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DIGITAL CERTIFICATION IN THE BRAZILIAN E-GOVERNMENT

CERTIFICAÇÃO DIGITAL NO GOVERNO ELETRÔNICO BRASILEIRO

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ABSTRACT

This article aims to analyze the role of digital certification in the development process of the electronic government actions in Brazil, as well to provide future perspectives. Qualitative research was done and the data gathering performed through semi-structured interviews. Ten nationally recognized stakeholders were interviewed either for the conceiving of public policies regarding electronic government as well for the implementation and inspection of related projects. The study demonstrates that digital certification is straightly connected with information security. Indirectly, the security that digital certification provides is the major condition for the development of the electronic government, once it can provide the bases for the improvement of internal process in Public Administration and the increase of public services and better quality for the interface between the State and the citizen.

Keywords: digital certification, electronic government, security information.

RESUMO

Este artigo tem como objetivo analisar o papel da certificação digital no processo de desenvolvimento das ações de governo eletrônico no Brasil, inclusive apontando perspectivas futuras. Foi realizada uma pesquisa de natureza qualitativa, cujo instrumento utilizado foram entrevistas semi-estruturadas. Procedeu-se à seleção de 10 *stakeholders* desta temática no País, tanto na formulação de políticas públicas quanto na implantação e fiscalização de projetos afins. O estudo mostra que a certificação digital relaciona-se diretamente com aspectos atinentes à

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segurança da informação. Indiretamente, esta segurança que a certificação digital proporciona é condição necessária ao desenvolvimento do governo eletrônico, a partir do qual pode haver tanto o aperfeiçoamento de processos internos da Administração Pública quanto a maior disponibilidade de serviços públicos e a melhoria da qualidade de interface do Estado com o cidadão.

Palavras-chave: certificação digital, governo eletrônico, segurança da informação.

1. INTRODUCTION

The current technological revolution, focused on Information and Communication Technologies (ICTs), has found the Public Administration faces increasing demands from the society, which requires more efficiency from the State, in addition to asking for more public services, with more quality, social control, and respect to individual rights.

ICTs have been applied for more than 50 years by the government to automatize its activities. Although the use of computer and communication networks is not a new issue, the Internet has improved the communications and allowed the government to offer digital services (Foley, & Alfonso, 2009).

Since the early days of the computer development, we have been able to devise three phases regarding the potential of new technologies to improve government performance. In the early fifties the application of digital technology targeted the automation driven to more efficiency and government operations control. Next, from the eighties to the nineties, two alternatives visions could be perceived: privatization and reinvention; both recognizing that the Information Age made Public Administration obsolete. More recently, in the third phase, the digital democracy became a core issue in the concerns about new alternatives for governance, based on the spreading of ICTs with low cost (Starr, 2010).

The electronic government applies the ICTs in order to ease its process and offer better services to the citizen, to the companies, and, obviously, among its components. For the citizens, the electronic government gives the power that makes possible their active participation in the democratic institutions and in the political processes (Huang, Siau, & Wei, 2005).

While this context is promising for the electronic government development, the digital universe expansion brings issues related to weaknesses of electronic information, for what digital certification is one possible answer.

The research problem approached in the paper refers to how the modern ICTs, in particular, digital certification, can contribute to the advance in the Brazilian electronic government. The aim is to analyze, by means of qualitative research, the current benefits and expectations regarding the role of digital certification, particularly, its potential to provide support for the Brazilian Public Administration development.

To accomplish the objective, ten interviews were done with key players of the Brazilian electronic government involved in digital certification processes.

2. JUSTIFICATION

Although the importance of information has been universally recognized (Moresi, 2001), what makes it especially significant in the current days is its digital nature (Capurro, & Hjørland, 2007).

A recent study estimated the world capacity to store, process, and communicate information by monitoring 60 different technologies (digital and analog) from 1986 to 2007. In 2007, humanity stored 2.9×10^{20} bytes, communicated almost 2×10^{21} bytes and processed 6.4×10^{18} instructions per second, considering the general use of computers. The computation capacity increased 58% per year during this time. The word capacity of bi-directional communication increased 28% per year and the information stored globally reached 23%. While telecommunications have been dominated by digital technologies since 1990 (with 99.9% digitally represented in 2007), almost all of our technology memory has been generated in a digital format since the early days of the year 2000 (94% digitally represented in 2007) (Hilbert, & López, 2011).

This expansion can be more easily understood by means of a set of trends (Stallings, 2007):

- Constant reduction in costs along with performance gains in computing and communications, mainly due to increasingly powerful machines, capable of processing complex applications, and the widespread adoption of optical fibers;
- Increment of equipment mobility, releasing workers from their confinement and allowing them to carry their work context wherever they go. It is already possible to envision the high speed Wi-Fi access increment, along with improvements in the ability to use services and resources anywhere;
- Rapid conversion of electronic assets into digital technology and the consequent conversion into a data storing format (including voice, image, and video) as it can be observed in DVDs (Digital Versatile Disk), digital cameras, digital TV sets;
- Emergence of Internet connected systems: digital TV, mobile computers, mobile phones, digital cameras, automobiles, remote data access, fax, e-mail and voice-mail, VoIP, Radio Frequency Identification, appliances, and security and surveillance systems.

While opening many opportunities, this scenario imposes new challenges related to the vulnerability of electronic information, due to its virtual nature or even to the characteristics of Internet.

Below, some situations are described, which illustrate the difficulties faced during the digitalization of information, usually present in paper documents (Stallings, 2005):

- Generally it is possible to recognize the difference between an original paper document and its copy. However, an electronic document is just a sequence of bits; there is no difference between the “original” and its copy;
- A modification in a paper document will leave some kind of physical evidence. For example, by erasing part of a document, a stain may be left behind. On

the other hand, the modification of some bits in a memory does not leave physical signs.

Regarding the world computer network, while the communication possibilities expand exponentially, it is important to consider that this channel is highly insecure. It happens due to its very conception that assumes a network of mutually reliable users, transparently connected. However, in the current days, Internet does not involve only mutually reliable users. Despite of this, communication is a necessity that must be satisfied even in the absence of widespread mutual reliability (Kurose, & Ross, 2008).

So, both the storage and communication of electronic data are subject to interception and content modification, including privacy violation or even the complete information destruction.

To understand the kind of threats in the virtual world, it is necessary to make explicit the main requirements related to information security (Stallings, 2007):

- Confidentiality – possibility to access data only by authorized people, even in a shared environment;
- Integrity – assurance of information accuracy, from the origin to the destination, without any modification;
- Authenticity – ability to verify the user´s identity, confirming the informed source of information.

After the main requirements related to information security ware made explicit, it can be defined as the preservation of confidentiality, integrity, and authenticity; additionally, other properties like availability, responsibility, non-repudiation, and reliability can be involved (Associação Brasileira de Normas Técnicas, 2005).

Regarding the role of the State in this context, the rapid digitalization development will create an increasing exclusion of nations that do not establish policies for society transformation. This trend requires from the countries decisions that assure their insertion in the Information Society (Scartezini, 2004). For Brazil, in particular, these decisions are more urgent considering the modest 61st position occupied by the country in the world ranking of electronic government development (United Nations, 2010).

In face of this discussion, this research is fully justified by the current dominance of information in digital format, requiring theoretical deepening in security information issues. In the same sense, the transformation process that the Public Administration has suffered as a consequence of the Technological Revolution and globalization works as a motto for this research. As one could expect, Public Administration looks for adapting to the new demands from the Information Society, where the electronic government arises as a promising possibility of leading to the modification of routines and bureaucratic proceedings, establishing interface improvements between government and citizens, paving the road for many kinds of benefits for the collectivity and institutions.

3. PROBLEM AND OBJECTIVE

The issues previously discussed, mainly the virtual nature of information in the current days and the urgency the State has in adapting to this new reality, originated the problem approached in this research. This problem can be described as *how could modern ICT, digital certification in particular, contribute to the advance of electronic government in Brazil?*

To find an answer to this question, it was performed an examination on the role of digital certification in the evolution of the Brazilian electronic government, as well as possible impacts to the Public Administration of Brazil.

4. METHODOLOGY

Regarding its form, this is a qualitative research since an understanding is developed from the patterns found in the data instead of proving or confirming a thesis. With respect to the purposes, it is considered descriptive, because it exposes opinions of people related to the electronic government on the digital certification application. As to the means, it is considered a field investigation, since interviews were carried out with people related to institutions involved in electronic government Brazilian policies (Moresi, 2001).

The selection of interviewees was based on the analysis of the functions of their positions – considering the strategic or management levels – and their degree of interaction/action in relation to the actions of a Certifier Authority belonging to the Brazilian Public Key Infrastructure (ICP-Brazil). The term “selection” was used instead of “sample” once in qualitative research interviewees does not follow quantitative procedures (Gaskell, 2002) which employs statistical sampling. The selection has considered one or more roles performed interviewees: (1) public policymakers of digital certification; (2) implementers and evaluators of projects and services of digital certification and; (3) auditors and inspectors of digital certification services.

The survey comprised five open questions that aimed at obtaining information on (1) pros and cons of the digital certification adoption, (2) the relation between digital certification and the electronic government, and (3) the prospects and proposals to broaden the digital certification use. Frame 1 shows the list of interviewees, along with affiliation and position.

Frame 1: Interviewees affiliation and position

#	**Affiliation**	**Position**[1]
1	National Institute of Information Technology	Director of Public Key Infrastructure
2	National Institute of Information Technology	Substitute Director of Audit, Inspection and Standards
3	ICP – Brasil Committee	Coordinator
4	ICP – Brasil Committee	Full Member (Association of Federal Judges of Brazil)
5	ICP – Brasil Committee	Full Member (Brazilian Chamber of Electronic Commerce)
6	Certifying Authority of the Federal Service of Data Processing (SERPRO)	Head of the Technical Sector of Digital Certification
7	Certificate Authority of Federal Savings Bank (CEF)	Superintendent of Information Technology
8	Certifying Authority of Federal Revenue of Brazil	Coordinator
9	Certisign Certifying Authority	Business Manager (Government Leader)
10	Certifying Authority of the Presidency	Coordinator

5. RESULTS

In this section, it is exposed the results obtained from the interviews, as well as the corresponding analysis and interpretation. The summary of the results related to the main pros and cons of the digital certification adoption can be seen in Frame 2.

[1] Position in the first semester of 2008.

Frame 2: Pros and cons of the digital certification adoption

What would be the main advantages of adopting digital certification, both for their institution and for the citizens?	**Total**	**Interviewee**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Assure the security of the electronic information	8		X	X	X		X	X	X	X	X
Allow authenticity of the electronic data	6	X					X	X	X	X	X
Provide legal validity to electronic documents	5	X		X		X			X	X	
Assure confidentiality to electronic data and transactions	4	X						X		X	X
Provide integrity to electronic data	3	X								X	X
Reduce bureaucracy in administrative procedures	3	X		X			X				
Improve efficiency	3	X		X				X			
Virtualize physical processes	3	X	X			X					
Assist the control and audit	2			X				X			
Waive physical presence in interactions with Government	1						X				
Save time	1				X						
Facilitate access to public services	1				X						

Most of the answers pointed out the information security of electronic information as the main advantage of adopting digital certification. In this case, it is included the assurance of secure identification among the people involved as well as data integrity and confidentiality in electronic transactions (Stallings, 2007; Associação Brasileira de Normas Técnicas, 2005).

Five answers to this question emphasized the digital certification due to the fact that it enables electronic data authenticity; as previously observed, authenticity is one of the information security requirements (Stallings, 2007).

Other five answers argued in favor of the ability to provide legal validity to electronic documents as the main advantage of digital certification[2].

To assure confidentiality to electronic data and transactions was the answer for four interviewees. Also, it refers to one of the requirements of information security (Stallings, 2007).

[2] Assured in the Brazilian Law by Medida Provisória (Temporary Measure) # 2.200-2, August 24th, 2001.

Three interviewees mentioned the ability to provide integrity to electronic data, also one of the information security requirements, as one of the most important consequence of adopting digital certification (Stallings, 2007).

It was reported as a consequence of adopting digital certification the possibility of reducing bureaucracy in the administration procedures. Three answers support this statement, confirming the tendency of the last governments (Butcher, 2003). This point of view is part of the reinventing process of Public Administration, specifically in eliminating unnecessary phases and in reducing or removing excessive formalities and the rigidity in procedural follow-up. It was described the reallocation of workers to more finalistic activities rather than to bureaucratic ones. As an example, it can be cited the case of Fiscal Auditors from the Federal Revenue Office of Brazil that had to be reallocated to audit operations in loco, after the introduction of virtual services to citizens (the service is known as *e*-CAC).

Three answers agreed with the efficiency improvements as the main reason for adopting digital certification. That is the result of the secure process of digitalization, avoiding the use and storage of paper. It totally adheres to the demand for a more responsive State along with a reduction in operational costs and resources optimization (Foley, & Alfonso, 2009; Starr, 2010; Butcher, 2003; Lévy, 2004; Stahl, 2005; Schelin, 2003).

Virtualization of the physical processes also appears as one of the main reasons for adopting digital certification. It is considered as a result of assuring security for electronic documents. It was also mentioned as an effect of providing legal validity to electronic document, enabling one to do better what already is done in the non-virtual world, promoting more reliability to digital processes.

The improvement of control and audit procedures, by increasing the traceability of digital documents with digital signatures, was reported in two answers. The consequence is the increasing reliability of digital processes by means of reducing frauds and the governance strengthening, as shown by Braga et al. (2008).

Finally, waiving the physical presence of people in electronic interaction with government was regarded by one interviewee as the main advantage of using digital certification. It is related to the legal and security layer provided by digital certification, which strengthens the confidence of the users in digital processes, allowing for the reduction bureaucracy and ease of the accomplishment of organization activities. Moreover, by being non mandatory, the physical presence leads to the reduction of time and money for travelling, for example (Zugman, 2006). To illustrate the access issue, one interviewee mentions a case of the Judicial Power in which the electronic process removes all limitations imposed by time and distance, being always accessible by any one of the parties involved.

Frame 3 summarizes the results related to the main barriers to adopt digital certification.

Frame 3: Barriers to the adoption of digital certification

What are the main barriers or disadvantages?	**Total**	**Interviewee**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Cultural	6	X	X	X	X		X		X		
Infrastructure and logistics	4	X				X	X			X	
Existence of few applications	3		X							X	X
High cost	2				X				X		
Access difficulty	1							X			
Difficulties to understand the technology involved	1						X				

Firstly, it is important to notice that there was no mention of possible disadvantages related to adopting digital certification. Also, although the large set of possible applications of digital certification in Brazil, as reported by the interviewees, its potential is not yet completely explored. It can be observed both in the weak development of the Brazilian electronic government and in the low level of digital inclusion in the country.

Regarding the barriers, most of the answers (six) pointed out cultural issues as the most relevant. This includes the habit of using paper and beliefs that the younger generations are more familiar with the digital world. In this case, it is expected a gradual reduction of resistance to a new model, that is, an unknown model. It was also mentioned that cultural resistance can be more easily reversed in institutions than individually.

Secondly, infrastructure and logistics were mentioned, indicating the necessity to improve the Brazilian Public Key Infrastructure (ICP-Brasil) capillarity, broadening its scale. Although enough certification authorities exist, there are still few Registry Authorities[3], most of them located in big cities. This can be considered as an important drawback since the physical presence of the digital certificate applicant is mandatory.

Three answers emphasized the existence of few applications using digital certification. There are not so many electronic services available, having little pressure to assure the information security with digital signatures. It is not enough to have the certificate, it is necessary to have an opportunity to use it.

High costs were mentioned twice. Regarding this issue, it was reported that not all institutions would be able to afford the infrastructure required for using certification.

[3] Entity responsible for the interface between the user and the Certifier Authority, being linked to the latter. Its aims include requests reception, validation, and the face-to-face identification of the applicants. They are also responsible for forwarding to the Certifier Authorities the issuance or revocation of digital certificates.

At one moment, access difficulties were mentioned as a barrier. Actually, this is particularly relevant for Brazil, as shown in the research results related to the low level of digital inclusion in the country (Instituto Brasileiro de Geografia e Estatística, 2007).

Finally, difficulty understanding the technology involved in digital certification was considered a barrier, what is a reality in face of the small amount of national technicians in the area.

Frame 4 shows a summary of the results related to the main approaches adopted by the Brazilian electronic government for using digital certification.

Frame 4: Electronic government and the use of digital certification

How could the electronic government make use of digital certification?	**Total**	**Interviewee**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Promoting a better interaction of the State with the citizens	6	X	X	X			X	X	X		
Secure authentication for accessing public services	4	X				X	X				X
Data bases authentication	1	X									
Electronic processing of documents	1				X						

Six answers argued that electronic government could use digital certification in order to promote a better interaction between the State and the citizens. The evolution and increasing availability of ICTs have created opportunities for the reorganization in the way the State offers its services by exploring electronic means for meeting the society´s demands. In fact, the improvement of this relation comes from the development of digital government rather than from digital certification. (United Nations, 2005; European Communities, 2003; Trosa, 2001; Zugman, 2006; Schelin, 2003; Smith, & Smythe, 2004; Huang, Siau, & Wei, 2005; Lenk, & Traunmüller, 2007). However, the increasing use of Internet and digital media requires an institutional legality status and security to the electronic transaction, enabled by the application of digital certification. By assuring the information security of electronic information, government can interact virtually, with no physical presence, faster, comfortably, transparently, and simplifying the administrative processes.

Secure authentication for data access was the answer in four cases. Again, a requirement related to information security is mentioned (Stallings, 2007). In this case, it is possible for the State to dematerialize its relations, leaving the physical world of the "front desks" and going into the universe of the virtually provided services. Digital certification can provide the citizen with digital identification in a safe and legally valid way.

In a suggested answer, the government could make use of digital certification to

authenticate its databases. As we have seen, authenticity is one information security requirement (Stallings, 2007). Government programs that require electronic transactions among many entities, also involving the citizens, can use this application of digital certification.

Finally, an answer pointed out the secure processing of electronic documents as an application of digital certification by the government. The Justice Section of Rio de Janeiro (part of the Brazilian Federal Justice), for example, has adopted digital certification to improve the processing of administrative electronic documents. Electronic processing with digital certification is a reality in most Brazilian Special Federal Courts and in some branches of fiscal and criminal federal courts of Rio de Janeiro (both from the Brazilian Federal Justice).

In Frame 5 results related to the perspectives of broadening the digital certification application are summarized.

Frame 5: Perspectives of broadening the digital certification application

What are the perspectives of broadening the application of digital certification?	**Total**	**Interviewee**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Providing more electronic public services	3	X					X		X		
Enabling digital identification	3	X		X				X			
Replacing the physical process by the electronic one	3				X					X	X
Improving State efficiency	3			X						X	X
Moving from the face-to-face to the virtual system	1					X					
Increment of electronic transactions	1									X	
More sustainable data archiving	1			X							
Transforming the bureaucratic culture	1			X							
Spreading digital certification	1		X								

Regarding the perspectives of adopting digital certification, three answers agreed that when more virtual services are offered, new possibilities of using digital certification arise.

Also, three answers refers to the future availability of a digital identification, along with a digital certificate to the common citizen, as already happens in Spain and Belgium. An additional possibility would be the association of digital certification with

some kind of biometric identification (facial, iris, or fingerprints recognition). In addition, more documents could be added to this digital identification, like tax payer's id, voter registration, driver's license, and worker license.

Replacement of the physical process by an electronic alternative was cited by three interviewees as a way to broaden the use of digital certification. According to one of them, the electronic processing with digital certification will soon replace the traditional physical processing in the Brazilian Federal Court.

Again, the increment of the State efficiency (Butcher, 2003) is seen in three answers. This would happen as a consequence of a series of events. It was suggested, for example, that the increasing of efficiency and tax collection capillarity, by means of instruments like the Electronic Invoicing System, would lead to a reduction in government costs. Another interviewee pointed out the reduction of operational costs with virtual public services as a consequence of the elimination of face-to-face assistance and the reduction of notarial costs. An interviewee noticed that this trend in Brazilian Courts will promote many benefits for society, emphasizing an increment in the processing speed and reduction in procedural costs.

It was mentioned in one answer, as a consequence of digital certification adoption, the security assurance for: moving from the face-to-face to the virtual system; increment of electronic transactions, removing progressively the paper use; more sustainable archiving; and a positive transformation in the bureaucratic culture, i.e., a paradigm shift in the State-citizen relation.

Finally, an interviewee envisions an extensive massification of digital certification, based on the technology convergence and increment in the Internet and mobile communication use for performing electronic transactions. These transactions include the electronic government ones, having the necessary security provided by digital certification. Another potential communication channel in this context is the Digital TV.

Frame 6summarizes the results related to actions that could be carried out to make digital certification widely known and used.

Frame 6: Actions to make digital certification widely known and used

What could be done in order to make digital certification widely used and popular?	**Total**	**Interviewee**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Extend the set of electronic public services	6		X		X	X			X	X	X
Develop information campaigns in communication means	5	X	X		X		X				X
Invest in interinstitutional partnerships	2	X						X			
Stimulate new applications	2	X		X							
Improve logistics	1						X				
Train people in digital certification	1	X									

Most of the answers (six) pointed out the extension of electronic public services as an effective approach to make digital certification more popular and used. According to interviewees, this extension depends basically on the government desire and the society's demands, mainly from local governments. Moreover, it was emphasized the necessity of offering quicker and simpler electronic services that can stimulate the use of digital certification, having as a consequence the drastic reduction of traditional processes, characterized by slowness and bureaucracy.

The implementation of information campaigns comes in the second place, with five answers. Brazilian National Institute of Information Technology intends to include actions like these in the next Annual Budget Planning of Brazilian Federal Government, arguing in favor of the change to overcome both the cultural resistance against new technologies and the fear of replacing paper on the basis of a false belief of its security.

Two answers were in favor of the interinstitutional partnerships with Brazilian Mail Post Company, notaries, banks, and NGOs as a way to increment the use of digital certification.

Still, two answers were in favor of stimulating new applications of digital certification, mainly the ones that involve many government sectors to increment its use. It was suggested the obligatory use of digital certification in electronic transactions that involve contracts and payment, like in Internet Banking and electronic commerce.

Improvement in logistics was once mentioned as a way to disseminate digital certification beyond big urban centers.

In one case training of people in digital certification was suggested to make it more popular. Moreover, it would be possible to consider academic partnerships to develop new digital certification applications, making its adoption wider.

6. CONCLUSION

A qualitative analysis was performed on the collected data about how digital certification can help the development of the Brazilian electronic government, particularly as a support for improving Public Administration in a context that is requiring the reinvention of the State in face of new demands from Information Society.

Based on this analysis, it can be concluded that the main advantages of adopting digital certification refers to the accomplishment of information security, including requirements as data authenticity, confidentiality, and integrity. Additionally, it can be cited arguments related to legal validity of electronic documents and improvements in government control and audit.

Although digital certification is regarded as a system that promotes expense reduction, speed increasing, people comfort, etc., actually, these benefits come from the underlying ICT process supporting Public Administration, particularly in electronic government. Digital certification enables security to these processes, when electronically performed.

Regarding the main barriers to the digital certification use, the cultural issue must be emphasized, in addition the incipient Brazilian infrastructure and the few electronic applications, mainly in public services.

For the Brazilian electronic government, digital certification applies mainly to the authentication of government databases, to access public services, and to the processing of electronic documents.

Regarding the alternatives to make the digital certification more popular and used, the main suggestions were to increment the set of electronic public services and the implementation of information campaigns.

Finally, some perspectives on the broadening of digital certification in Brazil were emphasized. It includes the offering of digital identification along with digital certification, the replacement of physical processes by electronic ones, all that leading to the State's efficiency improvement.

In addition, it was mentioned the transition from the face-to-face to the virtual practice, more sustainable archiving, and the bureaucratic culture transformation.

In short, it can be concluded that digital certification keeps a direct relation with information security and this one is a necessary condition for electronic government. In addition to this, digital certification maintains an indirect relation with the process improvements in Public Administration and with the interface quality between the State and citizens.

7. RECCOMENDATIONS

Taking into account the subject and time limitations imposed on this research, more investigation efforts can be suggested. A deeper study regarding the current applications of digital certification in Brazil could be developed. Additionally, it would be interesting, further, a comparative study on how the perspectives from now will meet

the reality from a near future. Another possibility would be a comparative study on the adoption of digital certification in Brazil and in the world. Another study could evaluate the potential of digital certification as the basic technology for a data archiving and retrieving system, avoiding paper use in a sustainable way.

REFERENCES

Associação Brasileira de Normas Técnicas (2005). NBR ISO/IEC 17799: código de prática para a gestão da segurança da informação. 2ª ed., Rio de Janeiro: ABNT.

Braga, L. V. et al. (2008). O papel do governo eletrônico no fortalecimento da governança do setor público. *Revista do Serviço Público* (Brasília), v. 59, p. 5-21.

Butcher, T. (2003). Modernizing civil services: an era of reform. In: Butcher, T., & Massey, A. (Eds.). *New horizons in public policy: modernizing civil services*. Cheltenham: Edward Elgar Publishing. p. 1-15.

Capurro, R., & Hjørland, B. (2007). O conceito de informação. *Perspectivas em Ciência da Informação*, Belo Horizonte, v.12, n.1, p. 148-207.

European Communities (2003). The role of e-government for Europe's future. Brussels: Commission of the European Communities.

Foley, P., & Alfonso, X. (2009). E-government and the transformation agenda. *Public Administration*, Vol. 87, No. 2, 2009 (pp. 371–396).

Gaskell, G. (2002). Entrevistas individuais e grupais. In: Bauer, M. W., & Gaskell, G. (Eds.). *Pesquisa qualitativa com texto, imagem e som*: *um manual prático*. 2ª ed. Petrópolis: Vozes. p. 64-89.

Hilbert, M., & López, P. (2011). The world's technological capacity to store, communicate, and compute information. *Science*, February 2011.

Huang, W., Siau, K., & Wei, K. K. (2005). Electronic government strategies and implementation. Hershey: Idea Group Publishing.

Instituto Brasileiro de Geografia e Estatística (2007). Pesquisa nacional por amostra de domicílios 2005: acesso à internet e posse de telefone móvel celular para uso pessoal. Rio de Janeiro: Diretoria de Pesquisas Coordenação de Trabalho e Rendimento.

Kurose, J. F., & Ross, K. W. (2008). Computer networking: a top-down approach. 4th ed., Boston: Pearson Addison Wesley.

Lenk, K., & Traunmüller, R. (2007). Broadening the concept of electronic government. In: Prins, J. E. J. (Ed.). *Designing e-government*. 2nd ed., Alphen aan den Rijn: Kluwer Law International, p. 9-21.

Lévy, P. (2004). Ciberdemocracia. Lisboa: Instituto Piaget.

Moresi, E. A. D. (Org) (2003). Manual de metodologia da pesquisa. Brasília: Universidade Católica de Brasília.

Moresi, E. A. D. (2001). Gestão da informação e do conhecimento. In: Tarapanoff, K. (Org). *Inteligência organizacional e competitiva*. Brasília: Editora Universidade de Brasília, p. 111-142.

Scartezini, V. (2004). Governo e comércio eletrônico nos países em desenvolvimento. In: Ferrer, F., & Santos, P. (Orgs). *E-government: o governo eletrônico no Brasil*. São Paulo: Saraiva, p. 3-15.

Schelin, S. H. (2003). E-government: an overview. In: GARSON, D. G. *Public information technology: policy and management issues*. Hershey: Idea Group Publishing, p. 120-137.

Smith, P. J., & Smythe, E. (2004). Globalization, citizenship and new information technologies: from the MAI to seattle. In: Mälkiä, M., Anttiroiko, A., & Savolainen, R. (Orgs.) *eTransformation in governance: new directions in government and politics*. Hershey: Idea Group Publishing. p. 272-307.

Stahl, B. C. (2005). The paradigm of e-commerce in e-government and e-democracy. In: Huang, W., Siau, K., & Wei, K. K. *Electronic government strategies and implementation*. Hershey: Idea Group Publishing, p. 1-19.

Stallings, W. (2005). Cryptography and network security: principles and practices. 4th ed. New Jersey: Prentice Hall.

Stallings, W. (2007). Data and computer communications. 8th ed. New Jersey: Pearson Prentice Hall.

Starr, P. (2010). The liberal state in a digital world. *Governance: An International Journal of Policy, Administration, and Institutions*, Vol. 23, No. 1, January 2010 (pp. 1–6).

Trosa, S. (2001). Gestão pública por resultados: quando o estado se compromete. Rio de Janeiro: Revan; Brasília: ENAP.

United Nations (2005). Unlocking the human potential for public sector performance. World public sector report 2005. New York: Department of Economic and Social Affairs.

United Nations (2010). United Nations e-government survey 2010: leveraging e-government at a time of financial and economic crisis. New York: Department of Economic and Social Affairs.

Zugman, F. (2006). Governo eletrônico: saiba tudo sobre essa revolução. São Paulo: Livro Pronto.