Quality Model for e-Government Processes at the University Level: a Literature Review

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ABSTRACT

Electronic Government (EGOV) refers to the use of digital technologies for improving government interactions with citizens and businesses. A major area in EGOV research is service delivery, and several classifications are available to categorize services provided by government institutions. However, there are also EGOV services that are delivered by non-government entities, like public registries, universities, and others. In particular, universities are institutions that have their own internal democratic government and have a great degree of autonomy from the political government. This paper presents findings of a literature review of research work produced in the last five years on the area of EGOV and quality assessment of EVOV services, from a Computer Science perspective, with special focus on EGOV services delivered by universities.

CCS Concepts

• **Applied computing~E-government**

Keywords

e-Government; Quality Model; Quality Assessment; University e-Government Services

1. INTRODUCTION

The concept of e-Government (EGOV) has been widely discussed and studied in recent years. As an example, knowing the level of citizens' satisfaction on services delivered through EGOV applications is a recurrent challenge for researchers in the area. Usually, EGOV refers to services provided by government agencies (districts or cities, regions, and countries), but there are also EGOV services that are delivered by smaller entities, such as non-government institutions – e.g. property registries, automobile registries, etc., as well as other autonomous institutions, like public universities, which have their own internal democratic government. In Argentina, the government of public universities is formed by students – graduate and postgraduate students, educators or teaching staff, and non-teaching staff, and they as a whole represent the university "citizens" that carry out their activities in the context of the regulations set forth by such governments. Therefore, to comply with university regulations, each university provides its citizens with a large number of services, which are in most cases, currently delivered through the use of Information and Communication Technologies (ICTs). We call such services University e-Government (U-EGOV) services. As any other services, and also due to the size of university communities, the quality of service provision can be accurately assessed.

According to [27], Argentina's higher education system currently comprises 129 educational institutions, 53 national universities, 3 state universities, and 7 provincial colleges of university level. It also has 50 private universities, 14 university colleges privately run, one international university and one foreign university. By 2014, Argentina had 1,871,445 undergraduate students and 144,152 graduate and postgraduate students. From these figures, 1,468,072 (78.44%) of undergraduate and graduate students were in public universities and 403,373 (21.56%) in private institutions. In addition, public higher education institutions had 76.59% of the total graduate enrollment, 115,400 teaching staff, and 46,469 non-teaching (administrative and support) staff.

This paper introduces the concept of U-EGOV services, presents quality assessment approaches and methods applied to such services, and presents a literature review of the area of EGOV and quality assessment and its application to U-EGOV services. Given the results obtained, there is scarce research work on U-EGOV services. Main contributions of this paper include the concept of U-EGOV services, and a landscape of the state of research on quality assessment of U-EGOV services.

After this introduction, the paper is structured as follows. Section 2 introduces main concepts of EGOV and U-EGOV; while Section 3, major standards of software quality assessment relevant to EGOV services. Section 4 presents and discusses findings of the literature review, depicting the state of the art. Finally, Section 5 draws some conclusions and future work.

2. E-GOV GENERAL CONCEPTS

The following sections introduces the concept and a classification of EGOV services based on service recipients, and the concept of U-EGOV services.

2.1 EGOV Services

EGOV is defined as "the use of Information and Communication Technologies, in particular the Internet, as a tool to achieve a better government" [4]. Governments deliver services to: citizens - Government-to-Citizens (G2C); companies - Government-to-Business (G2B), or other government agencies - Government-to-Government (G2G). The services provided by a government institution to any of these recipients, in particular through

Information and Communication Technologies (ICTs), are considered EGOV services.

2.2 U-EGOV Services

National universities in Argentina typically have a democratic government, whose highest authority is a Board of Directors comprising representatives of all "kinds of citizens" – i.e. graduate students, post-graduate students, teaching staff, and non-teaching staff, elected by their peers. Services provided by the university to these kinds of citizens, academic units, and external entities by means of ICTs, are called U-EGOV services. Examples include registering for an exam (to students), announcing lectures (to teaching staff and students), and paying salaries (to staff).

3. QUALITY MODELS

EGOV services are produced by software systems and therefore, assessed using widely accepted quality standards.

The International Organization for Standardization (ISO) and the International Electro-technical Commission (IEC) are the main authorities of standards related to international assessment of software. In Argentina, the Instituto Argentino de Normalización y Certificación (IRAM) - Argentine Institute of Standardization and Certification; is the only national body that has the authority to grant national validity to standards published by ISO or IEC.

Standards related to software quality can be classified into three major groups. The first group comprises standards related to the quality of software as a product. In this group, the standard IRAM - ISO/IEC 9126 [6] is one of the most relevant ones. It consists of four parts. The first part is the model that defines that product quality is based on the measurement of six attributes related to internal and external quality and four attributes related to use and the context in which the software is used. The other three parts define the metrics that have to be used to assess each of the attributes. The product assessment process must be carried out following IRAM - ISO/IEC 14598 – "Software Product Evaluation" [8] requirements. This standard has six parts: the first part describes the evaluation process, parts 2 and 6 deal with evaluation management, and parts 3, 4 and 5 provide guidelines based on the point of view from which the evaluation is to be carried out, namely, from a developer, a buyer and an evaluator's point of view, respectively.

The ISO/IEC 25000 standard [12], also known as SQuaRE (Software Product Quality Requirements and Evaluation) is a family of standards that has started the process of grouping all standards pertaining to software as product, gradually replacing existing ones. The ISO/IEC 25010 standard [13] is the new version of the ISO/IEC 9126, while the ISO/IEC 25040 standard [15] updates the ISO/IEC 14598 and adds new standards such as ISO/IEC 25012 "Data Quality Model" [14], among others. The adoption of standards under the SQuaRE denomination is still being evaluated by IRAM, therefore, they are not currently applicable in Argentina [13–15].

The second group of standards are those related to the software development process, including IRAM-ISO/IEC 12207 [7]. Such standards define the software lifecycle process, establish a common framework for software lifecycle processes from a global standpoint, and group processes related to the context in which the system and software-specific processes are developed. As a counterpart to the model proposed by the standard, there is the IRAM-ISO/IEC 15504 [9] - "Process Assessment" standard. It defines an assessment framework for software development processes, establishing two types of evaluations – by capability and by maturity level.

The guidelines established by the IRAM – ISO/IEC 90003 standard [10] for software process certification under standard IRAM – ISO 9001 [11] can be included in this group.

More generic in nature than the previous two, the third group includes standards related to software development organization management, such as the IRAM-ISO 9001 [11] standard, whose main objective is controlling that products or services meet applicable requirements, increasing customer and customer satisfaction and improving system efficacy.

4. LITERATURE REVIEW

To assess the state of the art on U-EGOV services and on the quality assessment of U-EGOV services, we searched on a scientific database – Scopus, for publications in which the terms "e-government" "electronic government", or "digital government" appear in their titles, abstracts or keywords, limited to 2010-2015 publications. The obtained results were analyzed based on: 1) publications per year, 2) publications of interest to Computer Science, 3) countries where research was conducted, and 4) publications from countries in the region. The search was further refined to consider the various quality standards mentioned in Section 3. The following sections present the findings.

4.1 EGOV-Related Findings

To give an overall idea of EGOV research, Table 1 shows results from the first search; in particular, the distribution of EGOV-related publications per year. As regards to the subject area, 63.9% of the publications are of interest (or address a topic related) to Computer Science. This shows that there is a positive relation between EGOV and computerization.

Table 1 Publications per year

Year	Publications per year
2015	124
2014	633
2013	720
2012	858
2011	1085
2010	1079
Total	**4499**

As regards to the geographic distribution, China and USA are clearly leading on the number of publications. Of interest to this research, countries in South America appear with less number of publications, while Brazil has the highest number of publications (100), Chile, Argentina and Uruguay has much less. Table 2 shows the geographic distribution of publications.

4.2 EGOV and Quality

Within EGOV-related publications, the search was further refined, first towards quality models and then towards assessment models. As shown in Table 3, only 51 publications linked EGOV and quality models, with 34 publications in the area of Computer Science (CS). When adding the term "assessment" as part of the filter, only 33 and 20 publications remained, respectively.

Finally, Table 4 shows the results of searching publications linking EGOV with the quality standards mentioned in Section 3. As figures show, there are very few results (research work) connecting EGOV and software-related quality standards.

Table 2. Geographic distribution of publications

Country	# of Publications
China	747
United States	636
United Kingdom	325
Australia	198
Spain	172
Greece	158
Italy	151
Malaysia	148
Germany	145
Netherlands	142
Brazil	107
Chile	17
Argentina	7
Uruguay	6
Bolivia	1

Table 3. Publications related to EGOV- and Quality

Search Term	# of Publications	Related to CS
Quality Model	51	34
Assessment	33	20

From the 20 publications that were included in the search results for the terms quality model and assessment within the area of Computer Science (see Table 3), five were discarded for not being related to the objective of this paper.

It should be highlighted that three targeted searches were carried out with the terms: 1) "e-government" and "university"; 2) "electronic government" and "university"; 3) and "digital government" and "university" for the period 2010-2015. As a result, only one article was found. However, the article was not related to the topic discussed in this paper.

Table 4. EGOV and ISO Standards

Standard	# of publications	Related to CS
ISO 9001	5	2
ISO/IEC 90003	0	0
ISO/IEC 9126	7	7
ISO/IEC 14598	0	0
ISO/IEC 25000	0	0
ISO/IEC 25010	2	1
ISO/IEC 25040	0	0
ISO/IEC 12207	0	0
ISO/IEC 15504	3	2
Total	**17**	**12**

4.3 Identified Publications

Publications were analyzed under four global concepts: 1) the quality model proposed (**Q-Model**); 2) the concept of citizen satisfaction (**Satisfaction**); 3) the evaluation or assessment technique (**Evaluation Type**), representing the technical aspects of the evaluation that were used to apply the model; 4) the application target of the model (**Target**), in particular, if the models were developed for EGOV services as part of a government agency (districts/cities, provinces, countries) or if they were developed for public entities of smaller size (e.g. public registries, universities, or others).

The models proposed by different authors are listed in Table 5. As shown, eight publications define the assessment feature based on different groupings of the classic McCall criteria [20]. Only Sivaji et al [25] and Ziembra et al. [27] refer to the use of ISO standards as quality model. In addition, [17, 21] mention other pre-existing models; while [26] discusses ergonometric and linguistic features, and the use of fuzzy logic for quality assessment.

Eight of the publications mention that the main objective of quality is gaining citizen satisfaction, and some authors describe the most relevant concepts to achieve this objective. Two articles argue that the use of quality models does not guarantee citizen satisfaction. Finally, most of the authors propose questionnaires, surveys, or interviews for the assessment of the suggested models.

Table 5. Selected Publications

Publication	Q-Model / Satisfaction / Evaluation Type	Focus
Bhattacharya et al 2012 [2]	Transparency, Technical Suitability, Usability, Completeness, Security and Privacy, Usefulness	EGOV in India
	The criteria do not guarantee citizen satisfaction	
	Questionnaires for users	
Louikies et al 2012 [19]	Service Layers, Efficiency, Efficacy, Impact on the User	Non EGOV e-Learning
Yucel et al 2010 [26]	Ergonomic, Linguistic	Non EGOV e-health
	Assessment through Fuzzy Logic	
Karking et al 2014 [16]	There is no integral assessment model. It uses traditional indicators	EGOV in Turkey
Papadomichel et al 2011 [22]	Efficiency, Trust, Reliability, Citizen Support	EGOV in Greece
	Satisfaction is perceived through various factors	
Funikul et al 2011 [5]	Availability, Objectivity, Usefulness, Integrity, Reliability	EGOV in Thailand
	Satisfaction as a measurement of success	
	Questionnaires for users	
Saha et al 2010 [24]	Efficiency, Privacy, Response Capacity, Web Assistance	EGOV in Sweden
	Satisfaction is focused on Efficiency, Response Capacity, Web Assistance	
	Questionnaires for users	
Misra et al 2013 [21]	GAP Model	EGOV in India
	Concept included in the model	
Alanezi et al 2012 [1]	Functionality, Procedures, Support	EGOV in Saudi Arabia
	Satisfaction in relation to categories	
	Questionnaires for users	
Loukis et al 2011 [18]	TAM acceptance technology	Non EGOV e-Learning
Byun et al 2011 [3]	Analytical test method to assess usability	EGOV in Australia
	Application Algorithms	
Sivaji et al 2014 [25]	Model based on user experience (usability). It uses the ISO 25010 standard.	EGOV in Malaysia
Liang et al 2014 [17]	KANO Model, 30 attributes that affect user satisfaction	EGOV
	It identifies attributes to improve satisfaction	
	Questionnaires for users	
Sa et al 2014 [23]	Bibliographic review	--
	It includes the concept of satisfaction	
Ziemba et al 2014 [27]	It uses the model defined by ISO to evaluate a set of e-gov portals	EGOV in Poland

In relation to the target, only three of the publications [18, 19, 26] use the concept of e-government for smaller-sized public organizations.

5. CONCLUSIONS

This paper addresses one initial stage in our research work on U-EGOV services and their quality assessment. We presented a classification of EGOV services and introduced such concept for services delivered by universities through digital technologies (U-EGOV services). To further explore the topic, findings from a literature review on the area were presented.

After analyzing the set of identified publications, we observe a peak in the number of EGOV-related publications during 2010-2011, after which a decrease in the number is noticeable. Most of the publications are originated in China and the United States. In the South America region, Brazil has the largest number of publications.

As regards to quality models applied, most of the proposals are linked to McCall attributes, while only two use the international standards proposed by ISO. The main application target of the models have been government bodies. There is also an incipient application of these models to smaller-size organizations. The concept of citizen satisfaction is present in half of the publications, and the most commonly used method to evaluate the models is a questionnaire.

We conclude that research work on EGOV in the context of universities is scarce and, therefore, carrying out a diagnostic study on the quality of the services provided by these institutions poses a significant challenge.

6. ACKNOWLEDGEMENTS

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