E-government and Interoperability Issues

Giorgos Laskaridis[1], Konstantinos Markellos[2], Penelope Markellou[2], Angeliki Panayiotaki[2], Evangellos Sakkopoulos[2] and Athanasios Tsakalidis[2]

[1]University of Athens, Greece, [2]University of Patras, Greece

Summary
Governments worldwide adopt e-government model and use ICT and particularly the Web as a key vehicle. This means the full integration of new technologies for transforming the public administrations and facilitating drastically the information flow among different governmental agencies, citizens and businesses. Interoperability appears as the mean for accomplishing the inter-linking of information, systems, applications and ways of working not only within governments but also in their interaction with the administration, enterprises and public sector. The paper highlights the critical role of interoperability and investigates the way it can be incorporated into e-government domain in order to provide efficient and effective e-services. It also describes issues-steps associated to interoperability, depicts the arisen technical dimensions, proposes solutions when possible, and discusses its effectiveness. Finally, it illustrates the future trends in the field and suggests directions that may produce new scientific results.

Key words:
ICTs; e-government; G2C; G2B; interoperability; XML; web services; WebML; SOA; governmental organizations.

1. Introduction

Over the last decade, we have witnessed the rapid evolution of the World Wide Web. This development allowed millions of people all over the world to access, share, interchange and publish information. At the same time, public and private sector organizations implement highly functional and interactive web-based applications, which are accessible to any user with the required infrastructure (a computer, a web browser and an Internet connection). These potentials impact all dimensions of our daily life. Thousands of new web sites are launched everyday providing electronic services (e-services), accessible through Internet, suspending bureaucracy procedures demanding personal contact and loads of paper-based forms. This "e-" prefix has been applied to a vast number of domains-applications e.g. e-commerce, e-business, e-learning, e-health, e-banking, etc., flavoring them with e-services.

In this context, governments worldwide have realized that their information resources are valuable economic assets, the fuel of the knowledge economy. By making sure that the information they hold can be readily located and passed between public and private sectors, taking account of privacy-security obligations, it will drive and stimulate national-international economy. Governments benefit from information and communication technologies (ICT) and the continuing expansion of Web and started e-government strategies to renew the public sector and eliminate existing bureaucracy and therefore reduce costs [24], [27].

During this decade, researchers study different aspects of how e-government may decrease bureaucracy. They deal with interesting but difficult venture to lead to common policies, able to be applied worldwide. However, many results-directions conclude to the definition of an interoperability framework. Interoperability means the ability of ICT systems and business processes they support to exchange data and enable the information and knowledge sharing. An interoperability framework can be defined as a set of standards and guidelines that describes the way in which organizations have agreed, or should agree, to interact with each other. It is, therefore, not a static document and may have to be adapted over time as technologies, standards and administrative requirements change [14].

There is a growing awareness that the interoperability of national public ICT infrastructures is a precondition for a more service-oriented and competitive public sector. Ever since the adoption of the Interoperability Decision (1720/1999/EC) of the European Parliament and Council in July 1999, the European Commission has focused on the pan-European dimension of e-government and on the interoperability requirements for its implementation.

Interoperable systems working in a seamless and coherent way across the public sector hold the key to providing better services, tailored to citizens and businesses needs at a lower cost. An essential requirement for information exchange is a single language that enables the description of the meaning and structure of underlying data, i.e. a mark-up language. Among current technologies and market developments this mark-up language is XML. XML offers a common meta-language and terminology to develop means for system and data integration and for gradual transfer to more consistent formats in information assets [26].

Interoperability aspects presented in this paper aim to lead the way of e-government helping private sector

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(enterprises, vendors, etc.) with e-business development being the ultimate scope, as well as citizens with their governmental transactions. Enterprises may form different legal entities, may adopt alternate business models, but the majority of them follow a certain path at their daily workflow. Advancing e-government at each step of this path will certainly facilitate enterprises' functionality and provide better background for e-commerce.

This paper aims to investigate how interoperability can be incorporated in the e-government domain in order to facilitate e-business. It presents a preliminary step at e-government, before applying interoperability, in order to enhance interoperability's success. It describes the issues, tasks and steps that are connected with interoperability in the enterprise environment, depicts the technical dimensions, proposes solutions when possible, and discusses the effectiveness of interoperability. Its goal is to illustrate the future trends in the field and, this way, suggest directions that may produce new scientific results. Hereafter, the term 'CLIENTS' is used for both citizens and businesses, as they are clients of e-government systems.

2. Background

Although countries worldwide are different culturally, politically, in population, etc., they have realized that national ICT investments provide vast opportunities for enabling the transformation to a citizen-centric e-government.

It is obvious that governmental institutions and agencies are the most complicated organizations in the society providing the legal, political, and economic infrastructure to support the daily needs of CLIENTS [3]. In their transition from the traditional operation and interoperation to the electronic one, the Web can be considered the key vehicle for the implementation and achievement of this scope. In this framework, governments across the world are grappling today with how to use electronic technologies to improve services to citizens, increase efficiency (including reducing inefficiencies due to redundant and overlapping government agency activities, investments, duplicative reporting requirements, among others), and streamline traditional paper processes.

A survey research was recently conducted in USA [2], by the Council for Excellence on Government that involved random telephone interviews with one thousand adults in USA and with two thousand Internet users from several countries (Australia, Canada, Hong Kong, India, Singapore, and seventeen European nations). When people were asked to report their experience with specific types of e-government, informational services garnered the most responses, however, many people thought that they would be very interested in using e-government for transactional services. The majority of the Internet users in each country thought that their government is doing a good or excellent job developing online resources that allow them access to information and conduct online transactions.

The types of e-government are categorized based on four citizen-centric groups for the delivery of e-services:

- *Individuals/citizens.* Government-to-citizens or G2C, building easy to find, easy to use, one-stop points-of-service that make it easy for citizens to access high-quality government services. Using the Web for accessing services organized by the needs of citizens such as benefits, loans, recreational sites, educational material, social services, and filing taxes.
- *Businesses.* Government-to-business or G2B, reducing government's burden on businesses by eliminating redundant collection of data and better leveraging e-business technologies for communication. Using the Web for accessing services in different areas such as regulation, economic development, trade, grants/loans, permits/licenses, and asset management.
- *Inter-governmental.* Government-to-government or G2G, making it easier for states and localities to meet reporting requirements and participate as full partners with the federal government in citizen services by sharing and integrating federal, state and local data, while enabling better performance measurement, especially for grants. Other levels of government are anticipated to see significant administrative savings and be able to improve programme delivery because more accurate data is made available and shared across agencies and levels in a timely fashion.
- *Intra-governmental.* Internal efficiency and effectiveness, adopting commercial best practices in government operation in areas such as supply chain, financial and knowledge management. Agencies must be able to improve effectiveness and efficiency, eliminating delays in processing and improving employee satisfaction and retention. This category has recently been identified as Government-to-Employees or G2E [20].

E-government also focuses on minimizing the burden on businesses, public and government when obtaining e-services by providing a secure infrastructure for online transactions, eliminating the need for separate processes for the identity verification and electronic signatures [23].

Recently various attempts have been made to establish e-government models. In [25] a model containing three progressive stages: e-government, e-governance and e-democracy is outlined. In this model, governments move from net presence (e-government), through to service provision and representative democracy (e-governance), to a final stage of e-democracy. Authors in [18] propose that for the implementation and successful operation of e-government, the proper design, which will be the basis in order to receive a series of strategic, administrative and

operational benefits, is necessary. The application of e-government in the public domain can be gradually performed in fourteen levels, easing the adjustment of the traditional governmental model to the electronic one. Depending on the maturity and the resources of each governmental authority, the authority is level categorized and the bottom levels may gradually be applied.

Barriers to efficient service provision arising from the way government is organized are no longer acceptable. The public and their political representatives now expect public administration to be as efficient and effective in achieving its goals as the enterprise sector. To do this entails both new ways of working, back-office transformation and better use of ICT. Furthermore, just as the public can transact business with enterprises over the Internet (e.g. reserve airline tickets, purchase books, etc.) they now expect to be able to carry out similar transactions as seamlessly and as easily with public administration. This requires government to provide both information and services that are developed from a 'customer- centric' viewpoint [9].

This combination of the use of advanced ICT, especially the Internet, in the support of new ways of working in public administration, together with the enhanced provision of information and interactive services accessible over different channels, is the foundation of e-government. The challenge here is to 're-write the rules' for how public administration works internally, interacts with its customers, and uses ICT, not only to increase productivity by making business transactions easier to carry out, but also to address issues of social inclusion and the digital divide. For this to happen, technology should ensure the communication and sharing of information, as well as administrative processes should be reorganized and be able to co-operate.

However, the reality today is the emergence of 'islands' of e-government that are frequently unable to interoperate due to fragmentation resulting from uncoordinated efforts in developing the services, at all levels of public sector.

By joining up administrative processes, everyone, whether in the public or enterprise sectors, could achieve a significant increase in efficiency and lower the cost of operations. Interoperability is essential for this 'joining up' of public administration, to share and re-use administrative information and to provide services and information over multiple channels. In essence, interoperability is a fundamental requirement, from both economic and technical perspectives, for efficient and effective development of e-government services at both the national and international levels, including the regional and local ones.

Three interoperability aspects need to be considered [14]:

- *Organizational interoperability.* This aspect of interoperability is concerned with defining business goals, modeling business processes and bringing about the collaboration of administrations that wish to exchange information and may have different internal structures and processes. It aims at addressing the requirements of the user community by making services available, easily identifiable, accessible and user-oriented.
- *Semantic interoperability.* This aspect of interoperability is concerned with ensuring that the precise meaning of exchanged information is understandable by any other application that was not initially developed for this purpose. It enables systems to combine received information with other information resources and to process it in a meaningful manner. It is therefore a prerequisite for the front-end multilingual delivery of services to the user.
- *Technical interoperability.* This aspect of interoperability covers the technical issues of linking computer systems and services. It includes key aspects such as open interfaces, interconnection services, data integration and middleware, data presentation and exchange, accessibility and security services.

In multicultural environments like European Union, public sector is a complex network of organizations, people, languages, information systems, information structures, rules, processes, and practices. Effective ICT utilization requires explicit rules for communication and means for the integration of heterogeneous systems and information resources. XML is a tool for this purpose [26]. Extensible Markup Language, shortened XML [4], consists of a set of rules for defining and representing information as XML documents where information structures are indicated by explicit markup. The markup vocabulary and the structures specified for a particular domain create an XML application, a formal language for representing domain information.

XML was developed from the Standard Generalized Markup Language (SGML) [11] for supporting the management of heterogeneous information resources of the Internet and to facilitate communication between various software applications. The simplicity of XML has encouraged active development work around XML, including both software development and development of XML applications and related languages. Where SGML has been primarily in use as a format for documents intended for human readers, e.g. in the form of HTML documents, the use of XML has extended towards data interchange between software applications. In public administration, likewise in other domains, the use of XML can be divided into two major categories: the format for data interchange and the format for information assets.

The information assets can be further divided into documents and metadata.

A web service is a software system identified by a URL, whose public interfaces and bindings are defined and described using XML. Its definition can be discovered by other software systems. These systems may then interact with the web service in a manner prescribed by its definition, using XML-based messages conveyed by Internet protocols [1]. The web service model consists of three entities, the service provider, the service registry and the service consumer. Other models, such as a peer-to-peer structure, also exist. Figure 1 shows a graphical representation of the traditional web service model [10].

The service provider creates or simply offers the web service. The service provider needs to describe the web service in a standard format, which in turn is XML and publish it in a central service registry. The service registry contains additional information about the service provider, such as address and contact of the providing company, and technical details about the service. The service consumer retrieves the information from the registry and uses the service description obtained to bind to and invoke the web service. The appropriate methods are depicted in Figure 1 by the keywords 'publish', 'bind' and 'find'. In order to achieve communication among applications running on different platforms and written in different languages, standards are needed for each of these operations.

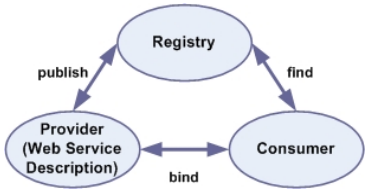

Figure 1: The web service model.

Web services architecture is loosely coupled, service oriented. The Web Service Description Language (WSDL) [8] uses the XML format to describe the methods provided by a web service, including input and output parameters, data types and the transport protocol, which is typically HTTP, to be used. The Universal Description Discovery and Integration standard (UDDI) suggests means to publish details about a service provider, the services that are stored and the opportunity for service consumers to find service providers and web service details. Besides UDDI, other standards have been developed as well. The Simple Object Access Protocol (SOAP) is used for XML formatted information exchange among the entities involved in the web service model. SOAP Version 1.2 is a lightweight protocol intended for exchanging structured information in a decentralized, distributed environment [12].

Nowadays, there is an active and constant trend worldwide to conclude to standards on interoperability framework and on web services. European Commission has recently adopted the Interoperable Delivery of E-government Services to Public Administrations, Business and Citizens (IDABC) Programme (http://europa.eu.int/idabc), in order to use the opportunities offered by ICT to encourage and support the delivery of cross-border public sector services to CLIENTS, improve efficiency and collaboration between European public administrations and contribute to making Europe an attractive place to live, work and invest. Especially, British government concludes to e-GIF (http://www.govtalk.gov.uk/schemasstandards/egif.asp) an E-government Interoperability Framework. E-GIF defines technical policies and specifications governing information flows across government and the public sector. Web Services Interoperability Organization (WS-I) (http://www.ws-i.org) is an open industry organization chartered to promote Web services interoperability across platforms, operating systems and programming languages. The organization's diverse community of web services leaders helps customers to develop interoperable web services by providing guidance, recommended practices and supporting resources. All companies interested in promoting web services interoperability are encouraged to join the effort. Last, but not least, there is the World Wide Web Consortium (W3C) (http://www.w3c.org), which develops interoperable technologies (specifications, guidelines, software, and tools) to lead the Web to its full potential.

3. Process Re-engineering and Web Modeling

Before proceeding to the proposed interoperability model, we have to discuss and introduce a required preparation step that is necessary for a robust web application development cycle of e-government solutions. Web information systems and applications development involve, in most cases, a number of players with different skills and goals [6]. In the Web engineering area, several Web application modeling methods have been proposed to tackle development setbacks caused in such a multi-facet activity. Such methods are usually based on the key principle of separating data management, site structure, page presentation and end-user services. Web Modeling Language (WebML) [6] builds on several previous proposals and it has established itself as a promising and leading platform. The generality is not lost if any web-enabled modeling technology is adopted as long as the e-government web-based processes can be depicted using it. In particular, it supports graphical specifications, incorporated in a complete design process that allows modeling the web application as a set of pages made up of linked content units and operations, and for binding such content units and operations to the data they refer to. WebML provides a model-driven approach to web site development, which is a key factor for defining

disciplined development processes for the construction of complex sites, supporting advanced features like multi-device access, personalization, and evolution management. Moreover, classification, aggregation and generalization-specialization are used throughout the re-modeling process to enhance abstraction and reuse. To assure that a smooth governmental process transformation will be achieved, a summary of the steps needed includes: 1) requirements gathering, 2) conceptual design, 3) navigational design, 4) abstract interface design and 5) implementation. The fundamental elements are services and entities, which are containers of data elements, and relationships, which enable the semantic connection of entities.

In order to support personalization, all hypermedia elements and their presentation styles have to be defined in such a way that will take into account a series of personalized data. This can be done in two complementary ways [6] through the declarative and the procedural personalization. In the first case derived concepts are defined (e.g., entities, attributes, multi-valued components) whose definition depends on user-specific data. In this way, customization is specified declaratively; the system fills in the information relative to each user when computing the content of units. In the latter, procedural personalization XML syntax is used for writing modeling conditions that compute and store user-specific information. This personalized content is used both in the composition of the multi-layer user profile and in the definition of presentation specifications for each modeled service. Typical tasks performed by modeling conditions are the assignment of keywords to the user profile appropriate level and activity, based on dynamically collected information (e.g., the path traversal history), the collaborative filtered information notification to users upon the update of the modeling profile (elaborating push technology) and custom usage logging of user actions.

Apart from content publishing, WebML allows specifying data update operations, like the creation, modification and deletion of instances of an entity, or the creation and deletion of instances of a relationship. However, in order to maximize the potentials of a modeling language while attempting to improve or even establish interoperability issues among web oriented e-government applications, the essence of governmental-business processes has to be revised accordingly for rebuilding them into service oriented ones and furthermore even detect useful and frequent patterns repeating themselves in multiple organizations [21].

For successfully delivering of web services, we assume the following three-layer logic. At first, we elaborate the integration of the internal re-engineered business processes. In the sequel, we determine the connection points for the web services and finally we shall publish these web services to the citizens. In this second act, the key point is to locate the internal connection point as the potential access point for a user (particularly essential for G2B and G2G communication) coming from the external hyperspace. As a final step one has to implement the infrastructure (for instance the software stubs that will consume i.e. utilize) to support the web service that it would enable all customers and associates to take advantage of the e-government business services through a published web interface.

4. A General Interoperability Model

The goal of our approach is to introduce a generic model, capable to manage administrative CLIENTS-related content and processes using a Web Service Oriented Architecture (SOA) and a Web Service Orchestration structure. The approach is one-stop where a governmental authority acts as a trans-government liaison (intermediary) between the government and CLIENTS. The E-government Interoperability Model could be used by Governmental Organizations (GOs), including other collaboration authorities, to create and develop common, multilingual, multi-platform, trans-governmental (even trans-european) e-services in a uniform and standardized way, thus enabling process transparency and facilitating services mobility.

The fore mentioned collaboration authorities are special individual authorities, or public/professional associations, engaged with GOs to carry out certain, mostly bureaucratic, procedures. For example, the majority of Champers of Commerce and Industry (CCIs) in EC Member States are public (governmental) authorities in which businesses are obliged to be registered. CCIs offer various obligatory services to their members, such as certificates based on Legal Information in Chamber's Registry, ATA Carnets, Certificates of Origin, Export Licenses, etc. Their institutional role is to advise the government, support local businesses, offer services, support internal trade and business development, as well as support and advise on trans-national business issues. Thus, CCIs are Governmental Organizations that are currently involved in many business-related processes.

Service-oriented architecture (SOA) is an architectural style based on the notion of services, which are independent but cooperating building blocks to develop distributed applications [7]. The SOA model isolates aspects of an application so that, as technology changes, services (components) can be independently updated, limiting the impact of changes and updates to a manageable scope. Managing change is an important benefit of leveraging component architectures and models. A shift towards a service-oriented approach not only standardizes interactions, but also allows more flexibility in the process. The complete value chain within an organization is divided into small modular functional units,

or services. A service-oriented architecture has to focus on how services are described and organized to support their dynamic, automated discovery and use. Today, web service is a powerful technology for implementing operational solutions based on SOA [5].
Web Service Orchestration describes how web services can interact with each other at the message level, including the business logic and execution order of the interactions. These interactions may span applications and/or organizations, and result in a long-lived, transactional, multi-step process model [22].

4.1 Current Situation

At present, practices and legislation in force requires CLIENTS to carry out a number of bureaucratic procedures. Their common denominator is the fact that interested persons/businesses act as information mediators. This means that they have to submit to GOs various documents issued by other Governmental or Collaboration Authorities, or they have to submit copies of the same documents to more than one. The emerging problems are many. CLIENTS have the constant care and responsibility to issue, update and keep those documents with a considerable resource cost. For many countries, where the specific phenomenon is extended, this cost is important. That is provoked due to the facts of low efficiency, bad service quality and significant resource waste for both authorities and CLIENTS (time, money, manpower).
The main objective of an interoperability network is data dissemination and collection between and from all involved authorities in order to release the interested persons from the fore mentioned obligations. Finally, all authorities will get the data they request without representatives have to visit them in person in order to submit recurrently the same documents, or documents issued by authorities, members of the network. We can note three relevant major phases for the lifecycle of a governmental case, where governmental case stands for the whole set of data and actions issued and triggered from interested persons in order to carry out a specific task. The phases are:

- *Initial data submission.* When a task is initiated from interested persons, they have to issue a documents set to a number of authorities. Each authority records the data it needs and proceeds to the appropriate actions.
- *Data update.* Recorded data for a CLIENT change frequently. When the concerning governmental case is still active and related data need to be updated, interested persons owes to inform all relevant authorities.
- *Task completeness.* When the concerning governmental case is no longer active, all relevant authorities need to be informed.

As an example we can mention the entire lifecycle of a business. We can say that an active business is an alive governmental case. Businesses have to interact with a number of national and/or international GOs, BRGOs (Business Registration GOs) and CCIs, in order to submit an important number of documents. Many of those documents are issued from some of those authorities and must be submitted to another. Subsequently, businesses owe to inform all the above authorities on each status's change or relevant data (e.g. major activity, address). Finally, when a business terminates its activity, the termination notification must be broadcasted to all involved authorities.
The existing bureaucracy embarrasses indirectly CLIENTS and public sectors to function and complete their daily tasks, especially when dealing with public services. The current functionality model of public sector inserts many difficulties in the citizen's routine and the operation of enterprises. The main problems often compounded are: 1) communication failures, 2) need for shared data and information, 3) difficulty in access the right information, 4) collection of large amounts of data over time, 5) incompatible data formats, 6) missing or obsolete data, 7) metadata is not universally acceptable, 8) inconsistent data policies and practices across organizations.

4.2 Interoperability Model Approach

An interoperability model should provide a standardized and flexible environment that will enable GOs to jointly establish and deliver common e-government services to citizens/businesses. Such joint delivery of common services involves the participation and collaboration of various GOs in terms of: 1) existing IT systems, 2) human interaction and 3) predefined processes and workflows. Thus, interoperability at all levels among GOs is a prerequisite to deliver common e-services and, for this reason, it is one of the major objectives of an e-government interoperability model. The investigated model is an ambitious attempt to delve with all three levels of interoperability [14].
Firstly, as regards organizational interoperability, the model aims at deploying SOA and Web Service Orchestration paradigm in order to enable GOs all over Europe to model and manage/streamline individual business-related administrative processes (involve both human actors and IT systems) and information architectures with the aim to deliver pan-European, cross-border, multilingual, multi-platform, common services in a transparent way for the end user. As regards semantic interoperability, the model aims at establishing a common semantic framework, using metadata, enabling GOs to exchange standardized information and content understood by all the involved human or systemic actors. Finally, as regards technical interoperability, the model aims at inter-linking existing GOs IT systems and infrastructures located in the same/different countries, by

defining and using open interfaces, standards and protocols.

At this section, the e-government interoperability model is investigated for a generic e-government service where a GO acts as a one-stop-shop (OSS) for the public. The assumptions taken into consideration are the following:

- The OSS maintains an IT system where it records information of the governmental case (in the example of a company's activity initialization, the CCI can be the OSS). The information recorded on contains general information and can record information on legislative documents and financial data on the company.
- The OSS's IT system includes a portal accessible to its target group (citizens, companies). The portal provides security as it provides authentication of the user through a unique login/password combination. Moreover, it supports on-line fill-in forms and requests.
- A number of GOs involved. All maintain an IT system where various CLIENTS data are constantly updated, usually under a unique key they generate and provide.
- The OSS's IT system record all unique keys the other GOs uses to recognize a certain governmental case.

The interoperability model will provide several web services for data exchange between two parties. The web services will be part of a governmental case workflow and in general have the following functionality: the OSS will send an XML message, containing unique information on a certain case, to a GO requesting from its database certain special data for the case. The GO, through the same web service will respond to OSS through an XML message where the unknown special data will be provided and selectively stored at OSS's database. The special data can be either storable (e.g. ID Key Number) or informational that do not need to be stored (e.g. certificate). Some times the requested XML message contains just Boolean information, determining how the case workflow will proceed.

The web services must be designed and implemented separately for each couple of interacting authorities. All web services will contain information on the authentication of the GO (including OSS) in order for the receiver to validate the requester is authorized to receive confidential information on the case. Moreover, the web services will contain input and output parameters, filled in with the requested and the received information respectively.

In our case example, company's activity initialization at national level where the CCI will be the OSS, three extra GOs involved: 1) a Tax Office GO (FGO), which maintains an IT system where financial data of citizens and companies are constantly updated, 2) a Legislation GO (LGO), which maintains an IT system with all companies' legislation and 3) a Business Registration GO (BRGO), which maintains an IT system with the companies' registry to record their corporate name and validate its uniqueness.

The interoperability model will provide several web services for the data exchange between two parties. The web services provided, in our case, will be the following:

- *Financial web service.* CCI (OSS) will send an XML message, containing unique information on a certain CLIENT (Business), to FGO requesting certain financial data concerning the Business. The FGO, through the same web service will respond to CCI through an XML message where the unknown financial data will be provided and selectively stored at CCI's database. The financial data can be either storable (e.g. Tax Registration Number) or informational that do not need to be stored (e.g. financial certificate).
- *Legislative web service.* CCI (OSS) will send an XML message, containing unique information on a certain CLIENT (Business), to LGO requesting certain legislative data concerning the Business. The LGO, through the same web service will respond to CCI through an XML message where the unknown legislative data will be provided and selectively stored at CCI's database.
- *Registration web service.* CCI (OSS) will send an XML message, containing unique information on a certain CLIENT (Business), to BRGO requesting the validation on Business's corporate name. The BRGO, through the same web service will respond to CCI through an XML message where Boolean information on the corporate name will be provided and selectively stored at CCI's database.

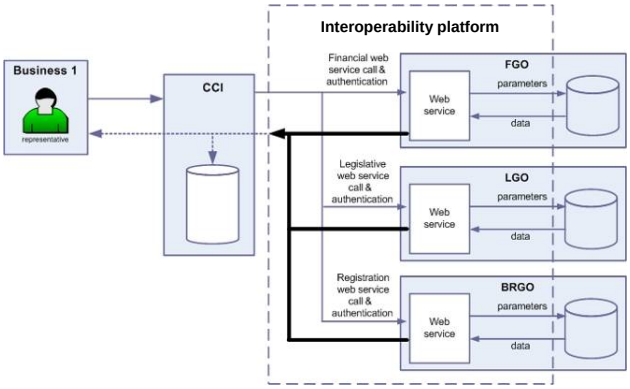

Figure 2: CCI – GOs web services exchange.

Figure 2 illustrates the proposed exchange of messages among the involved parties during the company initialization process. During the activity initialization, the interoperability model will use the fore mentioned web

services in the following interoperable manner. When Business wishes to initialize its activity, its representative enters CCI portal and fills in the respective registration form. Interoperability model will be triggered for CCI to collect the respective unknown financial and registration data simultaneously (Business Registration Number from BRGO and Tax Registration Number from FGO). When both web services are successfully terminated, CCI holds the necessary data associated with Business, sends a verification message that the registration is successfully completed and the activation of Business can be finalized.

4.3 Evaluation

An interoperability model implements the main interoperability goal for the public sector, the one-stop point-of-service that makes it easy for citizens to access high-quality government services. Businesses, in our example case, have to deal with a variety of GOs through a single 'provider' that can be the CCI, a GO as well. There are a lot of arising benefits implementing such an approach:

- *Improvement and simplification.* The specific procedures referring businesses are complex and bureaucratic. In our approach, business representatives have to deal electronically with only one governmental authority, and let it do the 'dirty' work in the background.
- *Acceleration.* Since there is no need for a considerable number of in-person visits to various authorities, the whole procedure will become faster. ICT guarantee the rapid completion of the procedure.
- *Cost effective.* The cost is reduced for businesses and authorities and refers to manpower and paperwork.
- *Utilization of technology.* The various authorities' technological infrastructure is upgraded and used more effective for the public service.
- *Reliability.* The interchanged data are accurate and up to date. There is no chance for someone to misrepresent or fake the required documents/certificates.
- *Less paperwork.* The need of submitting a lot of paper documents more than once is reduced significantly.
- *Monitoring.* All procedures can be monitored. It is possible to evaluate a case and detect problems or omissions. This is important for statistical reasons.

4.4 Recommendations

Nowadays, more and more governments worldwide try to change their traditional profile to an electronic one. E-government aims at improving G2C and G2B relationships by enhanced service provision on 24/7 basis. The ease and speed with which the transactions can be carried out over the Web has been the key driven force in the rapid growth of e-government. Especially, for businesses, the provided web applications can make governmental information easily accessed and improve significantly the interaction with government at all levels (local, regional, state, and federal).

In this framework, one of the most vital goals is to create the proper environment where businesses will meet Information Society targets. Therefore the enterprises will apply e-business platforms (ERP, CRM, etc.), use networks, promote e-commerce and e-marketing, automate transactions with local administrations and government and finally offer improved services to their customers. The advantages for the businesses will include: faster access to information, tenders and legislation, simple electronic data interchange capabilities with public administration, more efficient and cross-departmental processes, etc. On the other hand administration will profit from the service quality, customer orientation, acceleration and simplification of processes, cost savings through greater efficiency, transparency, etc.

Under this scope, international e-government and interoperability standards organizations should cooperate along with governments to provide a model. This model should deal with, among others, the definition of a commonly accepted messages' language, for the web services to encode/decode their parameters and the GO's authentication information. Additionally, it should deal with the hosting of one or more services registries to ease the web services functionality worldwide. A Third Trusted Party (TTP) can act as a moderator between all involving GOs, including CCIs and be the service registry. It can host the participating GOs' registries with their data, parameters and authentication information. TTP can also offer timestamp services, where the procedures are time-critical. Finally, it can be assigned the monitoring of cases evaluation.

The new e-government model will probably create the need for Governments' Business Process Reengineering (BPR). BPR is essential for GOs to loose their self-centric character and for CLIENTS to become the main core of e-government, as they will initiate the e-services, thus benefit from them at the most. BPR also must define the responsibilities and the flows for data update in order to maintain data integrity through all GOs. The interoperability model was studied in such a way that GOs, other than the initial ones, can easily adopt its mechanism and provides web services to businesses expanding the e-services provided to businesses and consolidating OSS as intermediaries.

5. Future Trends

According to [15], e-government progresses towards higher levels of integration and interoperability among and between government levels and branches. Interoperability in essence leads to extensive information sharing among and between governmental entities. The obstacles, which

prevent rapid progress to this direction, are not merely technical. In fact, technology side may prove the least difficult to address, while the organizational, legal, political, and social aspects may prove much more of a challenge.

Work must be done to define and agree upon government sector-specific semantics and on the alignment of business processes. Many e-government services exist, such as taxation functions and social services that require government agreement on their own semantics and processes. Likewise there are frequently additional public sector requirements in general business processes such as procurement that are not found in the private sector, e.g. specific competitive bidding requirements and/or specific approval approaches. For e-government, business process alignment often requires an alignment of laws and regulations, something that EU, with its Single Market approach, can leverage [16].

A major contributor to interoperability is voluntary open standards development and adoption. Open standards development, without significant adoption of the resultant standards, does nothing in the effort to achieve interoperability. Standards, like software, must evolve to take advantage of technology advances. Best-of breed solutions, evaluated on a best value for money basis, that are continually updated and have software support to meet customer standards-compatibility expectations are the best approach to achieve and ensure ongoing interoperability.

XML offers a rich variety of possibilities but its adoption in public sectors requires extensive collaboration in standardization. Work is needed at all levels: international, national, and local. International agreements are needed to avoid extra work and to facilitate international communication. At national level, work on international level should be considered as a potential basis for the national recommendations or standards. The amount of efforts needed for standardization in a particular organizational environment is highly dependent on the availability of well-documented base standards. On the other hand, the base standards describing the real world never should be considered totally stable. For example, the set of country codes standardized by the ISO (International Organization for Standardization) and also used in XML to refer to countries needs continuous maintenance caused by the geopolitical changes.

Many standards and various approaches have been proposed to create a widely accepted and usable way for developing web services. According to [10], QoS and semantic descriptions have been proposed to extend the current WSDL standard, but have not yet found overall acceptance. UDDI and other registry based data models have been implemented, but are not widely used, and in the case of dynamic service discovery, it does not yet meet requirements.

The work needed for local level standardization in a particular organizational environment depends not only on the availability of base standards and recommendations but also on the type of XML usage. In using XML, for example, for data exchange between software systems, the solution may be a technical implementation. Even though the human users of the systems may participate in the design as user need experts, they do not need knowledge about the implementation details. On the other hand, adopting XML as a format for documents, understanding needed changes in production processes and capabilities offered by the new solutions usually requires at least some knowledge about XML and about the approach of structured documents.

Continuous changes in specifications and software cause problems to all kinds of XML standardization. One of the hardest challenges is the Internet vulnerability. The lack of trust on the involved technology and people is causing disappearance of people from the Internet community. In the insecure Internet environment, well-planned services may remain without users. Therefore alternative and trust worthier network solutions have to be considered.

E-government services delivery requires interoperability both within and across organizational and administrative boundaries. However, this sharing of information should comply with personal data protection principles, laws and regulations and generally involves the following tasks: digital data collection, data storage, data processing, data transfer, and data share. This, in its turn, affects the way e-government architectures will be implemented [24].

Moreover, several issues related to privacy should be addressed. The threats for user privacy in an electronic environment are so many that a single solution does not exist. The future challenges and research in the direction of delivering e-services without jeopardizing, but in fact protecting- privacy relate to: standards support, intelligible disclosure of data, disclosure of methods, provision of organizational and technical means for users to modify their user model entries, user model servers that support a number of anonymization methods, and adapting user modeling methods to privacy preferences and legislation [17], [28].

Another key aspect of interoperability relates to secure interconnection and intercommunication [19]. This does not address only the advances in cryptography and protocols for secure Internet communication (e.g. SSL, S-HTTP) that significantly contributed in securing information transfers within e-government infrastructures [3]. It also encompasses policies, legal processes and operational guidelines. Specifically, the ability to share information and process over a secure environment involves publication, support, maintenance, ownership and access.

6. Conclusions

E-government has the potential to change public administrations' organization and operation and facilitate the interaction with CLIENTS. The transition from the traditional model of governance to the digital one involves technological, organizational, economic, social, legal and democratic dimensions. Furthermore, a number of challenges and risks have been identified and should be solved from both sides: government (e.g. complexity, poor IT infrastructure, human resources, financial constraints, legal issues) and users (e.g. lack of familiarity, trust, digital gap).

In this paper, we emphasized that interoperability is one of the most crucial barriers that e-government should overcome. This requirement relates to local-regional public administrations, enterprise sector and it also goes beyond the national borders and involves other countries administrations. Moreover, IT systems and applications interoperability, sharing and re-use of information-services, inter-linking of administrative tasks, within and between sectors are essential factors for the delivery of high quality, innovative, seamless and customer-centric e-services.

Under this framework, we presented our interoperability model and its required preparatory steps to ease its adoption at e-government domain. The model can manage administrative business-related processes and content using SOA and a Web Service Orchestration paradigm and follow a one-stop approach. It comprises an effort to deal with the three levels of interoperability i.e. organizational, semantic and technical. Its benefits include among others: significant time, cost and manpower saving, greater convenience, better accessibility, more choices and faster e-services delivery. Finally, this initiative needs more work in order to gradually integrate all the administrative tasks-processes that businesses want to complete in their interaction with the governmental organizations.

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Giorgos Laskaridis holds a degree in Informatics from the Department of Informatics, University of Athens, Greece, and is a PhD candidate in the same Department. His research interests include e-services, e-government and software engineering.

Konstantinos Markellos is MSc, Electrical and Computer Engineer and Researcher of the Computer Engineering and Informatics Department, University of Patras, Greece. His research interests include web engineering, web services, web searching, e-commerce, e-business and e-government applications.

Penelope Markellou received her PhD from the Computer Engineering and Informatics Department, University of Patras, Greece (2005). Her research interests focus on algorithms, techniques and approaches for the development of usable e-commerce, e-learning, e-government and business intelligence applications.

Angeliki Panayiotaki received her Diploma in Computer Engineering and Informatics from University of Patras (1996) and her MSc in "Advanced Information Systems" from University of Athens (2000). Her research interests focus on web mining and interoperability techniques applied in e-commerce and e-government domains.

Evangelos Sakkopoulos received his PhD from the Computer Engineering and Informatics Department, University of Patras, Greece (2005). His research interests include web engineering, web services, web searching, mobile web, information systems, information retrieval, and e-learning.

Athanasios Tsakalidis received his Computer Science Diploma (1981) and his PhD (1983) from the University of Saarland, Germany. He is currently a Full Professor in University of Patras, Greece. His research interests include data structures, graph algorithms, computational geometry, information retrieval, and bioinformatics.