E-Government in Chile and the adoption of XML as standard: Experiences, Challenges and Perspectives

Abstract. This paper presents the development of e-government in Chile from its beginning until the recent adoption of XML as standard for electronic documentation in Government agencies. The local legislation is the result of technical and legal discussions among the Government, private sector and academia. This work presents the context, the process of implementation, and relevant experiences. Then discusses challenges and open problems to be faced, focusing on IT technical issues, i.e., not considering in depth economic, sociological and political aspects.

1 Introduction

One of the basis of the modernization process in Chile is the development of an electronic government. This development is viewed as the "incorporation of Information and Communication Technologies in the administrative organizations of the State, in order to improve the information services offered to citizens, the efficiency of public management, and to increase substantially the transparency of the public sector and citizens participation" [14].

Recent studies show that e-government in Chile is between the "Presence" and the "Interaction" maturity phases[7]. This means essentially that the problem of interoperability is becoming one of the main issues. Based on this diagnostic, on international experiences, and available technologies, the Chilean Government took in the year 2004 the bold step of introducing XML as standard for all the electronic documentation exchanged among its agencies. From a technical point of view, this decision is easily understandable based on the well known features of XML and related technologies. The social, administrative and engineering consequences of this decision are less obvious.

This paper presents the origins and evolution of e-government in Chile, and the process that culminated with the adoption of XML as standard for digital documentation. First, the context is introduced in Section 2 by presenting the geopolitical situation and the process of adoption of Information and Communication Technologies in Chile. Then, Section 3 presents the state of the art of e-government in Chile, including the origins, legislation and the most relevant and successful experiences previous to the general adoption of XML.

In the second part of the paper, Section 4 presents the transition from paper document management to the adoption of XML as standard for digital documentation, and discusses the Chilean Norm about XML documentation in detail. Section 5 discusses the challenges and perspectives generated by this initiative, and presents our view of the forthcoming developments. Finally, Section 6 presents the conclusions.

2 The Context

The geography, the political, economic and administrative systems show the importance and urgency to establish an e-documentation system in Chile. This section briefly reviews these parameters and the IT infrastructure and the initiatives which forms the basis for e-government in the country.

2.1 Chile

Chile is a long and thin country located on the southwestern coast of South America, with a population of 16 million people. Considered as one of the countries in the area that has better consolidated democracy and stability after decades of turbulence and dictatorships, it is also shown as "example" in the area of fiscal accounting and macroeconomic figures. In recent years, Chile has advanced to an important economic opening based on Free Trade Agreements with the European Union, Korea, United States, EFTA, Central America and Mexico. Agreements with China, India, New Zealand and Singapore are currently under study [3]. These agreements bring opportunities of greater investment in the country, and development of new business and companies. They also rise the need of greater and better services provided from the Government to national and international companies, from national to international companies, among Governments agencies, and between citizens and Government.

Chile has a presidential system of Government democratically elected by popular suffrage. The Chilean State is split into three independent branches: the Executive, headed by the highest authority, the President of the Republic, the Judiciary, with its highest tribunal, the Supreme Court, and the Legislature, which has a Chamber of Deputies (or House of Representatives) and a Senate. Chile is divided in 13 regions, with cities dispersed along more than 4000 km., with an extremely complex geography including deserts, mountains and islands. This geographical diversity makes particularly complex the communication and access to services and Government agencies by citizens. Every region is further divided in provinces and every province in counties (51 and 346 respectively). Despite important local and regional attributions, Chile's Government is still strongly centralized [10].

2.2 IT and Interconnectivity in Chile

The nineties mark the introduction of digital interconnection at a massive level in Chile. The Internet connectivity dates from 1991. Since 1992, there has been a sustained effort to interconnect Chilean schools [15]. The first ATM network started to work in 1994 [5]. By 1999 the Government had a solid Intranet [13], and the law enforced the interconnection and quality standards of the Internet Service Providers. Currently there are 6 million people (more than 40% of the population) that have access to Internet, either from home, their jobs or educational establishment [12]. The Internet access of schools is 100% in high schools and 50% in primary schools [15]. The 97.8% of the public sector have

Year	Description	Technologies involved
1999	ISP interconnection	–
1999	Government Intranet	optic fiber
1999	Government Portal	standard Web devel.
2000	Portal "Easy Errand"	standard Web devel.
2002	Electronic Signature	XML, Web
2002	On-line Public Purchase and Hiring System	on-line transactions
2003	Electronic Invoice	XML
2004	Standardization of Digital Doc. (XML)	XML & related tech.

Table 1. Technical highlights of the development of e-government in Chile

e-mail servers and Internet connection, and at least 15 public services declare to implement some type of automated transaction together with another public service [2].

Nevertheless, a coherent policy of technological development in the IT area started recently with the year 2000. The first step in this direction can be considered the program compiled in the *Blue Book* (2000) reporting the state of IT in Chile and the perspectives for the future. Twelve initiatives were identified that would make IT progress in Chile, in the following three areas: massification of the access to digital networks, development of new capabilities using new technologies, and use of new technology to modernize the government.

The next step was given by a common effort of the Government, industry and academia, which together developed a program called *Digital Agenda* [4], released in February 2004 and improved in August 2004. The *Agenda* is a program comprising the guidelines for the development of the IT in Chile. It consists of a list of 34 strategic initiatives grouped in six priority areas that would contribute to the development of Chile by using information and communication technologies. Among its goals are improving competitiveness, providing equal opportunities, individual freedom, improving life quality, and efficiency and transparency of public affairs, while enriching national identity. The ultimate goal of the Digital Agenda is to make Chile a digitally developed country by 2010. Table 1 summarizes the most relevant technical initiatives of e-government in Chile.

3   E-Government in Chile: State of the Art

In this section we present an overview of the evolution of the e-Government in Chile, its maturity level, legal framework and paradigmatic experiences.

3.1   Origins and Development

The first step towards the development of the e-government was a Presidential document delivered in 1998, commanding simplification of procedures, focusing on process redesign and elimination of dependences. At the same time, the

Government was providing basic information online to citizens via an official Portal, and building a broadband Intranet to improve communication among its agencies.

The next stage of service availability for citizens was the development of the portal *Tramite Fácil* (Easy Errand). It was created the year 2000 to give information about errand procedures of different Government agencies. Some procedures were accessible online, forwarding the user to the corresponding agency portal, which implemented and owned the online service. Examples of available errands are: declare and pay medical and retirement funds, get birth certificate, declare and pay Value Added Tax (VAT) and apply to different help programs. Currently it has 1550 procedures on public services that permit to execute 220 errands online [2, 1]. Special mention deserves the possibility of online tax payment, a revolutionary initiative that guided future developments.

After the Presidential Instructive 905 released in 2001, the Government started developing initiatives oriented to build the legal and technical framework for a unified e-government. Among them are: the State Reform Committee of Ministries composed by representatives of the Industry, Presidency and Internal Affairs Ministries; the Committee for Interoperability Norms, under the umbrella of the Industry Ministry, whose objective is to advise the President in the definition of norms for interoperability; the *Project for the Reform and Modernization of the State* (PRYME by its Spanish acronym), under direct supervision of the President, whose work areas include: e-government, modernization, citizen participation, administrative procedure, regionalization and transparency [7]; the *Digital Agenda*; and new and better services in different government agencies (Central Identification Service, Tax & Revenue Service, etc.)

According to a standard classification of e-government phases, the United Nations estimates that Chile is in the "Interaction" maturity phase [9]. This estimation is similar to the results obtained in a local study showing that Chile is in between the phase of "Presence" and "Interaction" [7].

As for the near future, the action plan for the 2004-2006 period concentrates on promoting the generalization of the access and the sophistication of IT usage, specially through the use of the Internet by people, companies and institutions. There are six priority areas identified as part of the Digital Agenda that will contribute in reaching these goals. They are: *Massive access* (reach 900 thousand homes connected to the Internet); *Education and training* (training at least one million people in digital technologies); *On-line Government* (make electronic errands massively available and extend the use of IT in all Government agencies); *National industry* (promote connectivity and sophisticated usage of the Internet for at least 150 thousand companies); *Development of the IT industry* (promote the development of a large number of companies in the sector); and *Legal infrastructure* (new advances in current legislation incorporating digital issues). Table 2 summarizes political decisions associated to e-government in Chile.

There is a high impact initiative stated in the *Agenda* that is being developed: a back-office for the Government that interconnects the different services

Year	Political Initiative
1998	Presidential Instructive about simplification of procedures
2000	State Reform Committee of Ministries
2000	Reformulation of Management Modernization Policies
2001	Presidential document 905 about Unified e-government
2002	Committee of Interoperability Norms
2003	PRYME (coordination of e-government efforts)
2004	Digital Agenda (Private and Public sector)

Table 2. Main political and administrative initiatives for e-government in Chile

offered by each agency. The administrative motivation of this project is the implementation of the "Transparency Act" of 2002 (see section 3.2).

Finally, one of the major steps in the whole process is the adoption of a standard for digital documentation which will impact every level of e-government. The elaboration of the norm started in 2003 and finished in December 2004 with its public release.

3.2 Current Legislation on Topics of E-Government

One of the first legislation related to e-government in Chile was the privacy and security of digital data, promulgated on 1999, which permits to identify the owner of the data related to a procedure, and the attributions of the Government agencies when interchanging such data.

In year 2002, it was released the *Digital Document, Signature and Certification* law, which defines the electronic signature as a group of data that identifies uniquely the signer of an electronic document. This signature has the same legal value than a signature in paper.

The most important regulation, due to its administrative implications, is the Administrative Procedures Law ("Transparency Act"), which essentially enforces that Government agencies cannot ask a citizen (when doing an errand) for documents which another Government agency already has (e.g. when asking driving license, the identity card). This means that Government agencies should be able to at least exchange or validate information among them, which due to the volumes of information managed, implies automation of the process.

By the end of the year 2004, it was released the *Efficiency of Digital Communications* decree. This decree rules the communication by electronic media by which Government agencies and citizens can interact, caring that techniques used are appropriate and the information transmitted is correctly managed. In December 2004, it was released the *Interoperability of Digital Documents* decree, which –due to its importance– will be covered in detail in the next section. Table 3 summarizes the legal initiatives towards the development of e-government in Chile.

Date	Law	Description
1999	19.628	Privacy and Security of digital data
2002	19.799	Digital Document, Signature and Certification
2003	19.880	Adm. Procedures of Gov. Agencies ("Transparency Act")
2004	DS 77	Efficiency of Digital Communications
2004	DS 81	Interoperability of Digital Documents (XML)

Table 3. Legal Framework of e-government in Chile

3.3   Successful and Paradigmatic Experiences

Internet Revenue Collection. The automation of Revenue Collection has been one of the great success stories of e-government in Chile. Every year, Chilean citizens must declare their annual incomes to the Government through the Chilean Government's Tax and Revenue Service called *Servicio de Impuestos Internos (SII)*, and pay or be credited back with the so called "Global Tax". This used to be a prone-error process, also difficult to process by the SII, and therefore, a low and faulty experience. The flaws of the process allowed many people to cheat on tax declarations. As a way to make the process more efficient and reliable, the *SII* implemented in 1998 a Web based system to declare the annual taxes. Since the new automated system presented options from an almost ready-to-used pre-filled declaration form to more complicated formats, an ever growing number of people began to use it. The adoption of this system by tax payers has grown to 66,9% in 2004, over a universe of 2 million of declarations [8]. This is the first massive experience of citizens interfacing the Government via Web.

Electronic Invoicing in Chile. This project represents a pioneer experience and the first large-scale adoption of XML-based digital documents and digital signature in Chile. Since 2002 the *SII* has been promoting the adoption of Electronic Invoicing for managing and interchanging information about commercial transactions. In 2002, it began an experimental phase, with a few providers and customers (mainly large corporations). The goals were to obtain improvements in the citizens business processes, decrease significantly the associated costs of the invoicing process and to ease the development of e-commerce in the country. The estimation was to reach US$ 300 million in direct savings for this concept. The first stage of this project (2002) helped to define the technical issues of the new system (XML for encoding of the invoices, XML Schema for metadata specification, Xmldsig for digital signature), and some definitions to manage rights to emit invoices. For the interchange of these documents, an e-mail based asynchronous model was adopted, mainly due to the already wide adoption of this method of communication. Nevertheless, its complexity, specially related to ensure the success of a transaction, is still a challenge for the providers of electronic invoice software solutions. In April 2003, it began the official operation of the electronic invoices. Currently there are more than 500 organizations authorized to interchange electronic invoices, 15 providers of electronic invoicing software solutions, and several millions of documents interchanged every month.

National Identification Service. Today a citizen can obtain documents (e.g. birth certificate) by directly printing from the Web a document with encoded validations. The National Identification Service *(SRCeI)* is the agency intended to register citizen's information and facts that are relevant to protect the family rights and personal identification. Additionally, the SRCeI establishes and registers the identity of the citizens, and delivers the associated official documents and certificates. The SRCeI interacts with many private and public organizations, providing information and services according to Chilean legislation on privacy protection. Since 2003, the SRCeI began the operation of its new system which allows online errands, and permitted to implement automatic interoperability between the SRCeI and many Government agencies. Additionally, the system offers the innovative service of digital identity validation for the citizens in association with Certification Authorities.

4 XML as Standard for E-Documentation

Adopting a standard for digital documentation appears as a major step within the Government modernization efforts, and several of the initiatives in the Digital Agenda are based on it.

4.1 Document Management Today

Despite the current high level of automation, the bulk of documentation being processed in Chilean Government agencies in 2005 is still paper. Currently, public agencies use proprietary formats for electronic documents, most of which do not have legal value, jeopardizing the possibility to integrate and interchange information among public organizations. Typically, the legal value resides in a hard copy document, which is used as information source to feed the systems of an organization, and which in a few cases contains a code to check authenticity. Administratively, each autonomous organization has a division that interfaces the external environment with the internal workflows. It receives requirements, transported in paper-based forms, and performs the workflow collecting in a folder the corresponding signatures, stamps and related documents.

The tools for processing information are usually ad-hoc systems, office applications and e-mail. Basic services for managing electronic documents are available for several public agencies. These basic services include capture of information, store and search of digital and physical information, and the delivery of proprietary services based on that information (through Web systems or virtual Kiosk). Most of these services are outsourced to local software companies. There are few critical public agencies having advanced services for electronic document management (e.g. National Identification Service, Treasure, and Tax and Revenue Service). These advanced services include: standardization of the documents format, definition of data and services interchange protocols, use of workflow to support the internal process, definition and adoption of security policies, and use of business intelligence and shared knowledge management tools.

4.2 Electronic Document Management

The move towards electronic documentation is an international trend (see e.g. the well documented case of dissemination of U.S. Government electronic documentation [16]). Among its advantages are (a) Reduction of storing, maintaining and disseminating costs. (b) Greater functionality, like searching, linking to related information, manipulation, and other available features like images, audio an video. (c) Increase of document accessibility. E-documents are more accessible to citizens, including those with physical impairment; once posted, they are accessible to thousands of users from multiple locations around the nation, which in the Chilean case is extremely relevant. In summary, it eliminates geographic differentiation.

However, the migration to electronic documentation has several challenges. Among the most important are authentication, persistency, equally accessible rights to all individuals, and in general, legal issues.

4.3 The Chilean Norm

The Chilean Government has identified the electronic document management as a key issue in order to implement an effective e-government platform. In December 2004 was published the Decree 81 [14] which enforces the adoption of electronic documents by public agencies, and defines XML as the standard. The motivations from a political and administrative point of view were: to ease the access to Government information; to increase productivity and reduce operational costs of Government agencies; to ease the communication between citizens and Government agencies; and to ease the interaction among Government agencies. From a technical point of view, among the most important motivations that lead to the adoption of a standard for electronic document were: easy classification, storage and search of documents; interoperability among documents of different agencies at hardware, operating system and software levels; and easy development of generic applications for document processing in Government agencies.

The Committee for Standards of interoperability, a group of technical people from the Government, private sector, and academia, was called in 2003 to elaborate a standard for electronic documentation meeting the above requirements. This Committee worked for almost a year and a half, and presented a proposal to the Government. Although XML emerged as the main candidate to meet the desired requirements, there were other proposals, e.g. PDF. Finally XML and its family of technologies were chosen because of its flexibility to specify formats, modularity (mainly compositionality and reuse), scalability, the fact that it is an open *de facto* standard, its independence of platforms and applications, its good industrial and commercial support, and its architecture compatible with future extensions of the global information system.

The proposal became the Decree 81 that establishes three levels of implementation, and implicitly states the time-frame for its adoption. In *Level 1* (for whose adoption the decree gives 30 days after its release) the agencies should be able to receive, store and redirect electronic documents already generated by a

third part. The rationale behind this decision was the existence of browsers that currently read XML, like *Mozilla*. Communication can be done via e-mail. The *Level 2* (for whose adoption 2 years are given) states that each agency should be able to generate XML documents by itself plus the functionalities stated in Level 1. The *Level 3* and final, states that each agency should be able to process XML documents without restrictions. The Government think that this third stage should be completed by year 2009.

On the more technical perspective, the XML technologies enforced are XML v.1, XML Schema for schemas, XForms, XML Signature, UTF-8 (current digital documentation used in Chile used mainly UTF-8) and a translation service for UNICODE, XSL and XHTML for visualization, and Web Services as recommendation. The standard states also that each document must contain the following metadata: schemas used; metadata documenting use and meaning of the schemas used; semantic metadata to ease localization; metadata to permit follow the life of the document; and references to a dictionary of metadata.

Other important issues that are included in the standard refer to the fact that the document should permit signature, should have a unique identifier (associated to its localization), should allow alternative visual presentations for different media, and mechanisms to verify integrity and authenticity of the visualizations of the signed versions.

5 Challenges and Perspectives

Considering the current status of public information systems, the strategy of the Chilean Government to implement document management will face several *challenges*, and new opportunities and problems will arise. These give new *perspectives* for the near future.

5.1 Challenges

Development of Metadata and Schemas. The Chilean decision differs from advanced proposals like that of the UK GovTalk in the United Kingdom. There, metadata, structures, and specifications are the first stage in a long process to support interoperability. In the Chilean case, the reverse is what is being done in practice. The task of developing metadata, taxonomies and ontologies is one of the most urgent challenges, and will be a bottom-up process. ¿Is it possible? We think it is, but the success will heavily depend on the speed at which this important task is accomplished. As for the schemas to be developed, similar considerations hold for it.

Implementation of Repositories. Complementarily, a set of local, regional, and central repositories should be implemented in order to share metadata and schemas definitions. These repositories will bring advantages in terms of document format standardization, but several design issues should be faced, such

as: standardization of query interfaces, formalization of roles and grants to access the repositories, and implementation of security policies and algorithms to keep the integrity of the shared information.

Background of Developers. Usually, informatics personnel spend most of their time maintaining legacy systems and they are not familiarized with new software technologies. In fact, very few employees in charge of developing Government information systems in Chile know XML technologies. Moreover, few developers from Chilean software companies are ready to develop XML-based solutions. Chilean Universities and training Institutes are still very late in providing courses or training programs on XML and related technologies. One of the biggest challenges is to train thousands of developers from industry and public agencies during the next years in order to complete the proposed reform by 2009. Topics to be covered should include e-government fundamentals, electronic document in Chile, XML, digital signature, workflow, Web technologies including Web services.

Time, Cost and Commitment. The Chilean e-government initiative considers the whole transformation of the document management systems for 2009 (DS 81). Continuing the current tendency, most of the new solutions will be developed by Chilean software companies. Therefore, such companies will have to be able to deal with a huge demand for new systems. During 2003 a study identified more than 350 internal projects related to the e-government initiative [11], which should be updated in order to support XML-based documents. Consequently, the Government will have to assign enough resources (time, money and commitment) to make this initiative feasible. Two of the major challenges to face will be the available time and the commitment to adjust legacy systems and to implement the new ones.

Maintainability of Standards. Standards developed by the e-government initiative are just at their starting point. Additional standards related to security, metadata and document distribution are being developed in order to regulate several aspects of digital document management. To be successful, this process requires a public agency or committee to lead and coordinate the definition, adoption and evolution of these standards. Unlike the current Committee for Norms, the authority for standards should be permanent and collaborate with technical experts from the Government, academia and industry.

Interoperability of Services. Complete automation of services cannot be thought of today without Web services technology. Currently the major problems in the incorporation of Web services in government (and in the general practice) include: Complexity of execution, visualization and testing of the methods of a service (due to lack of adequate tools); Difficulty of finding Web services in UDDI directories as well as in the Web in general; Absence of mechanisms for maintaining descriptions of Web services in a persistent form; and Lack of semantic descriptions to simplify searching. The challenge is to develop a system

that allows to collect, store and query different Web services at a semantic level. In particular, tools for managing portfolios of Web services to be used when building new applications.

Data Migration. The adoption of XML for digital documentation brings a great opportunity to unify the current information and create a unique data model for the Chilean Government. However this opportunity involves a large effort in data migration and the answer of key questions: Who will be in charge of defining the data of the unified format for public agencies? How will current software systems be able to operate while the data are migrated? Who will be in charge of data migration? Are the Chilean Government and software companies able to assume the challenge of adjusting legacy software systems without affecting the current quality of service?

Security, Trustworthiness and Privacy. It is not only a technical challenge, but also a social one. Many online services will involve sensible information, and citizens and public and private organization should be sure that their information is protected. On the other hand, service provider organizations should also be sure that the information submitted by clients is trustworthy. In this moment, the Government is creating a task group in charge of dealing with security, trustworthiness and privacy issues of digital documentation [7].

5.2 Perspectives

Legacy – System Architectural Issues. Legacy applications within the Chilean Government have been developed independently, so they cannot naturally communicate. But defining the new XML standard for digital document interchange requires that all applications must be able to communicate. A standard solution for this architectural mismatch is to build wrappers or bridges [6] for each application so that they can communicate to a shared bus architecture. These strategies are consistent with other solutions proposed for e-government applications and have a small impact on legacy systems.

Legal Issues. From the legal point of view, there is a broad new area to be dealt with. Digital documents will be considered, from a legal point of view, as if they were a hard copy document. Current Chilean legislation gives the basis to extend classical approaches for paper-documentation to electronic ones. However, problems with document data protection and information privacy start to arise (e.g. seizure of e-mails of public offices employees by a Judge). There is still much work to do by Legislative and Judicial Branches, in order to assure that digital documents are as secure and trustworthy as the hard copies.

Include Semantics into Web Services and UDDI. A common limitation of XML based standards is their lack of an explicit semantics. Two identical XML messages may mean very different things depending on the context of their use. This proves to be a major limitation for a flexible and more powerful description

of Web services capabilities. It becomes a critical requirement in atmospheres like the Government where heterogeneity of information systems is a fact. Similar problems arise with Web services repositories. The UDDI is a very popular form of directory for Web services today, but it lacks several features to successfully implement this kind of repository for applications in e-government. The perspective is to develop Web services and UDDI at semantic level.

6 Conclusions

The e-Government initiative in Chile intends to improve the availability and interoperability of Government information and services, to reduce operational costs of public agencies and to increase public administration visibility.

Adopting the XML standard was a bold initiative. Several factors motivated this decision, among the most important are the priority given to macro-objectives over short term goals; the adoption by the Government of a *de facto* standard of the industry; the advantages of a centralized and stable government; the widespread IT infrastructure as compared with similar countries in the region; and the fact that there are almost no e-government legacy applications. These issues conform an advantageous situation to adopt a global solution for digital document management.

Nevertheless, the decision is not free of risks. The initiative will have to deal with technical, operational and economical problems. The assimilation of XML by the Chilean software companies and Government local developers is the main technical problem to be faced. Training programs will play a key role during the next years. In addition, an adoption plan of XML-based solutions should be designed and implemented by public agencies that leads this initiative. This issue and the available time represent the main operational challenges. The economic cost of adopting XML will be important, but it is a comparative smaller challenge.

Finally, let us say that with any degree of success, this process will bring experience not only to Chile but also to the region as a whole.

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