain licenses, pay taxes, bid on contracts, etc. eGovernments are intended to make these interactions more efficient and effective. Thus, Businesses are an important entity.

Non-Government Organizations (NGOs), are usually non-profit entities which are neither businesses nor part of the government but provide important services in the locality. It may be a charity, a shelter for the homeless, or a free medical care facility. They play a significant role in many localities and constitute an important entity of the eGovernment.

Thus the taxonomy of Entities includes the Governments, Intermediaries, Citizens, Businesses, and NGOs. The three subcategories of Governments are: Local/Municipal, Provincial/State, and Central/Federal. The eGovernment Media have to support the functioning of the Local/Municipal government as well as its interactions with the other Entities, and perhaps among the entities at a later stage.

3.3 Service

The taxonomy of services reflects their typical evolution – for providing/obtaining information, to supporting transactions, and then to supporting interactions [31]. This is similar to Fan and Luo [35] scale of Cataloging, Interaction, and Transaction, and to providing Content, Services, and Engagement [36].

Information services are the most rudimentary. The eGovernment website may provide information about parking permits, snow removal, etc. It may also allow Citizens to input information about potholes, complaints, and community actions.

Transaction services can be a little more complex. They may include paying real estate taxes, water bills, traffic tickets, etc. They often require real-time exchange of information with privacy, validation, security, and other features.

Interaction services are the most complex. In contrast to transaction services where the volume of information exchanged may be small and the type of information simple, in interaction services the volume may be large and the information complex. An example would be eProcurement services [36, 37].

Research regarding the acquisition, management, storage, retrieval and use of information and data are very limited. Gil-García and Pardo [38] suggest that inconsistent data structures, semantic issues, and incomplete data can have an impact on the success of the eGovernment initiatives, and also the integration of the information and data at

different levels of governments need to be explored. Bhattacharya et al. [11] claim that most of the literature on government e-services are theoretical and based on theories of management. They also analyze the quality of the e-services throughout the government portals in India and argue that since they are designed and implemented only by the IT professionals, they fail to provide the services needed by the citizens [11]. They highlight the problems with multi-language, interface design, services, interoperability, and communication. Norris and Reddick [31] analyze the trajectory of local government in the United States through the survey of 1,326 municipalities. They found the development of services has not been as good as predicted and most of those services have been mainly about delivering information and services online but there are few transactions and limited interactivity. They show that in the USA, local governments offering information and communication applications through the web grew considerably between 2004 and 2011; however, transaction-based services have not been growing at the same pace because of the difficulty in their implementation on the web and their cost.

From Information to Transaction to Interaction, there is an increase in the complexity, cost, and difficulty of providing the services. The technology is capable of providing the services at all three levels. Moreover, the availability of similar services in other domains, for example – online purchasing, may increase the pressure on Local/Municipal eGovernments to provide similar services. An eGovernment has to provide all the three types of Services, using all the three Media, for all the Stakeholders. The Medium x Service mix may vary by the stage of development. At an early stage of development the Information Services may be Electronic and the Interaction Services People-based; at a later stage all but the most complex services may be Electronic.

3.4 Outcome

The taxonomy of outcomes is based on the posited stages of evolution of eGovernment into eGovernance to eDemocracy. We draw upon Moreno-Jiménez, Pérez-Espés and Velázquez [39] to distinguish between them as follows. eGovernment is what Moreno-Jiménez, Pérez-Espés and Velázquez [39] call “*e-Administration*, oriented towards the improvement of public services offered to the citizens” [and other Entities] by the local/municipal government. eGovernance is the “processes that are based on the intervention of the citizens and their representatives in public decisions relative to the government of society...” [p. 186] for example, policy making. eDemocracy extends the Services to some of the core functions of the democracy such as political participation [35] through e-Voting [39] and similar mechanisms.

Linders [40] analyzed the role of citizens in the coproduction or what has been labeled as “Citizen sourcing” for shaping policies at local level in areas as budget and mass collaboration. The author discusses the potential implications of electronic citizen coproduction for public administration, presents the limitations of this concept, and raises social concerns about the role and power of public citizens in government. Nam [41] suggests that citizen sourcing has also been studied as a source of collective decision-making and an input for policymaking, and calls for assessments of the impact of citizen sourcing in order to reveal if this is mainly a rhetorical issue or it is really significant for society.

3.5 Components of eGovernment

The four dimensions of the ontology are arranged left to right with connecting word/phrases to enumerate all the components of eGovernment in natural English. A component can be concatenated by combining a word/phrase from each dimension (column) and combining it with the interleaved word/phrases. Four illustrative components of eGovernment with examples are listed below the ontology (Fig. 1).

The ontology has $5 \times 7 \times 3 \times 3 = 315$ components encapsulated in it. It can be argued that these components constitute the domain of eGovernment systematically and systemically. In any government it is likely that only some of these components will be instantiated. Moreover, some components may be instantiated frequently and some infrequently. We will call the frequently instantiated components the ‘bright’ spots; the infrequently instantiated ones the ‘light’ spots; and the uninstantiated ones the ‘blind/blank’ spots [42]. A component may be ‘bright’ because it is important, or because it is easy to implement. By the same token, a ‘light’ component may be unimportant, or difficult to implement. Last, a component may have been overlooked and hence ‘blind’, or infeasible and hence ‘blank’.

4 Discussion – Ontology of eGovernment as a Lens

The ontology of eGovernment presented in this paper makes visible the combinatorial complexity of a growing topic in public administration. Our attempt seeks to include, refine, and extend previous definitions and conceptualizations.

The ontology is logically constructed but grounded in the theory and practice of the domain. The dimensions are logically specified and not empirically generated. They are deduced from the definition of the domain.

The logical construction of the ontology minimizes the errors of omission and commission. For example, the inclusion of all the three basic Media compels the researcher to explicitly consider their roles individually and in interaction with each other. Without consideration of Paper (error of omission), for example, the researcher is likely to overlook the continued importance of a medium (especially in the government to fulfil legal requirements) despite the highest level of electronication. Further, within Electronics, the ontology can help specify the individual media for combination of them, instead of specifying it generally (error of commission).

The ontology can be extended and refined to adapt to technological changes over time and contextual differences (say between countries). But the core of the ontology and its logic are constant. The differences between contexts and countries will be revealed in the different ‘bright’, ‘light’, and ‘blind/blank’ spots. In fact, to study the differences, the ontology/lens has to be held constant.

Last, the ontology is a multi-disciplinary lens. The Medium and Service dimensions are drawn from the information systems literature and refined for eGovernment; the Entity and Outcomes dimensions are drawn from the public administration literature. The ontology compels the user to analyze the eGovernment problem and synthesize solutions by drawing upon these disciplines.

5 Conclusion

There is a need to address the issue of eGovernment holistically, instead of doing so fragmentarily. There is also a need to map the research, policies, and practice of eGovernment systematically and systemically to understand the gaps within each, and between them. Understanding and bridging the two sets of gaps will be critical to the translation of research to policy to practice.

The proposed ontology of eGovernment can advance the state-of-the-research, state-of-the-policy, and the state-of-the-practice in the domain. It can be used to systematically identify the ‘bright’, ‘light’, and ‘blind/blank’ spots in the three states and between the two states. Such mapping will reveal opportunities for research, policy, and implementation. It can be used to develop a roadmap for eGovernment.

For a domain without a standard definition, the ontology can serve as the nucleus of a standardized definition. The ability to extend and refine the ontology makes it suitable to study the phenomenon at different levels of granularity in different contexts. The present ontology encapsulates most of the present definitions; it also highlights the gaps in them. It can be a starting point for the systematization of the domain, its knowledge, and application.

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