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Ernani Marques dos Santos and Nicolau Reinhard

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Ernani Marques dos Santos¹ and Nicolau Reinhard²

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 establishing a government interoperability framework (GIF). However, this is a difficult task to be carried out due not only to technological issues but also to other aspects. This research is expected to contribute to the identification of the barriers to the adoption of interoperability standards for electronic government. The article presents the preliminary findings from a case study of the Brazilian Government framework (e-PING), based on the 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

¹Management School, Federal University of Bahia, Salvador, BA, Brazil

²Management School, University of São Paulo, São Paulo, SP, Brazil

Corresponding Author:

Ernani Marques dos Santos, Management School, Federal University of Bahia, Av. Reitor Miguel Calmon, s/n, 2nd floor - Vale do Canela, Salvador, BA, Brazil
Email: ernanims@gmail.com

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 (Tassey, 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 (IT) field because they enable data interchange between components from a system or between different systems (David & Steinmueller, 1994; Williams et al., 2004).

According to United Nations (2001), 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 & Wolken, 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 & 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, government agencies face several barriers that constrain the effective implementation of the interoperability (Dawes, 1996; Landsbergen & 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, & 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 article 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 among 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 also be 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 & 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 and making possible faster resolution of the problems; Landsbergen & Wolken, 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 (European Public Administration Network [EPAN], 2004). According to *Interoperable Delivery of European eGovernment Services to public Administrations, Businesses and Citizens (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 also pointed out the importance of e-government interoperability, for example, Cava and Guijarro (2003), Benamou, Busson, & Keravel (2004), Klischewski (2004), Bekkers (2005), and 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 (Andersen & Dawes, 1991) as seen in the Figure 1:

- 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;

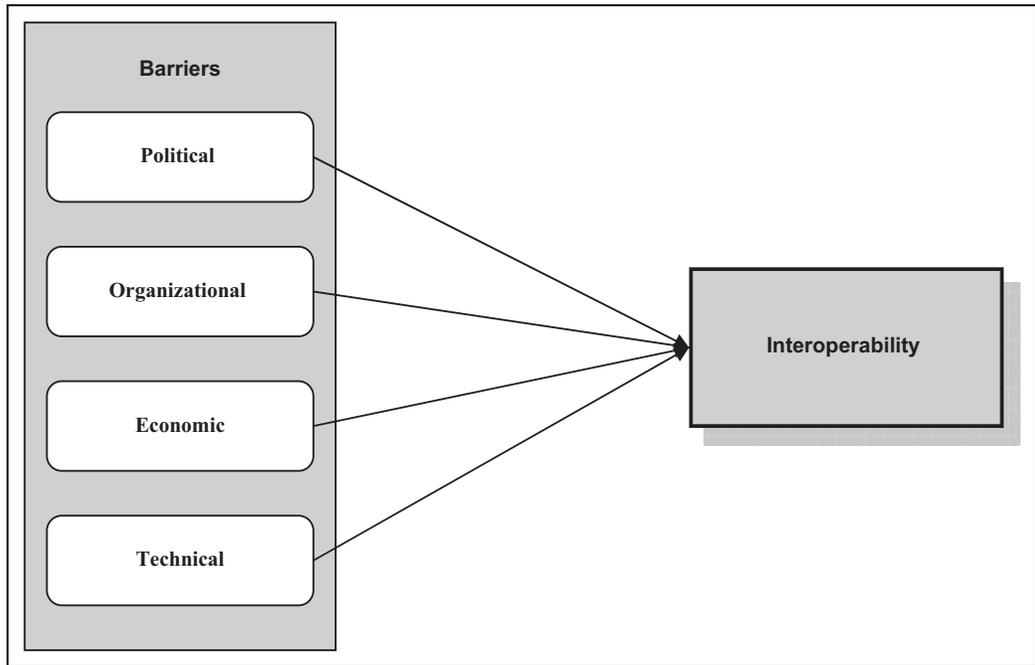


Figure 1. Interoperability barriers. Source: Based on Andersen and Dawes (1991).

- 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 (Figure 2).

Each of these 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 U.S. 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 nongovernmental 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,

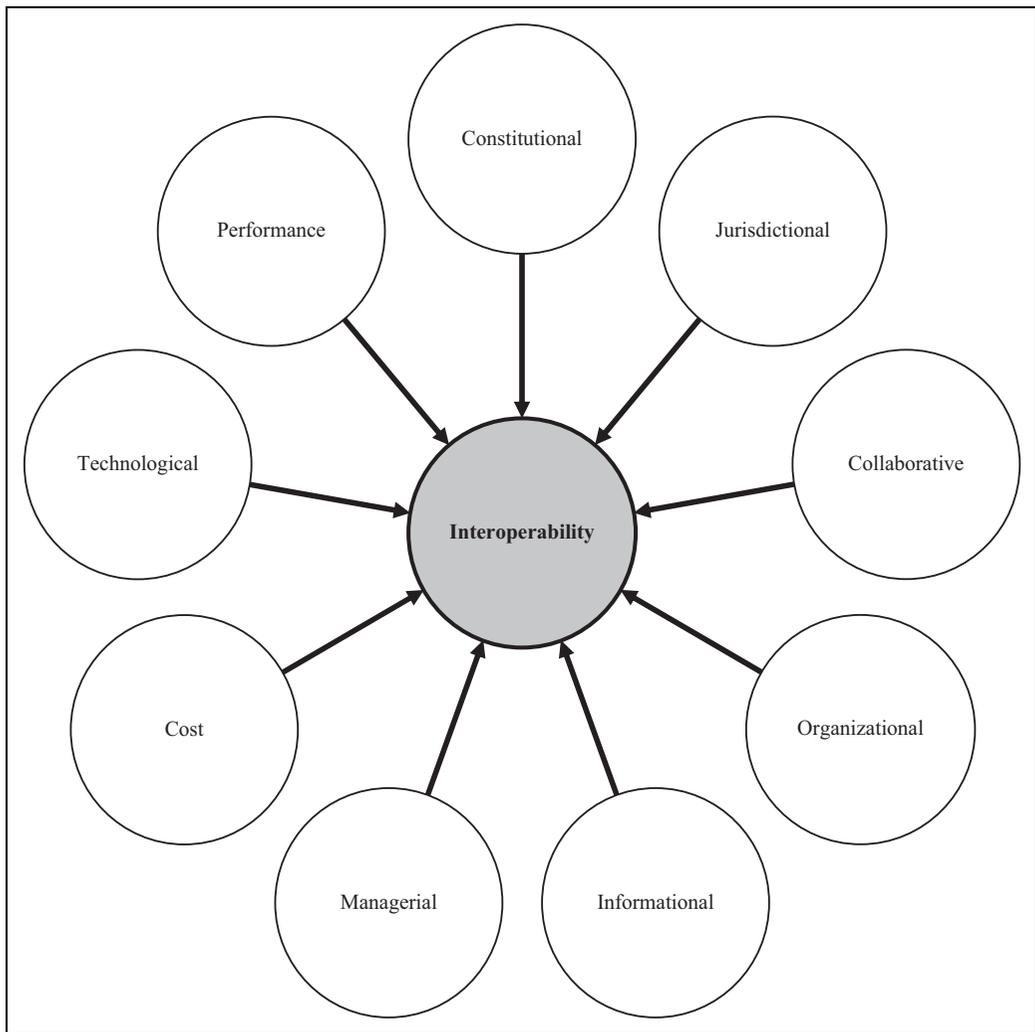


Figure 2. Interoperability barriers. Source: Based on Scholl and Klischewski (2007).

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, sociopolitical organization, and leadership style influence the degree of proneness and adeptness of potential interoperation. However, in cases of compatible leadership styles, adequate sociopolitical 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 the least difficult barriers to address, while the organizational, legal, political, and social aspects may be much more of a challenge.

Research Method

The research consisted of a case study based on the analyses of documents and face-to-face semistructured 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, Goldstein, & Mead, 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 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 e-mail 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 information and communication technologies (ICT) service providers. The questions included issues such as the general vision of the e-PING, policies of the researched institution regarding the use of ICT, and specific topics for each segment covered by the architecture. The first request was sent to 66 agencies and obtained a total of 45 replies (approximately 68%). The second one was sent to 52 agencies and got a total of 44 replies (about 85%).

In addition, structured interviews were conducted with members of the coordination group to discuss the answers given to the questions by the IT managers. The researchers also analyzed the

Table 1. Definition of e-PING Segments

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 electronic government services
Organization and exchange of information	Issues related to information management and transfer
Areas and issues for electronic government integration	New ways of integration and exchange of information based on the definitions of e-PING

Source: Brasil (2010).

documents specifying the standards guidelines and the reports of the implementation actions taken by the Federal Government.

Case Description

The e-PING is an architecture that defines a minimum set of premises, policies, and technical specifications ruling 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, 2010).

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 the Federal Public Prosecutor's Office; international organizations; governments of other countries; Brazilian and international businesses; and the Third Sector (nongovernmental organizations [NGOs], Civil Society Organizations, etc.). 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, 2010).

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).

In order to discuss the specifications of the standards that compose the framework, the sponsoring Ministry established five working 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, responsible for managing the activities of the work groups as well as presenting and discussing the project with others institutions from the public and private sectors.

It must be pointed out that, although the members of the working groups are technical experts indicated by their employers (among them federal government agencies), the participation is on a personal basis and does not imply the commitment of their employers to accepting the working groups results. And even though the framework adoption is compulsory for the agencies of the Executive Federal Branch, the program also does not yet impose direct formal sanctions for non-compliance with the standards.

A versioning scheme was established based on a two-stage model as shown in Figure 1: (a) development—when the discussions about the specifications of the standards that will compose the

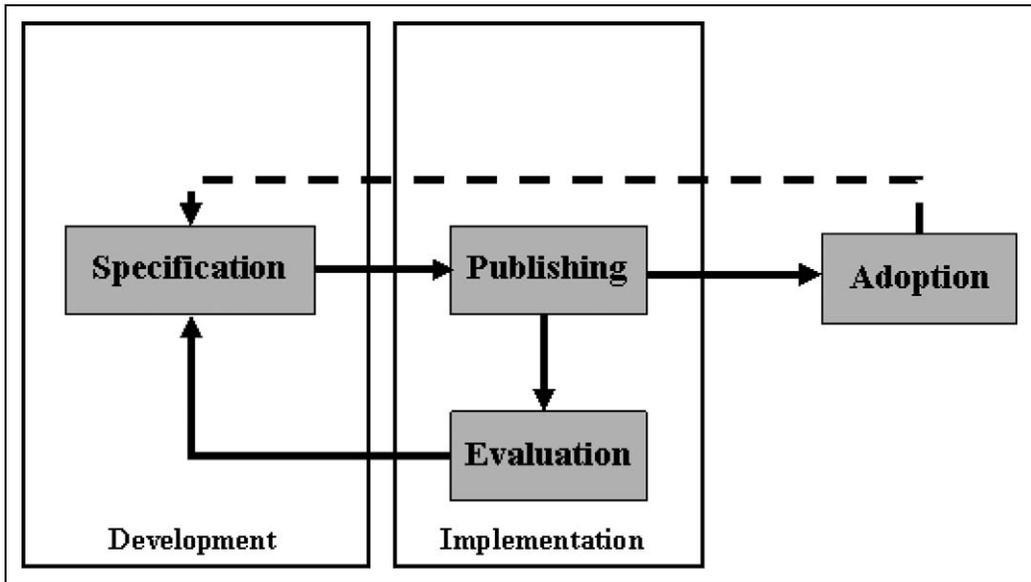


Figure 3. e-PING versioning model.

framework are carried out and (b) implementation—when the draft version of the framework is published and submitted to evaluation through 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. The resulting official e-PING documents are published in the usual way in the form of Ministerial resolutions made available on the program’s website (Figure 3).

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 of adoption (Brasil, 2010):

- Adopted (A)—evaluated and formally approved for mandatory adoption;
- Recommended (R)—may 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 2010 version (as of December 2009), the e-PING framework specified 156 standards. Table 2 presents the standards statistics, classified according to levels and segments.

Discussion

A strength 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 the opportunity to offer contributions to the process, potentially helping in reducing 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 project coordination aims at anticipating further questions about the effectiveness of the architecture

Table 2. Classification of the e-PING Standards

Segments	Total of Standards Specified	Classification				
		(A)	(R)	(T)	(E)	(F)
Interconnectivity	26	09	09	03	03	02
Security	35	10	18	–	07	–
Means of access	71	13	45	10	01	02
Organization and exchange of information	07	04	–	–	02	01
Areas and issues for electronic government	17	05	06	–	04	02
Total	156	41	78	13	17	07

implementation or issues related to the prevalence of the government's interests in its definition. This is also a way of reducing resistance to the standards adoption.

In the 2010 version (released in December, 2009), the e-PING had 156 specified standards, of which 78 were classified as recommended (R), corresponding to 50% of the total. Only 41 were defined as adopted (A), that is, about 26%. This means that, although the project has been active for more than 4 years, the level of standards already formally approved may be considered relatively low. This situation can be seen as an inhibiting factor, since 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 identifying difficulties and lack of adoption. E-mails were sent 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 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 having limitations in technical resources or professional skills to implement the standards, and about 17% stated to have time restrictions for implementation of their projects. These results point out important 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 not know their specifications. This fact shows that although the coordination of the project has been promoting an intense publishing strategy about the architecture, there still is a significant number of managers in the researched agencies ignoring the subject.

This first survey shed lights on the restrictions for the framework adoption but did not clearly identify what factors were the barriers, since it was based on closed-end questions. A second survey was conducted with 52 agencies, which got a response rate of around 85% (44 responses). This survey adopted open-ended questions to investigate what issues were considered limitations for the standards adoption. The following 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 that the adoption is mandatory only for the Executive Branch, the different policies and cultures of information management of each agency, besides the limitations in time, technical and financial resources, and professional skills already pointed out in the first survey.

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

are more easily identifiable. Nevertheless, the other dimensions play relevant roles in the framework adoption.

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. There is also the need of an attention to information security and integrity issues, including the definitions of who has the 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 assuring answers to the two surveys by the same agencies.

For future studies, it is suggested to investigate 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. Another suggestion is the elaboration of an analysis model based on the types of constraints and the interoperability dimensions.

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Bios

Ernani Marques dos Santos, PhD, is a professor of Information Systems Management at the Federal University of Bahia, Brazil. His research interests include implications of information technology adoption in organizations and society. He may be contacted at ernanim@gmail.com.

Nicolau Reinhard, PhD, is a professor of Management at the University of São Paulo, Brazil. His research interests are related to management of the IT function, the use of IT in public sector and information systems implementation. He may be contacted at reinhard@usp.br.