

National frameworks' survey on standardization of e-Government documents and processes for interoperability

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Abstract

e-Government can be defined as Internet applications for public administration processes and decision making on local, regional, national as well as cross-national level. Therefore, the strong necessity to ensure vertical and horizontal interoperation of administrative units is arrived. The main goal of the paper is to reveal how interoperability is built into the public administration engineering process. The paper covers explanations how interoperability is important for e-governmental processes covering documents flows and what activities have been realized with EU agencies to ensure interoperability development. The first part of the paper comprises explanation of e-Government document engineering and administrative process development. The second part covers consideration on interoperability for e-Business and public administration. The third part includes analysis of what standardization is demanded for interoperability of e-Government agencies and how different countries' governments are prepared to ensure such interoperability in public administration in the light of documents, institutional norms and open standards.

Keywords: Standardization, Documents, Business processes, e-Government, Interoperability

1 Theoretical background of e-Government as an innovative challenge

1.1 Vision of e-Government

The Internet, and the value it can deliver to government and people, relies on an agreed, standard-based approach. By using the same standard-based approach, agencies support the infrastructure of technologies that they increasingly rely on to deliver services and conduct the business of government. Adopting common standards also helps governments in various jurisdictions to interoperate. This becomes important when dealing with matters that can only be handled in a regional or global way.

Emerging trends in Europe suggest that current thinking on e-Government is focusing on great quality and efficiency in public services. According to the view, e-Government needs to be more knowledge-based, user-centric, distributed and networked. New public services will be required by the EU as well as innovative ways of delivering the existing ones. Secondly, technological advances in the miniaturisation and portability of ICTs suggest that in future, e-Government will form part of an ambient intelligence environment, where technology will surround people and serve them on their roles as citizens, customers and professionals. E-Government should have a strategic focus which includes the achievement of the Lisbon goals, the reduction of barriers to the internal market for services and mobility across Europe, the effective implementation of national policies and regional or local development. Providing user-centric services and cutting unnecessary administrative burden require that information is shared across departments and different levels of government. The vision of e-Government in the EU in the next decade defines e-Government as an ICT tool for better government in its broadest sense. It places e-Government at the core of public management modernisation and reform, where technology is used as a strategic tool to modernise structures, processes, the regulatory framework, human resources and the culture of public administrations to provide better government and ultimately increased public value [5].

By 2010, European public administration will have made public information and services more easily accessible through innovative use of ICT and through increasing public trust, increasing awareness of e-Government benefits and through improving skills and support for all users. According to the "i2010 eGovernment Action Plan: Accelerating eGovernment in Europe for the Benefit of All" [20] published in April 2006, Member States have committed themselves to inclusive e-Government objectives to ensure that by 2010 all citizens, including socially disadvantaged groups, become major beneficiaries of e-Government and European public administrations deliver public information and services that are more easily accessible and increasingly trusted by the public, through innovative use of ICT, increasing awareness of the benefits of e-Government and improved skills and support for all users.

e-Government is not an objective per se, it has to be seen more as means in organizing public governance for better serving citizens and enterprises [33]. E-Government concerns the whole scope of administrative actions and the connected political processes, because ICT is an enabling force that will enhance effectiveness, quality and efficiency of public actions as well as its legitimacy. The vision that emerged places e-Government at the core of public management modernization to increase public value. The creation of public value encompasses various democratic, social, economic, environmental and administrative roles of governments. The particular examples of the roles cover the provision of public administration services, implementation and evaluation of policies and regulations, the guarantee of democratic political processes [5].

In e-Government, two complementary perspectives are of equal importance i.e. cooperation and knowledge. Support of computer-mediated cooperation in a comprehensive sense means sophisticated tools. Multiple media become a must. The meeting activities as such may be performed online and via video techniques and improved by tools using multimedia. Prospects for knowledge management in e-Government are remarkable in the aspects of demand: nearly all administrative tasks are informational in nature, decision making is a public task, and for any agency its particular domain knowledge is an asset of key importance. The aim of e-Government is to enhance public participation in decision making. Worldwide varieties of e-Government websites have been set up, providing services and information at different levels [10].

The paper titled "eEurope An Information Society for All, Communication on a Commission Initiative for the Special European Council of Lisbon" [13] defines citizen interaction as an approach that does not always aim to change current conditions, but rather encourages activities such as the sharing of concrete, personal experiences, the acquisition of administrative information and monitoring of the functions of public office. These activities, quite within the existing political, legal and administrative framework, may be carried out both online and offline for mutual support and desirable benefits. As for public administration, the Internet is also providing information of two kinds. One is mandatory public information such as pertaining to laws, departmental operation, formal procedure requirements and so on. The other consists of personal experiences that are reported by individuals voluntarily.

e-Municipality covers a number of mechanisms which convert the paper procedures of a traditional municipal office into electronic processes, with the goal to create paperless office, to increase productivity and performance of municipalities. Its objective is to introduce transparency and accountability leading to better e-Government within municipalities [23]. The question is what knowledge in e-Municipality is transferred among municipal authorities and citizens. In public administration top-down flow of knowledge covers rules, regulations, and orders. Bottom-up transfer can include comments, suggestions, ideas, initiatives, critiques, and proposals.

e-Government initiatives enable receiving the following benefits:

- e-Municipality development, that is an opportunity to regulate public administration processes, to visualize and simplify them and to realize them online. Administrative tasks and processes are legally formulated, publicly accessible and realized the same way in different municipalities.
- Development of virtual communities, which are true innovations and the source of innovativeness. e-News, forums, blogs, emails, chats, webinars, webcastings encourage knowledge creation, externalization, dissemination and reusing.
- e-Procurement development, which makes it possible to capture accurate and timely information on every purchase. The first and most obvious are savings that come from automating the process. The second focus area for efficiency savings is more structural than procedural, and comes from shifting the selection and ordering process back to the employees' desktop, eliminating the multiple purchasing middlemen now involved in everyday indirect goods procurement.

Realization of e-Government tasks demands implementation of electronic documents and reengineering public administration processes.

1.2 Document engineering

The technology for encoding and exchanging documents has profoundly changed, but the concept of a document has remained surprisingly stable. Documents formalize the interactions between enterprises and their customers or clients, and it is natural and intuitive to view documents as the input requirements and as the output results from many kinds of processes. Document engineering helps specify, design and implement the documents and the processes that create and consume them [18]. It synthesizes complementary ideas from information and systems analysis, electronic publishing, business process analysis and business informatics to ensure that the documents and processes make sense to the people and applications that need them. The essence of document engineering is the analysis and design methods that yield:

- Precise specification or models for the information that business processes require
- Rules by which related processes are coordinated, whether between different firms to create composite services or virtual organizations or within a firm to streamline information flow between organizations.

Document engineering provides the concepts and methods needed to align business strategy, business processes and information technology, to bridge the gap between what we want to do and how to do it. Descriptions of business processes in terms of the more abstract notion of document exchanges makes it easier to understand the constraints imposed by legacy systems and technologies and to recognize the opportunities created by the new ones. Document engineering emphasizes the reuse of existing specifications, standards, or patterns that work, reducing costs and risks while increasing reliability and interoperability. The expressiveness of XML for the implementation of electronic document models bridges the traditional gap between business strategy and its technological realisation.

Both the common data model and conceptual information model approaches for ensuring that parties understand each other's documents are facilitated when the syntax, structure or semantics conform to common pattern or standards. Many of these have been developed for specific vertical industries by trade associations, industry consortia or formal standards bodies. Standards for information components needed in all businesses are a more recent development.

While many applications begin as user interactions with a form, the business processes that follow might be carried out by computer programs with no human involvement. But it makes sense for us to look at both kinds of model based interactions in the same way, comprising the idea of documents as interfaces for people with the idea that documents are interfaces to business services or business processes. Documents describe the interfaces to business processes. The document conveys or captures information in an exchange with another party or process without necessarily revealing anything about how the information is consumed or created by each participant in the exchange. The rules of the business process that control the pattern of document exchanges or, more generally, define the agreement or mutual understanding of the parties to the exchange, should be expressed in an explicit model.

If we design a new business process and no documents currently exist, we must identify information and process requirements by talking to people and analysing business environment. A document component model describes the complete set of semantic components in a domain. A document assembly model describes the way in which required components are assembled into a hierarchical structure. When technologies change, the optimal implementation model will also change even though the underlying conceptual model does not. Metadata consists of data structures used to discuss other data structures. Metadata augments the values of information (or data) with additional properties that explain the meaning, organization and other characteristics of interest in our models. Metamodels for business processes are especially important in document engineering because processes are inherently more abstract than documents, which exist as highly tangible implementations with a conventional notion of a document as a container or message with information components.

Business process models are central to document engineering because they are the bridge between higher-level strategic expressions of what businesses do represented in organizational models and the lower-level operational concerns reflected in document and information models. Information about the business processes is distinct from the physical flow of materials and goods. An information supply chain specifies the subjects, the objects and the frequency of information exchange. The documents exchanged package the content of the information flows.

Business process is defined as a chain of related activities or events that take specified inputs, add value to them, and yield a specific service or product that can be the input to another business process. Some business processes are conducted entirely within an institution and are called internal, or private business processes. In contrast, external, collaborative, or public business processes are carried out between two or more business parties [36]. The document engineering approach applies to both kinds of processes but is especially useful for the latter, where different implementation technologies mandate the loosely coupled architecture of document exchange. An important corollary to the business processes design, which shows the interconnections between software systems or applications, is the architecture by which this integration is achieved. Integration is defined as the controlled sharing of data and business processes between any connected applications and data sources. Interoperability is a more abstract goal than integration. Interoperability means that the recipient can extract the required information from the sender's document even if the sender's implementation is not immediately compatible with recipient's business systems. The word "interoperable" also implies that one system performs an operation on behalf of another system [8]. In literature there are many definitions of interoperability. According to the Oxford Dictionary "interoperable" means "able to operate in conjunction". Interoperability is usually defined as the ability of two or more systems or components to exchange and use information [21], [31], [4]. The best way to facilitate interoperability is often for the participants in the exchange to jointly define a conceptual model for the shared information, or for both of them to adopt the same industry standard. This approach allows them to use the same information model without any constraints on their implementation of it.

Interoperability can occur in various organizational environments. An interoperability can be defined as the ability of business processes as well as enterprise software and applications to interact. In order to achieve meaningful interoperability organizations must be interoperable on, at least three levels: the business layer, the knowledge layer and the ICT system layer [6]. This includes the business environment and business processes on the business layer, the organizational roles, skills and competencies of employees and knowledge assets on the knowledge layer, and applications, data and communication components on the ICT layer. According to Backlund et al. interoperability is achieved on the following levels: inter-enterprise coordination, business process integration, semantic application integration, syntactical application integration, and physical integration [2]. Interoperability should be analysed from an enterprise view (i.e. interoperability between two or more organizations), an architecture and platform view (i.e. between two or more applications/systems) and an ontological view (i.e. the semantics of interoperability).

Bailey adds that interoperability accepts heterogeneity of technologies while allowing users to work together [3]. The difficulty of interoperability with respect to interconnection agreements follows from the definition. Since interoperability is defined at the application layer and networks are interconnected at the Internet protocol layer, different interconnection architectures may affect interoperability differently.

Clark and Jones' model of organizational interoperability consists of five levels of organizational maturity:

- Level 0 – Independent – this level describes the interaction between independent organizations. These organizations do not have any interaction and do not have common goals or purpose, but they may be required to interoperate in some scenario.
- Level 1 – Ad hoc – at this level of interoperability only very limited organizational frameworks are in place which could support ad hoc arrangements
- Level 2 – Collaborative – the collaborative organizational interoperability level is where recognized frameworks are in place to support interoperability and shared goals are recognized and roles and responsibilities are allocated as part of on-going responsibilities, however the organizations are still distinct.
- Level 3 – Integrated – the integrated level of organizational interoperability is one where there are shared value systems and shared goals, a common understanding and preparedness to interoperate.

- Level 4 – Unified – a unified organization is one in which the organizational goals, value systems, command structure and styles, and knowledge bases are shared across the system [9].

According to Miller, interoperability is an ongoing process of ensuring that the systems, procedures and cultures of an organization are managed in such a way as to maximise opportunities for exchange and re-use of information, whether internally or externally [24]. Therefore he considers the following interoperability levels: strategy (and strategy mapping), business (design of processes, organization, infrastructure, product and decisions), process (flexible process interaction), services (composition, adaptation, packaging services), and data (data transformation). Chaari et al. argue that interoperability is by nature an evolving and highly dynamic practice which requires being aligned to suitable IT infrastructure characterised by agility, flexibility, adaptability and mostly modularity features, however as such, it requires a new generation of IT architecture offering more potential to the interoperability requirements [7]. Alter [1] defines five levels of business process interoperability: common culture, common standards, information sharing, coordination and collaboration. Ruokolainen et al. argue that the ability of a system to interoperate with another is a multi-dimensional concern which must be considered simultaneously from technical, semantic and pragmatic perspectives and covering all the concerns relevant for different stakeholders [28]. Interoperability is a requirement inside a system for allowing interaction or composition of its components, but also for the system itself, when it needs to be sufficiently flexible to exchange information with another system, or if it needs to be open to new components.

In e-Government interoperability can be considered on:

- Community level: policies, rules
- Administration level: processes, architecture
- Service level: structure, semantics
- Technology level: connectivity, communication.

A case study on interoperability, which assumes to be tremendous success of collaborative standardization efforts covers project of e-Passport implementation [11]. Core requirements for e-Passport are as follows:

- Usage of classical passport booklet
- Easy and convenient usage across the globe
- Customer acceptance
- Storage of biometrics
- Ability to execute cryptographic algorithms
- Reliable, trouble free technology
- Compatibility and interoperability
- Data security
- Privacy protection.

e-Passport requires international standards for interface data structure, biometric encoding, security and encryption method. So many parties are involved in the project i.e. independent governments, technology experts, technology providers, system architects, privacy advocates. International Civil Aviation Organization (ICAO) agreed to coordinate e-Passport activities, it covers 188 member states and is affiliated with United Nations. There is also a plan to utilize Machine Readable Travel Document Doc 9303, developed by Technical Advisory Group, with utilization of standardized data format (holders' identification, photograph) that can be read with Optical Character Reader, deployed by 110 States. In the project there is also Technical Advisory Group (TAG) which consists of experts from 13 ICAO member States: Australia, Canada, Czech Republic, France, Germany, India, Japan, New Zealand, Netherlands, Russian Federation, Sweden, United Kingdom, and United States. New Technology Working Group (NTWG) is to ensure document security and chip technology. In result of the project e-Passport solutions are provided:

- Classical passport booklet + passive contactless smartcard

- Chip and antenna integrated in a page or cover
- RFID communication based on ISO 14443 and 7816
- Technical specification standardized by ICAO and ISO/IEC covering standard 9303 (6th edition) and ISO/IEC 7501
- RFID logo on cover
- Global interoperability.

The presented above case study is to illustrate how a project, centrally managed by ICAO, can ensure international construction and global implementation of the interoperable e-Passport. However, generally, the process of interoperability development for e-Government is realized in different ways in many countries.

2 Standardization and interoperability for e-Business and e-Government

Standardization includes doing certain key things in a uniform way. Standardization may occur in a multitude of forms. Technical standards are easier to specify in a quantitative manner than its behavioural counterparts. Technical reference standards describe a reference point such as currencies, weights or measures of materials and products. Behavioural reference standards are exemplified by precedents in law and accreditation of institutions. Technical standards for minimal admissible attributes define a cardinal minimum board, as exemplified by safety levels or standards for product quality. The behavioural standards, for instance job qualifications (known as compatibility standards), define a minimal level of educational attainment (minimal scores in exams) or legal codes, which separate legal from illegal conduct. Standards may arise in a number of ways [22]. Market-mediated or de facto standards are determined by market forces. De facto standardization may occur in markets with sponsored or non-sponsored technologies. The class of sponsored technologies implies that each competing technology is held by a small number of firms; there by means of product pre-announcements a network sponsor tries to slow down the growth of the rivals' networks and standards implementations. As an alternative to the market mechanism, standards may be enforced by the government. These so called de jure standards can be classified into two ideal types, the bureaucracy and the committee solution. The first type refers to the situation where standards are formulated and enforced by governmental agencies. In the case of the committee solution, the involved parties discuss over the standard and the negotiated standard is enforced by the government. These committees may consist of standardization bodies and of stakeholders such as single firms, consumer and industry organizations. Committee standards may be based on voluntary cooperation i.e. they are not forced by the government.

There is a distinguishing between two different regimes of standardization [22]. Whereas the first regime assumes that firms compete within a joint network (intra-technology competition), the second regime refers to standardization by means of blockaded or deterred entry of a rival technology (inter-technology competition). Langenberg [22] considers the following models:

- Model I Reference Standards: Standardization as a means of reducing variation in examination requirements. Standardization process is exogenous
- Model II Compatibility Standards: Standardization as a credible commitment to a larger network, tradeoffs between network size and competition. Consumers' expectations determine evolution of standards
- Model III Compatibility Standards: Standardization of nascent technologies, experimentation involves complete information, ex-ante standardization leads to limited information; choice of the ex-post standard is based on expectations formed by users and tradeoffs between standardization and experimentation.

Generally standardization includes operating in a uniform way. Compatibility and associated role of standards are a core Information Systems (ISs) research domain. Since standards constitute networks, standardization is a predominant issue in IS and economic research. Networks as a widespread metaphor describe structures of interrelated elements. Expected network benefits result from improved coordination designs and generally include – depending on the particular problem domain – optimized business processes, more advantageous allocations, enhanced availability of information and other resources as well as decreased information costs or increased revenues.

Inherent in standards, the commonality property deriving from the need for compatibility implies coordination problems. From a theoretical perspective, the existence of network effects as a form of externality that is often associated with communication standards renders efficient neo-classical solutions improbable. The externality property deriving from network effects makes standardization problems somewhat complex and interesting to solve.

Compatibility is a technological property of system components enabling two components to work, act or go together. Communication between system elements is characterized by the output of one system becoming the input of another while this sending and receiving of content requires a connection between compatible system elements that is provided for by interfaces. Compatibility is different from interoperability. As it was said above, interoperability is the ability of two or more systems (computers, communication devices, databases, networks or other information technologies) to interact with one another and exchange data according to a prescribed method in order to achieve predictable results.

Interoperability was seen to be key in order for the market to progress. This was seen to have two stages; the first stage was coexistence between equipment. The second stage was full interworking (interoperability), between applications and between different manufacturers' equipment. Interoperability is a way to make services available to many different users in different business scenarios and business models [29]. This encourages the creation of open source software. Interoperability demands open standards. They are developed and defined in a transparent way by independent people from multiple organizations in an independent group.

3 Analysis of proposed strategies for interoperability implementation

Interorganizational information systems can only work if they are able to communicate and work with other such systems and interact with people. This requirement is called interoperability and it can only be met if communication standards are applied. A standard-based technology platform allows partners to execute a traditional business function in a digitally enhanced way. A common information systems platform then, basically, is a set of standards that allows network participants to communicate and conduct business process electronically. Interoperability requires standardization in four dimensions: technology, syntax, semantics, and pragmatics [27]. Technology standards concern middleware, network protocols, security protocols and the like. Syntax standardization means that the network organization has to agree on how to integrate heterogeneous applications based on the structure or language of the messages exchanged. Normally, commonly acceptable data structures are chosen to represent well-known constructs. Semantic standards constitute agreements in extension to syntactic agreements on the meanings of the terms used for an enterprise's information systems to communicate with and understand the messages of another enterprise's information systems. Semantic interoperability is of major importance to e-Business integration. Pragmatic standards are agreements on practices and protocols triggered by specific messages, such as orders and delivery specifications. The paper covers analysis of proposed strategy (included in governmental documents) for interoperability implementation for e-Government in different countries i.e. USA, Brazil, New Zealand, Australia, Hong Kong, India, Malaysia, Saudi Arabia, United Kingdom, Germany, Denmark, Estonia. At the end, European Union documents are presented.

3.1 USA – Federal Enterprise Architecture

The Office of Management and Budget's (OMB), Office of E-Government and Information Technology, with the support of the General Services Administration (GSA) and the Federal Chief Information Officers (CIO) Council, established the Federal Enterprise Architecture (FEA) Program, which builds a comprehensive business-driven blueprint of the entire federal government [35]. The FEA consists of a set of interrelated 'reference models' designed to facilitate cross-agency analysis and the identification of duplicative investments, gaps and opportunities for collaboration with and across agencies. Collectively, the reference models comprise a framework for describing important elements of the FEA in a common and consistent way. Through the use of the common framework and vocabulary, IT portfolios can be better managed and leveraged across the federal government. This framework introduces the purposes and structures of the five FEA reference models:

- Performance Reference Model
- Business Reference Model
- Service Component Reference Model
- Technical Reference Model
- Data Reference Model.

According to the FEA model interoperability defines the capabilities of discovering and sharing data and services across disparate systems and vendors. Aligning agency capital investments to the standardized vocabulary, allowing interagency discovery, collaboration and interoperability, agencies and the federal government will benefit from economies of scale by identifying and reusing the best solutions and technologies to support their business functions, mission, and target architecture.

3.2 Brazilian standards for interoperability

The e-PING architecture – Standards of Interoperability for Electronic Government – defines a minimum group of assumptions, policies, and technical specifications, which regulate the utilization of the Information and Communications Technology (ICT) in the interoperability of Services of Electronic Government, establishing the conditions for interaction with other spheres of power and government agencies, and with the society in general [16]. The e-PING architecture, for the purpose of the definition of standards, was segmented in five parts:

- Interconnection segment to establish the conditions under which the government units will interconnect, and to set the interoperability conditions between the government and the society
- Safety segment, which covers the ICT safety aspects to be considered by the federal government, including the standards for safety, cryptography, system development, net services, collection and filing the evidences
- Means of access to deal with the standards that apply to the means of access to electronic government services
- Organization and interchange of information to cover the aspects related to the treatment and transfer of information in electronic government services. The segment includes the standards for government subject matters and metadata, and encompasses the following components: data exchange language, data transformation language, definition of data to be exchanged, catalogue of data standards, list of government subject matters, standardized metadata for electronic government
- Areas of integration for Electronic Government covering 1) XML Schemes of applications related to the Areas of Government Performance that are displayed as a Catalogue in the e-PING site whose current contents are presented in a latter topic, 2) Components related to issues that cut across the Areas of Government Performance whose standardization is relevant for the interoperability of Electronic Government services such as geographical processes and information.

The e-PING architecture has the purpose of being the interoperability paradigm for the federal government, initially within the Executive Board. The initiative of assembling the architecture fell to three federal agencies, namely: The Ministry of Planning, Budget, and Administration's Secretariat of Logistics and Information Technology, The National Institute for Information Technology of the Presidency of the Republic, the Federal Data Processing Service, and a public company attached to the Treasury Department. The management of e-PING covers:

- To define the strategic and government administration objectives for the establishment of the standards
- To administer the Brazilian government's interoperability architecture by providing the necessary managerial infrastructure for its correct use and guaranteeing its update, considering the government's priorities and goals, the needs of the society and the readiness of new technologies, that are tested and approved by the ICT market
- To act as the coordination centre of the e-PING architecture, overseeing the alignment among the interoperability efforts and assuring the coherence of the initiatives undertaken by all government organs
- To manage and operationalize the popularization of the Internet e-PING standards
- To manage the interaction with same purpose initiatives by other governmental entities in the country and abroad
- To promote the training of Federal government staff by acting upon the public agencies to have them include the e-PING in their house training programs through corporate events aimed at dissemination of the e-PING standards
- To establish, to implant, and to publish performance indicators of the e-PING implementation work,
- To manage the interaction with technical standards organisms (i.e. W3C, IEEE, OMG, OASIS)
- To manage the interaction with national and international agencies to channel resources to assist the creation of the e-PING infrastructure and to promote research and development
- To make possible the implementation and approval of the standards to be established for the government

- To make possible the implementation and to manage the auditing processes for verifying the level of compliance with the e-PING recommendations and specifications
- To act cooperatively in support of the government organs to accomplish their necessary adaptation to the e-PING standards and to evaluate the possibility of sponsoring comprehensive programs to promote the intensive use of the proposed standards.

3.3 New Zealand e-Government Interoperability Framework

The e-Government Interoperability Framework (e-GIF) Version 3.3. consists of three documents: 1) Standards 2) Policy and 3) Resources [26]. Part 1 focuses on the standards that make up the e-GIF. The intended audience for this section includes state sector information technology strategists, technical analysts, and programme and project managers. Part 2 outlines the policy behind the e-GIF and its development. The intended audience for this section comprises: policy analysts, advisors, business analysts, anyone involved with interoperability strategy and projects. Part 3 contains resources related to the e-GIF. The intended audience for this section is all readers of the e-GIF. The model for this version of the e-GIF is illustrated in four basic structural components:

- **Network:** covers details of data transport, such as network protocols, this is crucial area for interoperability. Without agreement on networking standards, it is hard or impossible to make systems communicate. The e-GIF uses a subset of the widely proven Internet Protocol suite.
- **Data integration:** facilitates interoperable data exchange and processing, its standards allow data exchange between disparate systems and data analysis on receiving systems.
- **Business services:** supports data exchange in particular business applications and information contexts. Some of the standards in this layer are generic, covering multiple business information contexts. Others work with data integration standards to define the meaning of the data, mapping it to usable business information. For example, an agency will format a stream of name-and-address data in XML (Data Integration) using the business rules of xNAL (Business Services) to create a commonly agreed representation of name-and-address information.
- **Access and Presentation.** Covers how users access and present business systems. Most of the standards in this layer are in the Government Web Standards and Recommendations.

The e-Government Interoperability Framework (e-GIF) is a set of policies, technical standards, and guidelines. It covers ways to achieve interoperability of public sector data and information resources, information and communications technology (ICT) and electronic business processes. It enables any agency to join its information, ICT or processes with those of any other agency using a predetermined framework based on open international standards. While a universally agreed definition of open standards is unlikely to be resolved in the near future, the e-GIF accepts that a definition of open standards needs to recognise a continuum that ranges from closed to open, and encompasses varying degrees of openness. To guide readers in this respect, the e-GIF endorses open standards that exhibit the following properties:

- **Be accessible to everyone free of charge:** no discrimination between users, and no payment or other considerations should be required as a condition to use the standard
- **Remain accessible to everyone free of charge:** owners should renounce their options, if any, to limit access to the standard at a later date
- **Be documented in all its details:** all aspects of the standard should be transparent and documented, and both access to and use of the documentation should be free.

3.4 Australian Governmental Interoperability Framework

The Australian Government Interoperability Framework addresses the information, business process and technical dimensions of interoperability. It sets the principles, standards and methodologies that support the delivery of integrated and seamless services. Here, interoperability describes the ability to work together to deliver services in a seamless, uniform and efficient manner across multiple organisations and information technology systems. To be interoperable, agencies need to actively engage in a process of ensuring that their systems, information and business planning activities are managed to maximise opportunities for exchange with and reuse by others. Interoperability is more than just the flow of information between agencies and the connection of information technology systems. It requires a collective mindset, an understanding of how each collaborating agency operates and the development of arrangements which effectively manage business processes that cut across organisational boundaries.

The Business Process Interoperability Framework (BPIF) provides a valuable guide and a set of tools to assist agencies in making the transition to connected and shared modes of operation [32]. It has been endorsed by the Business Process Transformation Committee as a key tool to support whole of government business transformation. A key aim of BPIF is to support the whole of government policy goals, as outlined in the 2006 e-Government strategy. It links to other Australian Government guidance and frameworks, including the Technical and Information Interoperability Frameworks, the Australian Government Architecture and the National Services Improvement Framework. The BPIF provide a series of tools to support agencies undertaking business process interoperability initiatives, including:

- A roadmap which provides a series of steps for agencies to move towards interoperability
- A list of Australian Government sources to support and guide collaborative activity
- A capability maturity model which can be used by agencies to identify their current level of business process interoperability maturity
- A series of case studies to outline existing Australian Government business process management strategies and approaches to cross-agency process management.

Simultaneously, the Australian Government Architecture Reference Model v.1.0 (AGA) will be utilised to assist government in identifying gaps and overlaps in the investment intentions of agencies and opportunities for collaboration. The AGA consists of five reference models:

- Performance Reference Model (PRM): framework for performance measurement, providing common output measurements throughout the Australian Government
- Business Reference Model: facilitates a functional view of the Australian Government's lines of business, structured around common business areas, rather than agency structures
- Service Reference Model: a business drive, functional framework which classifies services according to how they support business and performance objectives
- Data Reference Model (DRM)
- Technical Reference Model (TRM): a component driven, technical framework, which categorises the standards and technologies that support and enable the delivery of services.

The AGA provides a useful framework, both for internal agency use and for interagency collaboration. At an agency level, it provided an organization with a taxonomy to trace from performance or outcomes of a program or process down to underlying services and technologies which support it. This will assist agencies to make informed decisions which affect interoperability within and outside the agency.

3.5 Hong Kong Interoperability Framework

The Interoperability Framework (IF) supports the Government's strategy of providing client-centric joined-up services by facilitating the interoperability of technical systems between government departments as well as between government systems and systems used by the public [19]. The IF defines a collection of specifications aimed at facilitating the interoperability of government systems and services. By bringing together the relevant specifications under an overall framework, IT management and developers can have a single point of reference when there is a need to identify the required interoperability specifications that should be followed for a specific project. By adopting these interoperability specifications, system designers can ensure interoperability between systems while at the same time enjoy the flexibility to select different hardware and systems, and application software to implement solutions. The IF covers:

- A set of technical standards and data standards that help define the interface across different systems
- Guidelines for project teams to work out some of the business-oriented specifications, where it is feasible to provide guidelines in that area
- Other standards documents that define infrastructure architecture, conventions and procedures.

3.6 India e-Governance Framework

e-Governance is more than e-Government or e-Democracy. It focuses more on what could be called interactions among citizens, community actors and stakeholders and their locally elected politicians. Good governance presents what would be applicable at all levels of government and governance within public administration i.e. transparency and openness, participation, accountability, effectiveness, and coherence. Governance is a process of broader consultation and participation, which results in mutually agreed goals and solutions. The public sector can no longer seek to attain its policy goals without active support from the citizens, local firms, voluntary organizations and other actors on the ground. To provide continuity of services by the government, records and documentation should be available with the government. Traceability is a major issue and for citizen-centric e-Governance applications it should be established. Quality and documentation standards would enhance the government functionality and would improve the service delivery.

The mandatory documents in the project life cycle of e-Governance Projects are as follows:

- Guidelines on preparation of RFP (Request for Proposals) i.e. functional, technical, and commercial specifications, legal specifications including Service Level Agreements (SLAs)
- Program management related documents i.e. Project Management Plan (PMP), Software Requirements Specification (SRS), Software Design Document (SDD), User Manual (UM), and Test Plan (TP)
- Private-Public Partnership (PPP) and revenue model for different categories of e-Government applications
- Design guideline for websites
- Record management, archival and retrieval [15].

3.7 Malaysian Government Interoperability Framework

The Malaysian Government Interoperability Framework (MyGIF) includes the detail recommendations resulting from the research and analysis conducted by the Malaysian governmental institutions [30]. MyGIF covers the following five interoperability areas: interconnection, data integration, information access, security and metadata. Instead of creating new standards or specifications, MyGIF adopts internationally recognised open and de facto ICT standards as well as technical specifications for all the interoperability areas mentioned. The key drivers guiding the recommendations of ICT standards and technical specifications for MyGIF are:

- Interoperability: Standards and specifications recommended must be relevant to the five interoperability areas specified above
- Maturity and popularity: Standards and specifications recommended should be internationally recognized or de facto standards that are matured and widely used in the IT industry
- Market support: Standards and specifications recommended should be widely supported by the dominant technology platforms, software packages and business applications in the market
- Open standards: Standards and specifications recommended should be open standards as far as possible. Standards that are vendor and product neutral should be considered in favour of the proprietary alternatives
- Internet: standards and specifications recommended should be well aligned with the Internet standards (e.g. W3C) since the Internet is a major delivery channel for the Government information resources and services
- Existing government policies and standards: standards and specifications recommended must comply with the existing government policies and standards wherever relevant
- Existing published government policies and standards that are relevant to be observed and complied are:
 - Electronic Government Information Technology Policy and Standards, published on 1 July 1997
 - The Malaysian Public Sector ICT Management Security Handbook published in January 2002
 - Digital Signature Act 1997 and Digital Signature Regulations 1998.

3.8 Yesser Framework for Interoperability

In Kingdom of Saudi Arabia interoperability is defined as a set of policies to be adopted by government institutions that standardise the way the information is being exchanged and shared services are being used [37]. Interoperability framework will define:

- Data types and schemes
- Metadata element and dictionaries
- Technical policies covering integration approaches and standards, connectivity standards, security standards, information access and delivery standards.

Yesser Framework For Interoperability (YEFI) is assumed to decrease the effort (time and cost) required for developing the electronic exchange of information between government institutions, required for successful e-Government implementation. The selection of the technical policy should be driven by:

- Interoperability: Only specifications that are relevant to systems interconnectivity, data integration and service access are specified
- Market support: The specifications selected are widely supported by the market in order to reduce cost and risk of the government systems
- Scalability: The specifications selected have the capacity to be scaled to satisfy changed demands made on the systems (e.g. data volume, number of transactions, number of users)
- Openness: The specifications are documented and available to the public
- International standards: Preference will be given to standards with the broadest remit.

Areas of system integration strategy comprise as follows:

- Integration approach: That outlines two things along the different phases: 1) the topology e.g. point-to-point, hub-and-spoke and bus, and 2) the architecture layer of integration, e.g. data, application layer
- Specification of all technology standards relevant to the integration
- Specification of semantics: All interfaces and services to be interconnected should be listed, specified and described in order to achieve consistency and high reuse
- Data integration: All major business objects and data to be transmitted between systems across organizations should be specified in order to achieve consistency.

3.9 United Kingdom e-Government Interoperability Framework

The United Kingdom e-Government Interoperability Framework (e-GIF) sets out the government's technical policies and specifications for achieving interoperability and Information and Communication Technology (ICT) systems coherence across the public sector [34]. The e-GIF defines the essential prerequisites for joined-up and web-enabled government. The e-GIF architecture contains:

- The Framework, which covers high-level policy statements, technical policies and management, implementation and compliance regimes
- The e-GIF registry, which covers the e-Government Metadata Standard and Government Category List, the Government Data Standards Catalogue, XML schemes and the Technical Standards Catalogue [34].

The e-GIF defines the minimum set of technical policies and specifications governing information flows across government and the public sector. These cover interconnectivity, data integration, and content management metadata and e-Services access. These are the key policy decisions that have shaped the e-GIF:

- Alignment with the Internet: The universal adoption of common specifications used in the Internet and WWW for all public sector information systems

- Adoption of XML as the primary standard for data integration and data management for all public sector systems
- Adoption of the browser as the key interface: All public sector information systems are to be accessible through browser-based technology; other interfaces are permitted but only in addition to browser-based ones
- The addition of metadata to government information resources
- The development and adoption of the e-GMS, based on the international Dublin Core model (ISO 15836).
- The development and maintenance of the GCL
- Adherence of the e-GIF is mandated throughout the public sector
- Interfaces between government information systems and intermediaries providing e-Government services shall conform to the standards in the e-GIF. Interfaces between intermediaries and the public are outside the scope of the e-GIF.

The selection of e-GIF specifications has been driven by:

- Interoperability: Only specifications that are relevant to systems' interconnectivity, data integration, e-Services access and content management metadata are specified
- Market support: The specifications selected are widely supported by the market, and are likely to reduce the cost and risk of government information systems
- Scalability: The specifications selected have the capacity to be scaled to satisfy changing demands made on the system, such as changes in data volumes, number of transactions or number of users
- Openness: The specifications are documented and available to the public
- International standards: Preference will be given to standards with the broadest remit, so appropriate international standards will take preference over EU standards, and EU standards will take preference over UK standards.

In UK the full participation of government departments, their agencies, devolved administrations and local authorities is essential to successfully deliver interoperability in the public sector. Although central decision will be provided where required, much of the action will take place in individual public sector organizations that will need to:

- Contribute to the continuous development and improvement of the framework
- Ensure that e-GIF compliance is a fundamental part of their organizational e-Business strategies
- Produce a roadmap for implementing their organization's conformance with the e-GIF
- Work with users of their services or data to identify those services that can usefully be made more widely available
- Ensure that they have the skills to define and use the specifications needed for interoperability
- Establish a contact that understands the impact of requests for change and can respond within the stated time period
- Budget for and supply resources to support the processes
- Identify the relevant customers or stakeholders within their organization and ensure their interests are represented
- Take the opportunity to rationalise processes (as a result of increased interoperability) to improve the quality of services and reduce the cost of provision.

The e-GIF is an enabling framework for delivering the services seamlessly and coherently. The government welcomes and encourages citizens to provide comments, suggestions and innovations that may help it to improve information access and service delivery.

3.10 German Standards and Architectures for Interoperability

In Germany simple and clear standards and specifications help to achieve interoperability of information and communication systems. Standards and Architectures for e-Government Applications (SAGA) framework identifies the necessary standards, formats and specifications, it sets forth conformity rules and updates these in line with technological progress [17]. SAGA pursues the following aims:

- To ensure ongoing flows of information between citizens, the federal government and its partners (interoperability)
- To establish comparable procedures for the provision of services and for the definitions of data models, federal-state governments and communal administrations have the opportunity to make use of the development results of the BundOnline 2005 initiative (re-usability)
- To provide specifications in the form of publicly accessible documentation (openness)
- To consider developments on the market and in the field of standardization (cost and risk reduction)
- To ensure the applicability of solutions against the background of changing requirements in terms of volume and transaction frequencies (scalability).

SAGA framework is a full-scale standardisation approach for the BundOnline 2005 initiative that focuses on four development directions as follows:

- The definition of technical normative references, standards and architectures.
- Process modelling.
- Data modelling.
- The development of basic components.

SAGA aims to facilitate communications, a common understanding of up-to date IT architectures, IT technologies and e-Government structures.

3.11 Danish e-Government Interoperability Framework

This Danish Interoperability Framework is intended as a guideline to public agencies as they develop IT plans and projects. It contains descriptions and recommendations of selected standards, technologies and protocols, which might be used and supported in relation with the implementation of e-Government in Denmark [12]. The Interoperability Framework has been compiled in collaboration with KIU (a committee that facilitates coordination of initiatives related to IT in the Danish public sector). Members of the KIU committee include The Digital Taskforce, The Ministry of Science, Technology and Innovation, The Ministry of the Interior and Health, The Ministry of Economic and Business Affairs, Local Government Denmark, Danish Regions and the National IT and Telecom Agency. The actual work on this interoperability framework has been governed by a subcommittee of KIU - The IT Architecture Committee. The e-Government Interoperability Framework ought to be consulted by authorities involved in developing IT strategies, IT plans and IT projects, as well as the suppliers and advisors involved in such developments. The intention is that this document contributes in ensuring a better coherence and technical consistency by using established technologies throughout the Danish public sector. The Interoperability Framework operates with three overall categories of standards:

- Technical standards: are often invisible to the users, but are necessary for the IT systems when exchanging information or performing other tasks. An example is the Web Service standard SOAP, which is a protocol that allows applications to communicate with one another. The technical standards are usually developed by market actors and can be found in the "old" part of the interoperability framework – the part that originally was referred to as the Reference Profile.
- Data standards: ensure that the terms exchanged between IT systems and their components are unambiguously defined. Such standards can e.g. define whether an address field contains street name as well as number, or whether the number is to be located in a separate field. Such aspects are usually not

specified in the technical standards, but they are important in order to ensure an efficient and problem free exchange of information with IT systems, that fully understand each other.

- Process standards: describe common approaches to processes and are particularly concerned with how and where information is sent and processed – and how it is handled. Hence, it is a category of standards more focussed on humans and work processes than the technical aspects of IT.

The recommendations outlined by the Interoperability Framework are based on the following assumptions:

- Use open standards
- Incorporate existing standards in a broader, pan-European context
- Stimulate reuse of established standards
- Redesign administrative processes to make the best use of available technology. This is also an opportunity to make services more user-centric
- Coordinate and manage the e-Government initiative. Centrally agreed XML schemes may be provided free of charge throughout the public sector. This form of re-use reduces cost while the need to develop separate mechanisms for interchanging data is greatly reduced.

The European dimension means that the national framework must also enable administrations to interoperate at the pan-European level. For that purpose, the EU IDA programme has initiated the European Interoperability Framework, (EIF), as part of the e-Europe 2005 Action Plan. The EIF has been developed in cooperation with member states, and is planned for release before the end of 2003. Denmark's strategy has been to ensure that the EIF and the Interoperability Framework are seen as a well-knit package, where the Interoperability Framework as Denmark's national interoperability framework complies with the EIF. As the European Interoperability Framework focuses on supplementing, rather than replacing, national interoperability frameworks by adding the pan-European dimension, it is recommended that countries that want to (be able to) interoperate at the pan-European level, have frameworks that are similar in structure, so as to make the comparison of national interoperability frameworks easier and to facilitate the identification of obstacles to pan-European interoperability. The scope of an interoperability framework, i.e. the area in which it is applicable, is usually the jurisdiction for which it was introduced. But as citizens and businesses increasingly demand to procure services from beyond their jurisdiction's borders (often necessitated by the freedom of movement and the freedom of business transactions), administrations must be ready to cater for those demands.

3.12 Estonian Interoperability Framework

The Estonian IT interoperability framework is a set of standards and guidelines aimed at ensuring the provision of services for public administration institutions, enterprises and citizens both in the national and the European context [25]. The IT interoperability framework and the related documents are obligatory to follow in order to ensure mutual communication between the information systems of central and local government agencies. Key principles of the state IT interoperability:

- The institution-based approach should be replaced by service-centric one.
- Public services are provided free of charge for public sector institutions.
- The development of information systems is based on Internet-centric approach.
- XML-based technologies are used for the integration of information systems and the presentation of data.
- Information systems provide and use services via a data exchange layer based on multilateral agreements.
- Course will be taken towards wider use of open standards.
- In developing information systems, open source based solutions are considered alongside proprietary ones.
- Access to public services should preferably be ensured via web browser by different channels and devices.
- All services requiring user authentication and authorization exploit the secure middleware X-Road for data transport.

- The authentication and authorization procedures of civil servants are based on the use of the Estonian ID card.
- As a temporary alternative, authentication mechanisms of internet banks can be used for citizen authentication.
- Central and local government agencies cooperate in order to ensure the provision of information and services for citizens, officials or entrepreneurs from one place.

Three dimensions of interoperability are considered:

- Organizational interoperability stands for the ability of organizations to provide, by making use of information systems, services to other organizations and their clients. It is ensured by legislation and general agreements.
- Semantic interoperability refers to the ability of different organizations to understand the exchanged data in a similar way. This presumes the creation of a mechanism allowing the presentation of service data and data definitions.
- Technical interoperability denotes the interoperability of infrastructure and software. It is the ability of hardware acquired by different organizations to work in a connected way. It is ensured by the Internet and the PKI infrastructure.

In the proposed architecture, the central and local government agencies, private companies as well as third sector organisations all provide services.

3.13 European Interoperability Framework

The Interoperability Framework is 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. The Interoperability Framework is, therefore, not a static document and may have to be adapted over time as technologies, standards and administrative requirements change. The objectives of the European Interoperability Framework are:

- To support the European Union's strategy of providing user-centric e-Services by facilitating the interoperability of services and systems between public administrations, as well as between administrations and the public (citizens and enterprises) at a pan-European level.
- To supplement national interoperability frameworks in areas that cannot be adequately addressed by a purely national approach.
- To help achieve interoperability both within and across different policy areas, notably in the context of the Interoperable Delivery of pan-European e-Government Services to Public Administrations, Businesses and Citizens (IDABC) programme and any other relevant Community programmes and initiatives [14].

Accordingly, the considerations and recommendations of the European Interoperability Framework are based on the following principles:

- **Accessibility:** There is a need to ensure that e-Government creates equal opportunities for all through open, inclusive electronic services that are publicly accessible without discrimination. Generally accepted design principles for interfaces should be applied in order to ensure access for disabled persons and offer support in a language understood by the user. The Web Accessibility Guidelines established by the Web Access Initiative of the WWW Consortium should be taken into account.
- **Multilingualism:** In Europe a vast variety of languages are used extensively in services today. At the presentation level (front office and web pages on the Internet), language is clearly a major factor in the effective delivery of trans-European e-Government Services.
- **Security:** Overall the reliable exchange of information takes place in conformity with an established security policy. This is achieved by conducting appropriate risk assessment activities prior to the set-up of the services and the appropriate security measures. From the user perspective, functions associated with security (identification, authentication, non-repudiation, confidentiality) should have a maximum level of transparency, involve minimum effort and provide the agreed level of security.

- Privacy protection: Including measures in which individuals have the right to choose whether their data may be used for purposes other than those for which they originally supplied the data in question. In particular, work on interoperability should be coordinated with the mechanisms already in place following the Directive 95/46/EC, when available; technologies that are privacy-compliant and privacy-enhancing should be used.
- Subsidiarity: In line with the principles, the guidance does not interfere with the internal workings of administrations and EU Institutions. The considerations are ensured on pan-European level.
- Use of open standards: Standard is adopted and will be maintained by a not-profit organization, and its ongoing development occurs on the basis of an open decision-making procedure available to all interested parties, the standards are published and publicly accessible (free of charge).
- Access the benefits of open source software, through the use of open standards and publicly available specifications.
- Use of multilateral solutions. The net effect of such an approach is that it requires as many communications as there are external partners, resulting in less efficiency and higher costs. On the other hand, if each of the interoperating partners adopts the same set of agreements for interoperability solutions, each of them can reap the benefits of a single solution that is developed once and fits the needs of all.

Three aspects of interoperability need to be considered i.e. organizational, semantic and technical interoperability. Therefore, open interfaces, interconnection services, data integration and middleware, data presentation and exchange, accessibility and security services ought to be ensured.

4 Conclusions

Public administrations must ensure that their information is accessible to all as a necessary first step to improving interaction with citizens and business. In this role, the public sector must avoid using products or formats for documents that force users to have a given product to interact. There is a common understanding among European public administrations that electronic document exchanges and storage should rely on open document format. Such formats are to be defined in a process open to all interested parties and to be available for all interested and competent actors to implement without restrictions. Using such formats provides public administrations, businesses and citizens with a wide range of products capable of reading, writing and manipulating documents while stimulating competition and innovation in the area of document handling.

Standardisation efforts have produced many positive results i.e. simplification of business processes, synergy effect creation, generating values in chains and networks. Utilization of standards as well as standardizing processes must be a commonplace practice. Basic definitions and processes should be set up on the global level. In standardizing activities, participation of all stakeholders is important as well as consensus in establishing the standards and reducing the threats of current political pressures. Standardization is a necessary condition to develop and ensure interoperability of e-Government institutions on different hierarchical levels and cross-countries. However, standards are not sufficient, e-Government institutions are based on well specified administrative processes and procedures. Well elaborated in different countries, interoperability frameworks consider mostly semantic, technical and organizational interoperability, focusing on open standards and open source software development. They receive quite good results in the development and implementation of open standards, however the administrative processes standardization is the most difficult effort and it demands further research.

In many countries a lot has been done to ensure interoperability, however with different speed of development and emphasis. Although there are works on standardized communications protocols, standardized interfaces for devices, standardization of applications is more controversial. Taking into account presented above survey on different national frameworks for interoperability, it should be noticed that interoperability in e-Government institutions follows citizens' needs and their mobilities. Therefore, interoperability models and practical solutions ought to be developed across national borders, across corporate boundaries, and across educational systems. So far, there is lack of coherent overall programme, specification of such requirements and competing expert organizations. The desirable future outlook for e-Government should cover new design methodologies and construction processes founded on interoperability frameworks.

References

- [1] S. Alter, Information Systems, The Benjamin/Cummings Publishing Company, Inc., Menlo Park, 1996.
- [2] P. Backlund, J. Ralyte, M.A. Jeusfeld, H. Kuhn, N. Arni-Bloch, J.B.M. Goossenaerts, F. Lillehagen, An Interoperability Classification Framework for Method Chunk Repositories, in Advances in Information Systems Development, New Methods and Practice for the Networked Society, Volume 2 , (G. Magyar, G. Knapp, W.Wojtkowski, W.G. Wojtkowski, J. Zupancic, Eds.) Springer NY 2007, pp.153-166.

- [3] J.P. Bailey, The Economics of Internet Interconnection Agreements, in Internet economics, (L.W. McKnight, J.P. Bailey, Eds.) MIT Press Cambridge, 1998, pp.155-168.
- [4] A-J. Berre, B. Elvesaeter, N. Figay, C. Guglielmina, S.G. Johnsen, D. Karlsen, T. Knothe, S. Lippe, The ATHENA Interoperability Framework, in Enterprise Interoperability II, New Challenges and Approaches, (R.J. Goncalves, J.P.Muller, K. Mertins, M.Zelm, Eds.) Springer Verlag London, 2007, pp.569-580.
- [5] C. Centeno, R. van Bavel, J-C. Burgelman, eGovernment in the EU in 2010: Key policy and research challenges. August 2004, [Online], Available: <http://www.jrc.es/home/publications/publications.html>
- [6] V. Chapurlat, D.Diep, A.Kalogerias, J.Gialelis, Building and validating a Manufacturing Ontology to achieve interoperability, in Enterprise Interoperability II, New Challenges and Approaches, (R.J.Goncalves, J.P. Muller, K. Mertins, M. Zelm, Eds.) Springer Verlag London, 2007, pp.261-272.
- [7] S. Chaari, F. Biennier, J. Favrel, C. Benamar, Towards a service-oriented enterprise based on business components identification, in Enterprise Interoperability II, New Challenges and Approaches, (R.J.Goncalves, J.P. Muller, K. Mertins, M. Zelm, Eds.) Springer Verlag London, 2007, pp.495-506.
- [8] D. Chen, G. Doumeings, Basic concepts and approaches to develop interoperability of enterprise applications, in Processes and Foundations for Virtual Organizations (L.M.Camarinha-Matos, H.Afsarmanesh, Eds.) Kluwer Academic Publisher, Boston 2004, pp.323-330.
- [9] T. Clark, R. Jones, Organizational Interoperability Maturity Model for C2, 1999, [Online], Available: http://www.dodccrp.org/events/1999_CCRTS/pdf_files/track_5/049clark.pdf
- [10] J. Cordoba, Communities and Evaluation of e-Government Services, in Encyclopedia of Communities of Practice in Information and Knowledge Management (E.Coakes, S.Clarke, Eds.) Idea Group Reference, Hershey, 2006, pp.32-35.
- [11] H. Dannenberg, Case study on interoperability; The Electronic Passport, NXP Semiconductors, RFID Standardization Architect Interoperability Conference, Warsaw, 6-7 February 2008, [Online], Available: <http://www.interoperabilityconference.org/>
- [12] Danish e-Government Interoperability Framework, [Online] Available: <http://standarder.oio.dk/English/>
- [13] eEurope An Information Society for All, Communication on a Commission Initiative for the Special European Council of Lisbon [Online], Available: <http://europa.eu/scadplus/leg/en/lvb/l24221.htm>
- [14] European Interoperability Framework for Pan-European e-Government Services v. 1.0., April 2004 European Commission, Brussels, Belgium, [Online] Available: <http://ec.europa.eu/idabc/servlets/Doc?id=19528>
- [15] e-Government Quality and Documentation standards – An Approach Paper, Government of India, Ministry of Communication and Information Technology, Department of Information Technology, National Informatics Centre, [Online], Available: <http://egovstandards.gov.in>
- [16] e-PING v.2.0 Standards of Interoperability for Electronic Government, Brazilian Government Executive Committee on Electronic Government, [Online], Available: https://www.governoeletronico.gov.br/acoee-projetos/anexos/E15_677e-PING_v2.0.1_05_12_06_english.pdf
- [17] Germany – Standards and Architectures for e-Government Applications, December 2003, KBSt Publication Series, Volume 59, Federal Ministry of the Interior, Berlin, [Online], Available: http://www.bilgitoplumu.gov.tr/kdep/34/almanyaSaga_2_0_en_final.pdf
- [18] R.J. Glushko, T. McGrath, Document Engineering, Analyzing and designing documents for business informatics and Web services, The MIT Press, Cambridge, 2005.
- [19] Hong Kong Office of the Government Chief Information Officer The HKSARG Interoperability Framework, December 2007, [Online], Available: <http://www.ogcio.gov.hk/eng/infra/download/s18.pdf>
- [20] i2010 eGovernment Action Plan: Accelerating eGovernment in Europe for the Benefit of All [Online], Available: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52005DC0229:EN:HTML>
- [21] IEEE STD 610.12 Standard Glossary of Software Engineering Technology, IEEE May 1990, ISBN: 155937067X
- [22] T.Langenberg, Standardization and Expectations, Springer, Berlin, 2006.
- [23] L.L.Lee, M.Neff, M., How Information Technologies Can Help build and sustain an organization's CoP: Spanning the Socio-technical Divide? in Knowledge networks, Innovation Through Communities of Practice, (P.Hildreth, Ch. Kimble, Eds.) Idea Group Publishing, Hershey, 2004, pp. 165-183.
- [24] P. Miller, Interoperability, What is it and Why should I want it? Ariadne Issue 24, 2000, [Online], Available: <http://www.ariadne.ac.uk/issue24/interoperability/>
- [25] Ministry of Economic Affairs and Communications Department of State Information Systems, Estonian IT Interoperability Framework, [Online] Available: http://www.riso.ee/en/files/framework_2005.pdf
- [26] New Zealand e-Government Interoperability Framework (NZ e-GIF) Version 3.3 February 2008 State Services Commission, [Online], Available: <http://www.e.govt.nz/standards/e-gif/e-gif-v-3-3/>
- [27] M.P. Papazoglou, P.M.A Ribbers, e-Business Organizational and Technical Foundations, Wiley & Sons, Chichester, 2006.
- [28] T. Ruokolainen, Y. Naudet, T. Latour, An Ontology of Interoperability in Inter-Enterprise Communities, in Enterprise Interoperability II, New Challenges and Approaches, (R.J. Goncalves, J.P.Muller, K. Mertins, M.Zelm, Eds.) Springer Verlag London, 2007, pp.159-170.
- [29] B.Sutor, Why interoperability matters more than ever, IBM Open Source and Standards, Interoperability Conference Cen Cenelec, ETSI, ANSI, Warsaw, 6-7 Feb 2008 [Online] Available: <http://www.sutor.com/blog>.
- [30] Standards, Policies and Guidelines – Malaysian Government Interoperability Framework (MyGIF) version 1.0. August 2003, [Online], Available: <http://www.mampu.gov.my/mampu/pdf/ISPlan/ispdoc/Interoperability%20Framework.pdf>
- [31] TOGAF, The Open Group: The Open Group Architecture Framework: version 8.1.1. Enterprise Edition, 2007.

- [32] The Australian Government Business Process Interoperability Framework (July 2007) [Online], Available: http://www.agimo.gov.au/_data/assets/pdf_file/0007/58849/Business_Process_Interoperability_Framework.pdf
- [33] R.Traunmuller, M. Wimmer, E-Government – a roadmap for progress. In Digital Communities, in Networked society, e-Commerce, e-Business and e-Government (M.J.Mendes, R.Suomi, C.Passos, Eds), IFIP Kluwer Academic Publishers, Boston, 2004, pp. 3-12.
- [34] United Kingdom e-Government Interoperability Frameworks Version 6.1. 2005, [Online], Available: [http://www.govtalk.gov.uk/documents/eGIF%20v6_1\(1\).pdf](http://www.govtalk.gov.uk/documents/eGIF%20v6_1(1).pdf)
- [35] USA –Federal Enterprise Architecture (FEA) v.2.0 2002-2006. FEA Consolidated Reference Model Document Version 2.0, FY08 Budget Formulation June 2006. [Online], Available http://www.whitehouse.gov/omb/egov/documents/FEA_CRM_v21_Final_Dec_2006.pdf
- [36] D.Walters, Operation strategy, Palgrave Macmillan, NY, 2002.
- [37] YEFI – Yesser Framework For Interoperability, e-Government Program, Kingdom of Saudi Arabia, Riyadh, October 28, 2005, [Online], Available: <http://www.yesser.gov.sa/documents/YEFI.pdf>