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The Challenges in Establishing a Government Interoperability Framework: The e-PING Brazilian Case

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49. THE CHALLENGES IN ESTABLISHING A GOVERNMENT INTEROPERABILITY FRAMEWORK: THE E-PING BRAZILIAN CASE

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Abstract
Interoperability standards play a crucial role in systems integration and information sharing in the electronic government environment. However, establishing these standards is not an easy process. Several factors, such as the number of involved agents, the environment in which the process takes place and the interrelation between the agents and the environment, not to mention the likely conflicts of interests that can rise from this interrelation, can influence it. This paper analyses the establishment of interoperability standards for electronic government. It presents the findings of a qualitative case study based on document analysis and semi-structured interviews of the Interoperability Framework specified by the Brazilian Federal Government (e-PING). The results point out some challenges to be faced, from the conception to the adoption of those standards.

Keywords
Electronic Government Interoperability; Electronic Government; Interoperability Framework; Standardization; e-PING; Brazil.

1. Introduction
The establishment of standards can bring several benefits to public administration, such as improved data administration and better support for providing public services; it can also contribute to the information infrastructure, enhance accountability and better the coordination of programs and services, among other positive effects.

In the specific case of electronic government, the UN considers that the ideal environment for users is a single access point to all information and services (United Nations 2001). In this context, it is easy to see the importance of adopting standards, given the need for systems integration and information sharing. Several authors, such as Akbulut (2003), Dawes (1996), and Landsbergen & Wolken (2001), have already investigated these processes among government agencies and identified standardization as a conditioning factor.

Standardization is necessary to enable data exchange and its re-use over time. It also prevents getting locked into proprietary tools and formats (EPAN 2004). However, to be successful a standard must be accepted by all agents involved in the transactions that are affected by it.

Furthermore, this adoption may depend on the perception of the standard's relevance by the agents involved. Therefore, the conduction of its development and implementation processes is very important, because of the influence that it can exercise over that perception.

The objective of this paper is to analyze the development and implementation processes of an interoperability framework for electronic government and, using this analysis as a starting point, to identify the mechanisms employed for the establishment of those standards and the likely implications of their adoption. It presents a case study of the e-PING framework - Interoperability Standards for Electronic Government, a set of specifications implemented by the Brazilian Federal Government (Brasil 2008).

2. Standards and Standardization

In a broader sense, a standard is defined as a group of specifications that all the product elements, processes, formats, or procedures under its jurisdiction must comply with (Tassey 2000). David & Greenstein (1990) state that a standard can be understood as a group of technical specifications that a group of suppliers complies with tacitly or as a result of a formal agreement. David & Steinmueller (1994) classify standards into four categories: reference, minimum quality, interface and compatibility. Compatibility standards, which include interoperability, play an important role in the ITC field, because they are enablers of data exchange among components of a specific system or different inter-organizational systems.

According to Williams et al. (2004), the development and implementation of compatibility standards not only define technically an inter-operational method among the different components of a network, but are mainly a proposal for the future of the complex socio-technical systems that are the form of an inter-organizational network.

Standards can also be classified according to the processes that led to their establishment. A distinction is frequently made between formal, *de facto* and *de jure* standards. Formal standards are created through standardization entities; *de facto* standards are technologies unified by market mechanisms, and *de jure* standards are those imposed by law (Hanseth & Monteiro 1998).

According to Graham et al. (1995), the standardization process is an attempt to align the interests and business practice expectations of a group of people interested in developing and using the system that will be standardized. Therefore, standardization is not only meant to provide a usable solution but, mainly, to articulate and to align expectations and interests (Williams 1997).

David and Greenstein (1990) argue that in relation to Information Technology (IT), standardization can be defined as the process whereby two or more agents agree and comply with a group of technical specifications of a system, their parts or their functionality, tacitly or as a result of a formal agreement. Consequently, those standards both enable and constrain the several agents' future behavior (Garud, Jain & Kumaraswamy 2000). Therefore, developers of standards should take those effects over the involved agents' future actions into account, because they can influence the degree of their adoption.

3. Interoperability

Interoperability can be defined as the ability of two or more systems to interact and exchange 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 the information exchanged;
- the capacity of equipment units to work together to accomplish useful functions;
- the capacity of heterogeneous equipment, usually manufactured by several suppliers, to work together in a network environment, thanks to compliance with a certain set of standards that fosters work integration, although it cannot guarantee this integration;
- 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). According to Archmann and Kudlacek (2008), it is the ability of ICT systems to communicate, interpret and interchange data in a meaningful way.

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, such as enhanced effectiveness (interconnection instead of isolated solutions), efficiency (reduction of the cost of transactions and enhanced participation of the involved agents) and responsiveness (better access to more information, making it possible to solve problems faster) (Landsbergen & Wolken 2001).

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 & Guijarro (2003), Benamou et al (2004), Klischewski (2004), Bekkers (2005), Klischewski & 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 & 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.

Although information sharing among government agencies is a common objective, the scope of this interoperability is still limited (Dawes & Bloniarz 2001). Though recognizing the importance of sharing and the significant benefits that this offers to policy makers, government organizations and the public at large, government agencies face several technical, organizational and political barriers (Dawes 1996; Landsbergen & Wolken 2001; Rocheleau 1997). The summary of the benefits and barriers are presented in table 1.

Category	Benefits	Barriers
Technical	• Improvement of data administration • Contribution to information infrastructure	• Incompatible technologies • Inconsistent data structure
Organizational	• Better support for problem solving • Expansion of professional contacts networks	• Organizational-self interest • Dominant professional standards
Political	• Expansion of public policies' action context • Improvement of public accountability • Better program and service coordination	• External influences over decision makers • Power of agency discretion • Priority of the programs

Table 1: Benefits and barriers of information sharing for electronic government
Source: Dawes (1996); Landsbergen & Wolken (2001); Rocheleau (1997).

4. Methodology

This study consisted of a qualitative case study (Yin 2001) based on the analysis of documents and of data collected through semi-structured interviews. The research object was the e-PING framework, a set of standards specified by the Brazilian Federal Government for adoption by government agencies.

An analysis of the documents that establish the guidelines of the adopted standards and the reports describing the actions the Government took to implement them was carried out. It was also analyzed the syntheses of the questions and answers from the public hearings and consultations held for evaluating the definitions of the specifications.

It was also carried out an analysis of the data collected through a survey conducted by the e-PING coordination group. The objective of this survey was to investigate the use of the interoperability standards by the Federal Government's agencies, as well as to identify the barriers in their adoption. The survey was conducted through one web questionnaire consisted of 46 questions made available in the internet on a page managed by the Ministry of Planning, Budget and Administration, the executive agency of the project. The request for completion of the questionnaire was sent by email to IT managers from 66 agencies of the direct and indirect administration of the Federal Executive Branch and it was obtained a total of 45 answers (approximately 68%). 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 data collection was complemented with three semi-structured interviews, each one conducted with the project's coordinator, one of its technical assistants, and with three other members of the project coordination group. These interviews aimed at clarifying how the decisions regarding the specifications of standards and the strategies adopted for their implementation were taken.

5. The e-PING Framework

5.1. The conception

e-PING - the Standards for Electronic Government Interoperability - defines a minimum set of assumptions, policies and technical specifications that regulate the use of Information and Communication Technologies (ICT) in the interoperability of electronic government services, establishing the interaction conditions with other government institutions (besides states and municipal districts) and with society. Those standards include five segments: (1) interconnectivity, (2) security, (3) means of access, (4) organization and exchange of information and (5) integration areas for electronic government, as presented in table 2 (Brasil 2008).

Segments	Covered issues
Interconnectivity	Conditions for government agencies to connect to each other and to external institutions.
Security	Security aspects to ensure the validity and confidentiality of operations
Access means	Devices for access to the services of electronic government.
Organization and exchange of information	Issues related to the management and transfer of information.
Integration areas for electronic government.	New ways of integrating and exchanging information based on the e-PING definitions.

Table 2: Definition of e-PING segments

For each one of these segments, there is a process for analysis of the standards that will make up the architecture. That process considers that the selection, approval and classification of the specifications has five levels:

- Adopted (A) - evaluated and formally approved;
- Recommended (R) - should be used by the government agencies, but is yet to be formally approved;
- Transition (T) - not recommended due to non-compliance with a technical requirement. 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 December 2008, e-PING specified 210 standards. Table 3 presents their classifications, grouped by 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 3: Classification of the e-PING standards

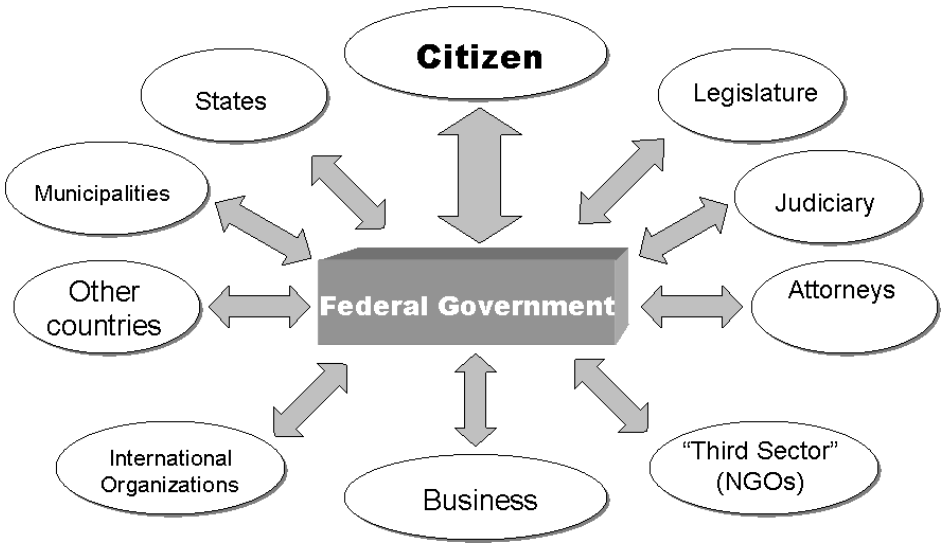

Figure 1: e-PING relationships

The e-PING framework is seen as a basic structure for the strategy of electronic government in Brazil and its development was based on the e-GIF project (Government Interoperability Framework) implemented by the British government as from 2000 and currently in its version 6.1 (e-GIF 2004).

Initially applied to the Brazilian Federal Government's Executive Branch, the framework foresees an exchange of information between the Executive Branch and citizens, state and municipal (local) governments, the Legislative and Judiciary Branches of the federal government, the Public Prosecution service, international organizations, other countries' governments, national and international companies and also NGOs (figure 1).

e-PING was devised as compulsory for adoption by all Executive Branch agencies (including the government-owned companies and other federal entities), applicable to all the new information systems, the legacy systems that incorporate electronic government services or integration among systems, and all other systems that involve electronic services (Brasil 2008).

5.2. Management model

The management model adopted by the e-PING coordination to establish the framework consists of the following stages (figure 2): development – when the discussions about the specifications of the standards that will compose the framework are carried out, and implementation – when a 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 released a new version.

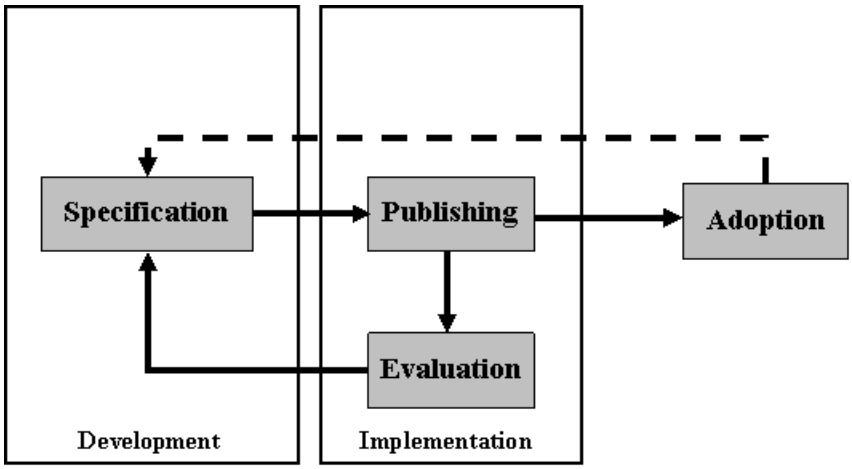

Figure 2: e-PING management model

5.3. Development and implementation

In June of 2003, a Brazilian Government committee visited the United Kingdom with the purpose of becoming acquainted with the e-GIF project. After that visit, a group was created in November 2003 to coordinate the e-PING project. One month later, the workgroups were formed, with IT professionals from several government agencies.

A workgroup was created for each of the five segments covered by the architecture. Each group is responsible for holding the meetings and the discussions of its area and also for presenting the results to the other groups during the meetings with the coordination group. The coordination group is responsible for supervising the activities of the workgroups and also for presenting and discussing the project with other institutions from the public and private sectors (figure 3). This group also reports to the Electronic Government Executive Committee (CEGE) on the project's progress, through its Executive Secretary.

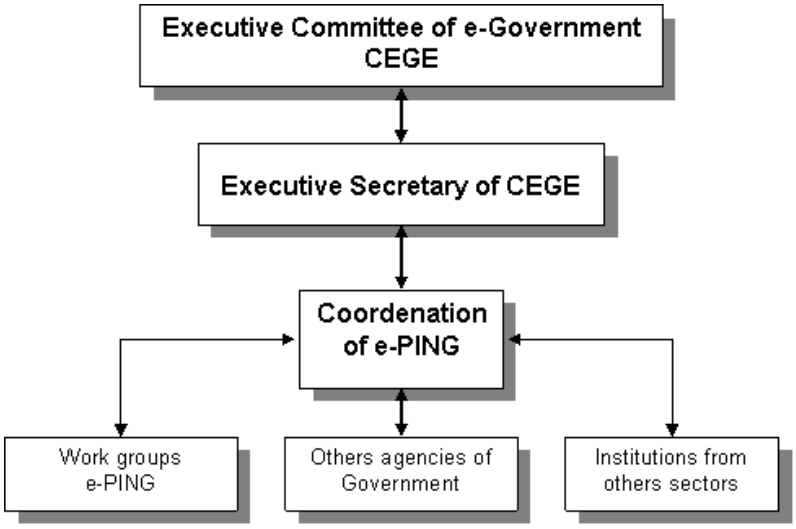

Figure 3: e-PING management structure

In January 2004, the workgroups began their discussions to specify the preliminary version of the architecture (version 0) that was released in May. From June to August this document was submitted to public scrutiny via the Internet. During the same period, six public hearings were held; they were attended by more than 600 people. The public scrutiny and hearings added the contributions of public agencies, researchers and ICT suppliers to the specification of the standards, more than 90 suggestions having been submitted. After these were analyzed, the document was updated and the version 1.0 was published in March 2005. This document established the guidelines for implementing interoperability among the several technological solutions used by the Brazilian Government. Those guidelines cover issues such as network security, computational infrastructure, technological requirements, standards for software development, and access to data and information. In July, a Federal law was passed regulating the use of the architecture (Brasil 2005).

As a result of the discussions driven by the workgroups, other versions were published: the 1.5 one in December 2005 and the 1.9 one in August 2006. The latter was also submitted to public consultation and hearings. After evaluation of the suggestions received, the version 2.0 was published in November 2006. In December, Spanish and English versions (2.01) were released. The version 2.9 was published in October 2007 and was also submitted to public consultation and hearings. After an analysis of the suggestions presented the version 3.0 was released in December 2007, including an English version. The version 3.9 was published in October 2008 and, again, after public consultation and hearings, the version 4.0 was released in December 2008.

6. Discussion

One of the project's strong points has been its publishing strategy and discussion. Since its inception and up to the release of the version 4.0, more than 40 national and international

presentations about the project were delivered in seminars, workshops and conferences. This lent the project visibility, driving awareness of its guidelines not only among government managers but also in society at large. The public hearings and consultations were useful to air in a public arena the expectations of all interested agents, while also providing them with the opportunity to contribute to the process, which can help to reduce the conflicts that are likely to arise as the standards are adopted. By publishing the specifications of the standards and making them available for discussion through public consultations and hearings, the project's coordinators tried to eliminate further issues regarding the effectiveness of the implementation of the architecture or issues related to the prevalence of the government's interests in its definition.

The definition of the e-PING framework was originally based on the e-GIF standards established by the British government. Additionally, the technologies adopted by the Brazilian government (such as XML and web services, for instance) are regarded as *de facto* standards, which can make the managers be more willing to adopt e-PING. Before a complex process such as the specification of standards, the adoption of already consolidated models and technologies reduces the possibility of failure and increases the involved players' level of trust in the project.

The workgroups' members are ICT professionals from several government agencies that meet to specify the standards that will make up the architecture. Those professionals, due to their formal education and previous experiences, end up establishing a process of isomorphism. The current pressures regarding the level of professionalization required in their functions and the socialization of their experiences drives the isomorphism of these professionals and, consequently, of the practices adopted in their organizations. Finally, this homogenization reflects the construction of the architecture during the professionals' interaction in the workgroups.

In the version 4.0, 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.

In the survey conducted by the coordination of the project, more than 82% of the managers claimed that they knew the specifications of the architecture and about 53% affirmed to have already adopted it, at least partially. But just little more than 2% did not have difficulties in adopting the standards, while the rest had some kind of restrictions. More than 33% had technical resources or professional skills limitations to implement the specifications, and about 28% affirmed that they did not know what was being accomplished by other agencies. Approximately 17% stated to have time restrictions for implementation of projects and more than 12% declared they did not know the architecture specifications. Those results point out barriers for the effective adoption of the standards since the agencies do not have resources to implement them and to manage the changes imposed by the process. It is also necessary to notice that, although the coordination of the project has been promoting an intense publishing strategy about the architecture, still there are managers in the researched agencies that ignore the subject.

The survey also revealed that more than 58% of the information systems in use are aligned with the main internet and Web standards specifications. About 44% of the researched agencies already adopt XML as data exchange standard and more than 82% adopt browsers as the main information access mean and, in this group, approximately 78% use a minimum standard of the browse, to allow the systems to operate in multiple platforms. These standard adoption levels suggest a possibility of a high adherence to the e-PING since there is a low level of incompatibility between the technologies already implemented by the agencies and the framework specifications.

7. Conclusions

It is difficult to develop and implement standards. Some advance no further than their development phase, due to problems in the process of articulation of the discussions and definitions. Others, although specified, are not adopted as a result of construction or institutionalization processes.

The dynamics of standardization, a continuous process of evolution and adaptation, also encompass constant tension between the definition of standards and the flexibility and necessary generalization for the standards to last and be adopted.

The main results of this case study are the identification not only of factors that can facilitate the establishment of the standards specified but also several barriers and constraints to the implementation and adoption of the framework. The restrictions of technical and human resources, for example, still remain as significant barriers to adoption of interoperability standards for electronic government.

Certain issues can be suggested for future studies, such as investigating the implications of adopting the standards in the electronic government transactions, or analyzing what barriers or constraints are more influent.

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