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Ernani Marques dos Santos
Federal University of Bahia, ernanims@gmail.com

Nicolau Reinhard
University of São Paulo, reinhard@usp.br

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Barriers to Government Interoperability Frameworks Adoption

Ernani Marques dos Santos
Federal University of Bahia, Brazil
ernanim@gmail.com

Nicolau Reinhard
University of São Paulo, Brazil
reinhard@usp.br

ABSTRACT

Interoperability is a crucial issue for electronic government due to the need of agencies' information systems to be totally integrated and able to exchange data in a seamless way. A way to achieve it is by the establishing of a Government Interoperability Framework (GIF). However, this is a difficulty task to be carried out, due not only to technological issues but also other aspects. This research is expected to contribute to the identification of the barriers to the adoption of interoperability standards for electronic government. The paper presents the preliminary findings from a case study of the Brazilian Government framework (e-PING), based on analyses of documents and face-to-face interviews. It points out some aspects that may influence the establishment of these standards, becoming barriers to their adoption.

Keywords

Interoperability, government interoperability framework, standards adoption.

INTRODUCTION

One of the biggest challenges of implementing electronic government is to promote modernization and integration of fragmented systems to form a technological infrastructure able to support the improvements of services offered to citizens, such as the reduction or elimination of the need to access several agencies in order to receive information or services. Nevertheless, integration of systems and information sharing do not mean only data exchange but, mainly, integration of processes and transactions. Therefore, in order to get seamless integration, government agencies face several political, technical, economic, social and organizational challenges.

Interoperability is established through networks and systems that are able to correctly receive transfer and use data from different information systems. It is based on technologies that interact with each other, building an information network ready to be used in real time by different agencies. The result is an increase in the quality of public services and in citizen's life.

However, government agencies' acquisition and internal development processes may lead to solutions that are unable of being integrated with other agencies' networks and systems, resulting in tasks overload and duplication of data storage. The consequences are bureaucracy increase, higher services costs and emergence of barriers to provide a quicker response to citizen's demands. A way of reducing these problems is the adoption of interoperability frameworks. Interoperability allows reduction of operational costs, a higher level of information integrity and effective financial and administrative integration among the different agencies.

A standard can be defined as a group of specifications to which all products, processes, formats, or procedures under its jurisdiction have to agree (Tassej, 2000). For David and Greenstein (1990), a standard can be understood as a group of technical specifications stuck by a group of vendors, tacitly or as the result of a formal agreement.

David and Greenstein (1990) distinguish three types of standards: reference, minimum quality and compatibility. Compatibility standards (which include interoperability standards) play a relevant role in the Information Technologies field because they enable data interchange between components from a system or between different systems (David and Steinmueller, 1994; Williams et al., 2004).

According to United Nations the ideal environment for electronic government must provide a unique point of access to information and services for the users. In this context, it is easy to see the need of the adoption of standards, based on the requirements of systems integration and the information sharing of the involved agencies. In addition, previous studies about information sharing for electronic government pointed out that the standardization as a form of supporting compatibility is a conditioning factor in these processes (Akbulut, 2003; Dawes, 1996; Landsbergen Jr. and Wolken Jr., 2001).

Standardization is an important action to enable information sharing in information systems. Therefore, it is necessary to define compatibility standards to be adopted among those systems (Dos Santos & Reinhard, 2007).

However, although information sharing among government agencies is a common objective, the scope of this interoperability is still limited (Dawes and Bloniarz, 2001). Even recognizing the importance of the sharing and the significant benefits that it brings to the policy makers, public organizations and to the public in general, the government agencies face several barriers that constrain the effective implementation of the interoperability (Dawes, 1996; Landsbergen and Wolken, 2001; Rocheleau, 1997).

A common approach undertaken by governments to address the problem of interoperability is the adoption of standards by agencies when developing new or upgrading existing IT systems. These technical standards, policy principles and guidelines are generally published by Governments in the form of an Interoperability Framework (Ray, Gulla and Dash, 2007). The objective of this collection of specifications is to facilitate the interoperability of government systems and services.

Aiming at identifying some of the barriers for adoption of interoperability standards for electronic government, this paper presents the preliminary findings from a case study of the e-PING framework, an evolving set of interoperability standards for electronic government established by the Executive Branch of the Brazilian Federal Government.

INTEROPERABILITY

Interoperability is the ability of a system or process to use information and/or functionality of another system or process through the adherence to common standards. According to Archmann and Kudlacek (2008), it is the ability of systems to communicate, interpret and interchange data in a meaningful way. In other words, it is the ability of two or more systems of interacting and exchanging data according to a defined method, in order to obtain the expected results. IEEE (2000) presents four definitions:

- the ability of two or more systems or elements to exchange information amongst themselves and to use those information that were exchanged;
- the capacity of equipments units of working together to accomplish useful functions;
- the capacity, promoted but not guaranteed by the adhesion to a certain group of standards, that enables heterogeneous equipments, usually manufactured by several suppliers, to work together in network environment;
- the ability of two or more systems or components to exchange information in a heterogeneous network and to use this information.

Interoperability can be also defined as the ability of government organizations to share information and integrate information and business processes by use of common standards (State Services Commission 2007).

E-government interoperability is the process by which independent or heterogeneous information systems or their components managed by different jurisdictions/administrations or by external partners work together in predefined and agreed terms and specifications (Gottschalk and Solli-Saether 2009).

Interoperability can bring several benefits to government, such as more effectiveness (interconnection instead of isolated solutions), efficiency (reduction of the transaction costs and increase of the involved agents' participation), and responsiveness (better access to more information, making possible faster resolution of the problems) (Landsbergen Jr. and Wolken Jr., 2001).

One way to achieve electronic government interoperability is by the establishment of a Government Interoperability Framework (GIF) - a set of standards and policies that a government uses to specify the preferred way that its agencies, citizens, and partners should interact with each other. This interoperability framework is composed by a range of technical specifications, systems, standards, guidelines and policies that are supplementary to each other (EPAN, 2004). According to IDABC (2004, p.5), a GIF is "a set of standards and guidelines which describe the way in which organizations have agreed, or should agree, to interact with each other". The framework includes the technical specifications that all agencies involved in electronic government implementation should adopt (Guijarro, 2007).

BARRIERS TO INTEROPERABILITY

Goldkuhl (2008) states that interoperability is perhaps the most important issue of e-government. According to the author, the establishment of advanced solutions with integrated e-services and one stop government imply high demands on e-government interoperability. Several other authors have pointed out the importance of e-government interoperability, e.g. Cava and Guijarro (2003), Benamou et al (2004), Klischewski (2004), Bekkers (2005), Klischewski and Scholl (2006).

However, there are several barriers for organizations to achieve interoperability broadly and effectively. These barriers can be classified as being of a political, organizational, financial or technical nature (Anderseen & Dawes 1991):

- political - definition of the guidelines for the adopted policies; conflicts in the definition of the levels of privacy regarding access to information; predominant organizational culture; ambiguity of the authority regarding collection and use of information; administrative discontinuity;
- organizational - lack of experience and absence of a willingness to share; level of skills of the personnel involved in the processes; organizational culture;
- financial - other agencies' lack of resources for providing information; how the resources are acquired (usually based on the criteria of lowest price rather than of best value);
- technical - hardware and software incompatibility; property rights; insufficient awareness of data generated and stored by the systems; multiple data definitions.

Scholl and Klischewski (2007) also argue that there are several constraints that influence the interoperability. According to these authors, these constraints can be classified as constitutional and legal, jurisdictional, collaborative, organizational, informational, managerial, cost, technological and performance.

Each of the nine constraining influences on electronic government integration and interoperability are described by Scholl and Klischewski (2007, p. 893) as follows:

- **Constitutional/legal:** Integration and interoperation may be outright unconstitutional because the democratic constitution requires powers to be divided into separate levels and branches of government. The US constitution, for example, separates government into federal, state, and local government levels and into legislative, judicial, and executive branches. Total integration and interoperability between and among branches and levels would virtually offset that constitutional imperative of checks and balances. On the other hand, the constitution also affords and sanctions integration and interoperation within certain boundaries.
- **Jurisdictional:** Since under the constitution, governmental and non-governmental constituencies operate independently from each other and own their information and business processes, neither integration, nor interoperation, nor information sharing can be imposed on them, rather as an independent entity each constituency's participation in any interaction is voluntary. However, by means of jurisdictional authority, the government entity can engage in integration and interoperation with other entities.
- **Collaborative:** Organizations are distinct in terms of their disposition and readiness for collaboration and interoperation with others. Past experience, socio-political organization, and leadership style influence the degree of proneness and adeptness of potential interoperation. However, in cases of compatible leadership styles, adequate socio-political organization, and positive past experiences, integration and interoperation might flourish.
- **Organizational:** Organizational processes and resources may differ between organizations to such an extent that integration and interoperation might prove exceedingly difficult to achieve without standardizing on processes, systems, and policies. Yet, where organizations align their organizational context they enable themselves to enjoy increased degrees of integration and interoperation.
- **Informational:** While transactional information might be more readily shared, strategic and organizational information might be not; also, information quality issues arise when integrating information sources across various domains of control and quality standards. Still, information stewardship fosters use of shared information, which in turn fosters stewardship for sharing information.
- **Managerial:** Interoperation becomes inherently more complex the more parties with incongruent interests and needs become involved. As a result, the demands of the respective management task might exceed the management capacity of interoperating partners. However, along the lines of shared interests, interoperation and integration can materialize.
- **Cost:** Integration and interoperation between diverse constituencies might be limited to the lowest common denominator in terms of availability of funds: also, unexpected budget constraints might pose serious challenges to

long-term interoperation projects over time. On the other hand, information-sharing initiatives have reportedly helped contain cost. Within the cost boundaries of the respective partners, certain projects appear to be sustainable.

- **Technological:** The heterogeneity of E-Government platform and network capabilities might limit the interoperation of systems to relatively low standards. On the other hand, an increasing number of E-Government information systems might adhere to higher standards over time, such that increased interoperation becomes possible.
- **Performance:** As performance tests suggest, the higher the number of interoperating partners, the lower is the overall system performance in terms of response time. Yet, the focus on prioritized needs might enable fewer but more effective interoperations.

Gottschalk and Solli-Saether (2009) state that these nine constraints represent a complex environment for electronic government interoperation. According to Scholl (2005) the technology issues may be considered as the least difficult barriers to address, while the organizational, legal, political, and social aspects may be much more of a challenge.

RESEARCH METHODOLOGY

The research consisted of a case study based on analyses of documents and face-to-face semi structured interviews. The analysis was exploratory and sought to understand a contemporary phenomenon within its real context; therefore, a single case study analysis is considered appropriate (Yin, 2002). A case study allows the researcher to understand the nature and complexity of the processes taking place and it is a way to research an area in which few previous studies have been carried out (Benbasat et al., 1987). It is also useful when a phenomenon is broad and complex, where the existing body of knowledge is insufficient to permit the posing of causal questions, and when a holistic, in-depth investigation is needed (Bonoma, 1985; Benbasat et al., 1987). The object of the case study was the Brazilian Government Interoperability Framework (e-PING).

Aiming at identifying the barriers of the framework's adoption, it was analyzed data collected through two surveys. These surveys were conducted by the project coordination group through web questionnaires made available in the internet on a page managed by the Ministry of Planning, Budget and Management, the executive agency of the project. The requests for completion of the questionnaires were sent by email to IT managers from agencies of the direct and indirect administration of the Federal Executive Branch. The objective was to investigate the level of adoption of the e-PING by government agencies and its ICT service providers. The questions included issues as general vision of the e-PING, policies of the researched institution in relation to the use of ICT and specific topics for each segment covered by the architecture. The first request was sent for 66 agencies and it was obtained a total of 45 replies (approximately 68%). The second one were sent for 52 agencies and got a total of 44 replies (about 85%).

In addition, it was conducted structured interviews with coordination group members to discuss the answers given to the questions by the IT managers. It was also made an analysis of the documents that specify the standards guidelines and the reports of the actions taken by the Federal Government to implement them

CASE DESCRIPTION

The Brazilian Government Interoperability Framework (e-PING) is an architecture that defines a minimum set of premises, policies and technical specifications that rule the usage of ICT in the Federal Government, establishing the conditions of its interaction with the other government institutions (including states and municipalities), and with society (Brasil, 2008).

The e-PING is considered as a basic structure for Brazil's electronic government strategy, to be applied initially to the Executive Branch of the Federal Government. However, the architecture envisaged covers the exchange of information between the Federal Executive Branch and citizens, state and municipal governments, the Legislative and Judicial Branches of the Federal Government and the Federal Public Prosecutor's Office, international organizations, governments of other countries, Brazilian and international businesses, and the Third Sector (NGOs, Civil Society Organizations, etc.). The e-PING standards are mandatory in the Federal Executive Branch (including federal public agencies and other federal entities) for all new information systems, for legacy systems involving the provision of e-government services or interaction between systems, and other systems involved in the provision of e-government services (Brasil, 2008).

The framework covers five broad segments: interconnectivity, security, access means, organization and exchange of information and areas and issues for electronic government integration (Table 1).

Segments	Covered issues
Interconnectivity	Conditions for government agencies to connect to each other and to external institutions.
Security	Security aspects to assure operations validity and privacy
Means of access	Devices for accessing to the services of electronic government.
Organization and exchange of information	Issues related to the management and transfer of information.
Areas and issues for electronic government integration.	New ways of integration and exchange of information based on the definitions of e-PING.

Table 1. Definition of the segments of the and-PING

In order to discuss the specifications of the standards that compose the framework, there are five work groups, one for each covered segments. Each group is responsible for promoting meetings and discussions about their related area and for presenting the results to the other groups. There is also the Coordination Group that is responsible for managing the activities of the work groups as well presenting and discussing the project with others institutions from the public and private sectors.

A versioning scheme was established based on a two stage model (Figure 1): (1) development – when the discussions about the specifications of the standards that will compose the framework are carried out, and (2) implementation – when the draft version of the framework is published and submitted to evaluation by public hearings and consultations. The suggestions received in the latter phase are discussed and, when accepted, included in the document and the final version is released.

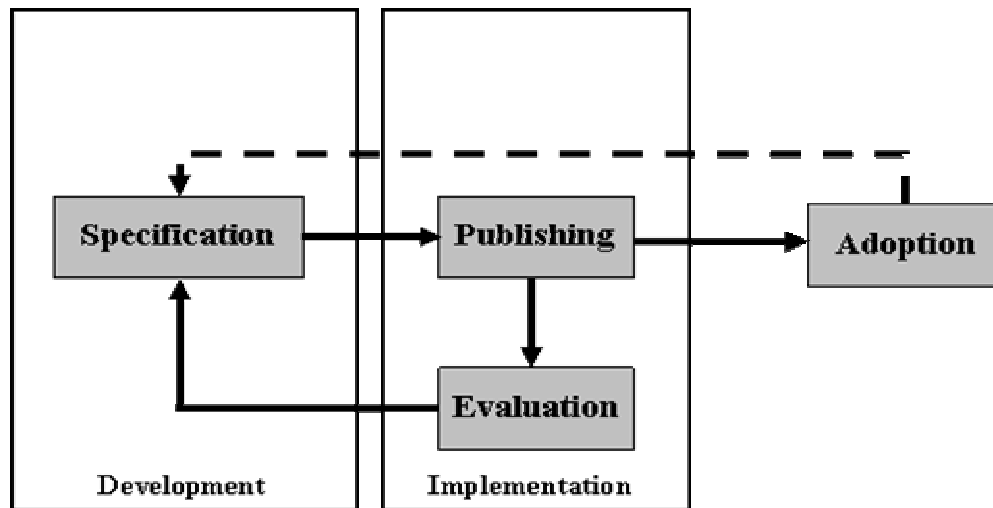


Figure 1 . e-PING versioning management model

For each one of the five segments defined in the e-PING framework, there is a process to analyze the corresponding proposed standards. This process includes the selection, approval and classification of the selected specifications in five levels (Brasil 2008):

- Adopted (A) – evaluated and formally approved;
- Recommended (R) – must be used by government agencies, but has not yet been formally approved;
- Transition (T) – not recommended because it does not conform to some technical requirement. It may be used only temporarily;
- Under Evaluation (E) – still under evaluation;
- Future Evaluation (F) – not yet evaluated. Left for future consideration.

In its version 4.0 (as of November 2008) the e-PING framework specified 210 standards. Table 2 presents the standards statistics, classified according to levels and segments.

Segments	Total of specified standards	Classification				
		(A)	(R)	(T)	(E)	(F)
Interconnectivity	23	9	8	2	2	2
Security	34	9	18	-	7	-
Means of access	129	22	47	33	2	25
Organization and exchange of information	7	4	-	-	2	1
Areas and issues for electronic government	17	4	5	-	6	2
Total	210	48	78	35	19	30

Table 2. Classification of the standards of the e-PING

DISCUSSION

A strong point of the project has been its publishing strategy and discussion. The public hearings and consultations are useful to take to a public forum the expectations of all interested agents, and to give them opportunity to offer contributions for the process, what can help to reduce the likely conflicts that may rise during the adoption of the standards. By publishing the specifications of the standard and putting them in discussion through the public hearings and consultations, the coordination of the project looks for eliminating further questions about the effectiveness of the architecture implementation or issues related to the prevalence of the government's interests in its definition. This is also a way of diminish resistances to the adoption of the standards.

In the version 4.0 (released in November, 2008), the e-PING had 210 specified standards, out of which 78 were classified as recommended (R), corresponding to about 37% of the total. Only 48 were defined as adopted (A), i.e., less than 23%. This means that although the project has been active for more than four years, the level of standards already formally approved may be considered relatively low. This situation can be seen as an inhibiting factor, since that only a small part of the specified standards is already formally ratified.

The first survey conducted by the e-PING coordination aimed at investigating the use of the interoperability standards in the Federal Government's extent, as well as to identify the difficulties and lacks in its adoption. It was sent e-mails to 66 IT government agencies managers presenting the objectives of the survey and providing a web link for answering. The response rate was about 68% (45 responses). Only just little more than 2% of the responding managers declared not have difficulties in adopt the standards, while the remaining had some kind of constraints. More than 33% informed to have technical resources or professional skills limitations to implement the standards, and about 17% stated to have time restrictions for implementation of their projects. These results point out barriers for the adoption of the standards since the agencies do not have resources to implement them and to manage the changes imposed by the process.

Almost 7% declared that they completely ignore the framework and more than 12% affirmed that they already had heard about the architecture but did know their specifications. This fact shows that although the coordination of the project has been promoting an intense publishing strategy about the architecture, still there is a significant number of managers in the researched agencies that ignores the subject.

This first survey shed lights on the restrictions for the framework adoption, but it did not clearly identified what factors were the barriers, since it was based on closed-ended questions. A second survey was conducted with 52 agencies, which got a response rate of around 85% (44 responses). In this survey were adopted open-ended questions to investigate what issues were considered limitations for the standards adoption. The followings aspects were cited: legacy systems integration restrictions due to technologies they are based on, lack of suppliers' compliance to the standards, little knowledge about the framework by the IT agencies managers and technicians, lack of a clearly defined strategy for adoption, the fact of the

adoption is mandatory only for the Executive Branch, the different policies and cultures of information management of each agency, beside the time, technical and financial resources, and professional skills constraints already pointed out in the first survey.

The findings support the not only some of the Andersen and Dawes (1991) arguments about the barriers for interoperability, but also the Scholl and Klischewski (2007) ones. However, several aspects were not mentioned by the IT managers such as legal, jurisdictional, and information security issues, for example.

CONCLUSION

The present study is expected to contribute to the identification of the barriers of government interoperability frameworks adoption. This is a complex process and requires special attention to the variables and factors beyond the technological issues, such as availability of resources, financial costs, knowledge barriers, external influences, legal and jurisdictional restrictions, information security, governmental incentives and market forces, among others.

The main results of this case study are the identification of several barriers and constraints to the adoption of a government interoperability framework. The restrictions of technical and economical resources, professional skills limitations, and clearly defined strategies and policies for the standards adoption were pointed out as significant barriers.

However, several other factors should be taken into consideration, as for example the possibility of legal and privacy restrictions on sharing information. In addition, it is likely to have organizational barriers between agencies since they operate as separate silos. It is also needed an attention about the information security and integrity issues, including the definitions of who has rights of doing what with the data stored in cross agencies systems.

Some limitations of this research are the number of agencies that participated in the surveys and the impossibility of conducting the two surveys with the same agencies.

For future studies, it can be suggested the investigation of what constraints are more influent in the process, and to what extent these barriers act together and what are the implications of these likely interrelationships. Other suggestion is the elaboration of an analysis model based on the types of constraints and the interoperability dimensions.

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