



SEVENTH FRAMEWORK PROGRAMME



GREEK INTEROPERABILITY CENTER

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A Practical Guide for e-GIF Development & Maintenance

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LIST OF TERMS AND ABBREVIATIONS

| | |
|---------------|---|
| BPMN | Business Process Modeling Notation |
| CFPSP | Certification Framework for Public Sites and Portals |
| COTS | Commercial, off-the-shelf |
| DAF | Digital Authentication Framework |
| DMPAPD | Documentation Model for Public Administration Processes and Data |
| ebXML | Electronic Business using eXtensible Markup Language |
| e-GIF | e-Government Interoperability Framework |
| eGMS | e-Government Metadata Standards |
| EIF | European Interoperability Framework |
| EU | European Union |
| GIC | Greek Interoperability Center |
| HKSARG | Hong Kong Special Administrative Region Government |
| ICT | Information and Communication Technology |
| ISD | Interoperability Standards Documentation |
| ISP | Interoperability and Services Framework |
| IT | Information Technology |
| OWL | Web Ontology Language |
| PEGS | Pan-European e-Government Services |
| RDF | Resource Description Framework |
| RSS | Really Simple Syndication |
| SAGA | Standards and Architectures for e-Government Applications |
| SCORM | Sharable Content Object Reference Model |
| SLA | Service Level Agreement |
| SOA | Service-Oriented Architecture |
| UDDI | Universal Description Discovery and Integration |
| UK | United Kingdom |
| UML | Unified Modeling Language |

| | |
|------------------|---|
| UN/CEFACT | United Nations Centre for Trade Facilitation and Electronic Business |
| UN/CEFACT | United Nations Centre for Trade Facilitation and Electronic Business |
| CCTS | Core Components Technical Specification |
| UNDP | United Nations Development Programme |
| UNECLAC | United Nations Economic Commission for Latin America and the Caribbean |
| WSDL | Web Service Description Language |
| XML | eXtensible Markup Language |
| XSD | XML Schema Document |

EXECUTIVE SUMMARY

Interoperability is defined as the ability of two or more systems or components to exchange information and to use the information that has been exchanged. The advances in ICT, the cross-border eGovernment service provision as a result of EU integration, the competitiveness in a globalized world and the tendency for better administration services to business and citizens contribute in huge interest and advances in the Interoperability domain. Variations of interoperability are applied to engineering, health, telecommunications and software. The main focus domains of the various versions of this guide are Enterprise Interoperability, eGovernment Interoperability, technical interoperability, semantic interoperability, organisational interoperability, business process interoperability and legal interoperability.

In the last decade, interoperability appears as the most long lasting and challenging problem for governmental organizations which has emerged from the proprietary development or extension of heterogeneous hardware and software platforms and the unavailability of standards. The establishment of interoperability standards has become a key objective for the European Union's digital agenda, UNDP's Asia-Pacific Development Information Programme, as well as UNECLAC's e-Government agenda for the Latin America and the Caribbean.

In this context, e-Government Interoperability Frameworks (e-GIFs), as strategic documents containing guidelines, specifications and standards to be applied in national and local level, in order to ensure interoperability among public administrations and their beneficiaries, pose today as the governmental policy cornerstones for the resolution of interoperability issues in the public sector, the deployment of joined-up information systems and the provision of one-stop, fully electronic services to citizens and businesses. A thorough e-Government Interoperability Framework addresses:

- The “*Standards & Specifications*” Level, which includes the paper-based specifications. It formulates the rules and directions for resolving organizational, semantic and technical interoperability issues, designing web portals and information systems, creating security and authentication mechanisms. It also states the data, technical, authentication, web portal and multi-channel access standards that will prevent vendor lock-in when procuring information technology (IT) infrastructure and will make integration of applications and tools in the public sector easier.
- The “*Systems*” Level which consists of repositories for storing services and process models, XML Schemas and their Core Components, web services descriptions and system reference definitions (which include explicit definitions for systems and their topology). Furthermore, Access and Collaboration Tools ensure access to the distinct Repositories and provide the potential for bidirectional communication by seeking and retrieving the e-GIF specifications and posting change requests and comments.
- The “*Coordination*” Level, which mainly deals with winning ‘hearts and minds’. It includes theoretical and practical training of the public administration employees, marketing and dissemination plans for increasing awareness on the Framework, and coordination activities planning among the various stakeholders in order to ensure acceptance of the Framework.

Establishing the e-GIF is a complex and time-consuming process which requires cross-government coordination. In this respect, the establishment of a central e-GIF Management Authority is considered essential to define the strategy on the design and implementation of public administration web sites and information systems and act as the focal point for coordinating interoperability efforts throughout government. The e-GIF Management Authority should establish maintenance procedures that allow the revision of the e-GIF, in order to adapt to technological changes, the emergence of new standards and changes in eGovernment policy. Finally, the e-GIF Management Authority is responsible for establishing communication mechanisms to support public organizations on the application of the e-GIF, developing a dissemination plan to enlighten the target audience of the e-GIF on the potential benefits from its application, and monitoring framework compliance.

1 Introduction

1.1 Scope of the Guide

The **objective** of the G.I.C. Interoperability Guide series is to provide a volume of concise and comprehensive information on Interoperability that can help its targeted audience, mainly managers, IT managers, decision makers of enterprises, policy makers of governments and citizens, to design their strategies, find solution tactics on specific interoperability problems and generally benefit from the Interoperability aspects in their everyday communications and transactions. For this purpose, the Interoperability Guide comprises, in its **six versions**, material on Interoperability from a multitude of sources:

- **Research results** from ongoing projects and initiatives in EU and international level, focusing on the specific sub-domains and applications of Interoperability.
- **Deliverables and Reports** from projects, initiatives, standardisation bodies and institutions on various issues that impact the Interoperability domain.
- National, EU and global **Best Practices** and **Strategies** on specific areas of the Interoperability domain that describe how key Interoperability issues/problems have been tackled effectively by enterprises and governments.
- Reports on **standards from international organisations**, working groups and standardisation bodies on existing and emerging key technological approaches in the various domains associated with interoperability.
- **Legal and Statutory Framework documents**, reports and white papers that affect the Interoperability domain or shape specific areas of business/governmental practice where Interoperability has a major impact.

In order to make the previous material comprehensive to readers with limited knowledge on the Interoperability domain, the Guide incorporates declarative definitions in plain terms on the subjects it engages in its various versions and concludes by providing a set of straightforward recommendations to enterprise decision makers and government policy makers.

1.2 Focus of Previous Versions of the Guide

As interoperability is a vast and multilateral subject matter, attempting to provide a single, all-inclusive report would be futile and at best would render the document elaborate, lengthy, verbose and finally useless for its potential audience. Instead, the Interoperability Guide is published in six separate versions, each version focusing on different aspects of Enterprise and e-Government Interoperability, in order to provide a set of comprehensive reports and straightforward recommendations that could be used by decision makers and policy makers in enterprises and organisations. The previous published versions of the Guide cover the following topics:

- The first version provides guidance to Enterprises on middleware platforms and architectures, the technical aspects of the European Interoperability Framework and web service standards.

- The second version gives a glimpse on the European Union research landscape in three interoperability-related research domains and outlines the basic research results. Furthermore, the European Union Legal Framework is reviewed in regards to interoperability-related issues.
- The third version focuses on the frameworks, methods and tools for Enterprise and Business Process Modelling and proposes recommendations and guidelines to enterprises and organisations on what they should do and what they should avoid regarding Enterprise Modelling.
- The fourth version offers practical guidelines for enterprises, public sector bodies and citizens in establishing and using interoperability services in their everyday communications and transactions.

1.3 Focus of the Current Version

Since the late '90s, the utilization of modern information and communications technologies has become an important issue in the public agenda. eGovernment services do not merely replicate existing paper-based systems as a matter of convenience, but improve radically the way public organizations work with their customers, be they citizens, enterprises or other administrations, in order to provide improved, effective and cost-efficient solutions [2].

However, the main concern of e-Government initiatives in several countries has focused on the vertical integration of the public sector in order to provide services online through many small-scale projects not being based on any interoperability standards, which has resulted in the information and services being provided not being easily accessible by, or compatible to, information systems, technologies or business processes in other public-sector organizations, or even other offices within the same organization [27].

To rectify this issue, the concept of the e-Government Interoperability Framework has emerged, a strategic document containing guidelines, specifications and standards to be applied in national and local level, in order to ensure interoperability among public administrations and their beneficiaries, and allow for the deployment of joined-up information systems and the provision of one-stop, fully electronic services to citizens and businesses. Furthermore, the issue of interoperability standards has gained a broader scope for international cooperation, in order to help create the infrastructures necessary to solve cross-border problems such as drug trafficking, environmental pollution, money laundering and illegal arms trade [23] or deliver e-Government services to citizens and businesses across a region, as in the case of the European Interoperability Framework [12].

The current fifth version of the Interoperability Guide is addressed primarily to ICT executives within the Public Sector, as well as policy and decision makers in government, in order to provide a set of recommendations for the design and maintenance of e-Government Interoperability Frameworks. This document is intended to function as a practical guide for countries embarking to establish their own national interoperability standards, as well as for countries that want to extend their e-GIF in order to provide a thorough set of specifications. In this context, the present document provides guidelines for the development and maintenance processes, analyses the

contents an e-GIF is expected to consist of and, finally, proposes the establishment of a central agency responsible for maintaining and updating the e-GIF.

1.4 Structure of the Document

This version of the Interoperability Guide is structured as follows:

Chapter 1 explains the scope of the G.I.C. Interoperability Guide and presents the structure of the present document.

Chapter 2 explains the necessity for an e-Government Interoperability Framework and its role within the context of public ICT infrastructure and e-Government services. Furthermore, this chapter provides guidelines and directions for the development process and outlines the underlying principles which guide such a process.

Chapter 3 goes into detail on the contents of the e-GIF. The individual components an e-GIF is expected to consist of are analysed and practical guidelines are provided to assist in their development.

Chapter 4 identifies the stakeholders involved in the management, maintenance and application of the e-GIF and their respective roles. This chapter focuses on the establishment of a central e-GIF Management Authority and details its competences and proposed organisational structure.

Chapter 5 concludes this Guide with final remarks and recommendations on the material and information reported in the previous chapters.

2 e-Government Interoperability Frameworks

2.1 Rationale

Nowadays, the importance of modernizing and innovating the public sector is more and more stressed with arguments like “e-Government is a catalyst for change in organization, work processes, mindsets and for innovation” [1] and “e-Government is the key to unlocking potential in the public sector” [2]. Public administrations are striving to leverage modern information and communications technologies to improve the quality of their services to citizens and businesses [3,4], to provide multiple communication channels, and to make their internal and cross-organization operations more efficient [5], even if this requires changing their modus operandi [6]. The e-Government era implies fundamental knowledge redistribution and requires a careful rethinking of the management of information resources and knowledge bases. Ample access to remote information and knowledge resources is needed in order to facilitate:

- Citizen- and business- oriented service delivery including one-stop service provision.
- Inter-organizational co-operation among governmental agencies.
- Cross-border support for complex administrative decision making.
- Limiting the loss of critical knowledge assets during the life cycle of e-Government services.

Since the late 90s, most countries have released their eGovernment strategies defining their milestones and action plans and have thereafter made significant progress on eGovernment at all levels of public administration [7]. Until recently though, the main concern of e-Government initiatives in several countries has focused on the vertical integration of the public sector in order to provide services online through many small-scale projects not being based on any interoperability standards, which has resulted in the information and services being provided not being easily accessible by, or compatible to, information systems, technologies or business processes in other public-sector organizations, or even other offices within the same organization.

Yet, fully integrated, both vertically and horizontally, one-stop, electronic services are rapidly becoming a necessity and the main issues that arise in this case are the complexity, the multiplicity and the diversity of public organizations’ information systems that demand a high degree of interoperability either between the new or the legacy systems involved. In fact, the lack of interoperability appears as the most long lasting and challenging problem for governmental organizations which has emerged from the proprietary development or extension of heterogeneous hardware and software platforms and the unavailability of standards. It has become apparent that the absence of common technological standards and interoperability guidelines yields considerable leeway to governmental authorities and lets them be focused on their own requirements and define inflexible information systems according to their own assumptions and interpretations [8].

Thus, interoperability has become a key issue in the agenda of the public sector [9] since providing one-stop services calls for collaboration within and across public authorities, while i2010 [2,9] explicitly addresses interoperability as one of the four main challenges

for the creation of a single European information space and as an essential prerequisite for ICT-enabled public services. In fact, the achievement of pan-European, cross-border interoperability appears as a key element and prerequisite of all the EU's ambitious e-Government initiatives: many of the elements of the EU's main policy objectives in the coming years are anticipated to be characterized as having a high degree of dependency on achieving interoperability, and of commanding high priority because of the high-profile nature of the work involved, the potential impact on citizens and businesses, and the extremely short timescales involved.

Interoperability is defined as *“the ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together”* [10]. Interoperability means the ability of information and communication technology (ICT) systems and of the business processes they support to exchange data and to enable the sharing of information and knowledge [11]. Through the years, however, interoperability tends to obtain a broader, all-inclusive scope of a repetitive, well organized, and automated at ICT level feature of organizations, as indicated in the definition of the draft EIF 2.0 [12]: *“Interoperability is the ability of disparate and diverse organizations to interact towards mutually beneficial and agreed common goals, involving the sharing of information and knowledge between the organizations via the business processes they support, by means of the exchange of data between their respective information and communication technology (ICT) systems”* and the Enterprise Interoperability Research Roadmap [13] notes that *“Interoperability is a utility-like capability that enterprises can invoke on the fly in support of their business activities”*.

Achieving interoperability requires resolution at various distinct interoperability levels as argued by [11,12,14,15,16,3]; it embraces cultural, legal, process-alignment, semantic and technological issues and necessitates agreements on common ontology, formats, content and system interfaces [17]. Therefore, the following aspects of interoperability should be considered [28]:

- **Technical interoperability** entails addressing the technical issues (hardware, software, telecommunications) involved in interconnecting computer systems and services, including key elements such as open interfaces, interconnection services, integration of data and middleware, presentation and exchange of data, accessibility and security services.
- **Semantic interoperability** ensures that the precise meaning of information that is exchanged is unambiguously communicated in all of the applications involved in a given transaction, and that systems are able to combine information received from other information sources and process it properly.
- **Organisational interoperability** entails defining business objectives, modelling processes, and facilitating collaboration among organizations wishing to exchange information, even when their organizational structures and internal processes differ. In addition, it means addressing the requirements of the user community and defining the services that need to be made available and made easily identifiable, accessible and user-friendly.

In this context, e-Government Interoperability Frameworks (eGIFs) pose today as the governmental policy cornerstones for the resolution of interoperability issues in the

public sector, the deployment of joined-up information systems and the provision of one-stop, fully electronic services to citizens and businesses. Such interoperability frameworks aim at outlining the essential prerequisites for joined-up and web-enabled e-Government Services, covering their definition and deployment over thousands of front-office and back-office systems in an ever extending set of public administration organizations [18,19]. They further provide the necessary methodological support to an increasing number of projects related to the interoperability of information systems in order to better manage their complexity and risk and ensure that they deliver the promised added value [20,21].

2.2 Target Audience and Objectives

E-Government Interoperability Frameworks appear as the instruments for a common approach to interoperability for organizations wishing to interact with each other. They specify a common vocabulary, concepts, principles, policies, guidelines, recommendations and practices and form the basis for the assessment and selection of standards and technical specifications [12]. The intended audience of an e-GIF includes:

- **High-ranking Executives of the Public Administrations and the Private Sector**, who are responsible for defining the strategy, the fundamental principles and the directions to be adopted for efficient e-Government service delivery to businesses, citizens and other public authorities.
- **Business Executives within the Public Administrations**, who manage and optimize the administrative processes, as well as other organizational and operational issues, relevant to the allocation of roles and responsibilities for the support of e-government services' provision.
- **ICT Executives within the Public Administrations**, who are responsible for designing, developing and monitoring e-Government portals and information systems.
- **ICT companies**, such as e-government project contractors, software vendors, ICT service providers and ICT consultants.

The expected **benefits** from the exploitation of the eGIF guidelines for each of the stakeholders' categories are:

- **For Public Administration**
 - Help Public bodies to overcome their introvert character.
 - Achieve a high level of homogenization, as regards the ergonomic and functional aspects, of e-government portals.
 - Reduce bureaucracy and utilize reliable channels for the delivery of e-government services.
 - Promote the interoperability between Public Bodies on a legal, organizational, operational and technical aspect for the provision of integrated e-government services.
 - Reduce the development cost of Public Administration Information Systems through the reuse of software components and the exploitation of existing e-governments services

- **For the end users of Government Services**
 - Improve satisfaction by offering high quality government services and by reducing the expected service delivery time.
 - Enable access to e-government services through multiple channels.
 - Allow easier search and retrieval of information for e-government services.
 - Enhance citizen trust by providing high level of quality, reliability, credibility, and transparency, when using e-government services.
- **For the ICT Companies**
 - Assist the development of standards-compliant products, services and applications.
 - Promote the reuse of common code lists, vocabularies, Process Models and data schemas, resulting in better quality and lower cost products and services.
 - Promote the standardization of Calls for Tender requirements, for the development of Public Administration information systems.

2.3 e-GIF Development Principles

The development of an e-GIF is a lengthy process that can draw experience from other countries that have already established a national Interoperability Framework, as well as experience from the industry in enterprise application interoperability [23] and business-to-business integration. International standards and common practices in interoperability have emerged that may function as guidelines to the design and implementation of an interoperability framework in the public sector.

Based on UNDP's review of seven e-Government Interoperability Frameworks [22] and the principles set by the European Interoperability Framework, v2.0 [12], the following underlying principles are commonly acknowledged to guide the development and maintenance of an e-GIF:

- **Interoperability.** The primary purpose of a national Interoperability Framework is the guarantee of a consistent flow of information between citizens, businesses and the public sector. To this end, the e-GIF focuses on the provision of clearly defined standards and specifications that constitute a common basis for data exchange, information sharing and interconnectivity between a wide, diverse range of systems and processes, thus eliminating the need to rely on a specific hardware and software infrastructure.
- **Scalability.** The specifications set by the e-GIF should be able to scale and adapt to fluctuating demand for eGovernment services, as the implementation of new eGovernment services may lead to an increasing number of supported users and transactions.
- **Maintainability.** The e-GIF is not a static set of specifications. Requirements may change as new technologies and standards emerge, while older technologies become obsolete. Furthermore, practical issues may arise when implementing

interoperable services. Therefore, procedures should be set that allow the e-GIF to be revised, so as to correct defects and meet new requirements, with consideration to the effects on existing services.

- **Reusability.** The e-GIF should augment the ability of public administrators to share and benefit from reusable service components and data structures. Re-use is a key issue in interoperability, as it enhances a culture of collaboration and information sharing in the public sector. Furthermore, reusable components provide cost-effective solutions.
- **Openness.** Interoperability involves the sharing of information and knowledge between organisations, hence a certain degree of openness is implied. The selected specifications and standards should be well documented and available to the public at large. Adopting open standards plays an important role in this regard, as they fill the requirement for open accessibility to read and implement. Furthermore, open standards create a fair, competitive market by being vendor-neutral and reducing barriers to market entry.
- **Market Support.** Selecting specifications and standards that are widely adopted by the market reduces the cost and risk of government information systems.
- **Security.** The e-GIF should establish a security policy that ensures the reliable exchange of information. Adoption of eGovernment services is highly reliant on establishing an environment of trust with citizens and businesses.
- **Privacy.** While the goal of an e-GIF is effective information sharing, there may be limits imposed by privacy laws and data protection acts which should be respected. The e-GIF should establish the appropriate policies regarding information exchange, so as to assure that eGovernment services preserve the fundamental rights and privacy of citizens and businesses. Appropriate information regarding the use of personal data should be made available to the individuals concerned.
- **Accessibility.** eGovernment should create equal opportunities for all citizens and businesses through open, inclusive services that are publicly accessible without discrimination.
- **Transparency.** Citizens and businesses should be able to understand administrative processes. They should have the right to track administrative procedures that involve them, and have insight into the rationale behind decisions that could affect them. Furthermore, transparency allows citizens and businesses to actively contribute in the development and maintenance of the Interoperability Framework, by providing feedback and suggestions. To achieve transparency, the e-GIF should provide publicly accessible documentation (through the e-GIF website), implement mechanisms for dissemination and provide the tools for the submission and evaluation of public feedback.

As a final remark, it should be noted that the development of an e-GIF is an initiative that supports a wider-encompassing overall national e-Government and ICT development strategy and, therefore, needs to align its goals and policies accordingly within this context. Furthermore, the international environment should be taken under consideration, as international interoperability standards emerge. The European Union

has established the European Interoperability Framework [12] in order to define interoperability guidelines for cross-border services to citizens and businesses among Member States, while similar attempts for common interoperability standards have been initiated in Latin America [28]. Such initiatives are not just a source of information for commonly accepted practices, but may function as a guide in the development process, so as to account for future considerations regarding cross-border services and international cooperation.

2.4 E-GIF Development Process

The development of a new e-Government Interoperability Framework is a lengthy process that is expected to take 2-4 years and requires the active involvement of government agencies [22]. The establishment of the e-GIF Management Authority is proposed in order to lead the development and maintenance of the framework and act as the focal point for coordinating interoperability efforts throughout government. The e-GIF development process is comprised of the following steps:

Step 1: Requirements specification phase.

A governmental agency performs an initial study that identifies the needs and requirements an interoperability framework is expected to fulfil. The e-GIFs implemented in other countries, as well as the experience of the private sector in terms of interoperability, are reviewed and the expected contents of the e-GIF are outlined. Finally, the action plan and time table for the development of the e-GIF is devised.

Step 2: Establishment of the e-GIF Management Authority.

In this step, the e-GIF Management Authority is established, either as a governmental agency or a private contractor. According to UNDP [22], the e-GIF Management Authority is comprised of the GIF Secretariat, which oversees the operations, and the GIF Working Group is the technical body that works on the technical policies. The GIF Working Group may be comprised of experts from various government agencies or involve wider stakeholder participation, involving industry, research institutions, etc. Finally, the e-GIF Management Authority may use the service of Expert Groups which function as an advisory group or as an independent review committee. In complement to the guidelines and specifications for interoperability, the e-GIF Management Authority is responsible for the development of a dissemination strategy and compliance control procedures which aim to guarantee the successful application of the framework in the public sector.

The role, competences and organizational structure of the e-GIF Management Authority are detailed further in chapter 4.

Step 3: Framework development.

The development process follows an iterative approach where drafts of the framework are published for public consultation. This process of open public participation, which may include requests for proposal or public hearings, is essential to evaluate the impact and usability of the specifications to the various stakeholders. The e-GIF Management Authority should provide the relevant tools and encourage the active involvement of all government agencies.

Step 4: Approval and establishment of policy.

Once the framework has achieved sufficient maturity, the appropriate governmental authority (Ministry, Cabinet, etc.) performs a formal review and the e-GIF is recognised as an official standard for the public sector ICT infrastructure and e-Government services. Compliance with the e-GIF is either mandated by law or encouraged by providing incentives for the development of framework-compliant systems.

Step 5: Maintenance phase.

Finally, the role of the e-GIF Management Authority does not end with the initial release of the framework. The e-GIF specifications will inevitably change in order to ensure that the e-GIF remains up to date and is aligned to the requirements of all stakeholders and to the potential of new technology and market developments [31]. The e-GIF Management Authority owes to define and implement procedures that allow such revisions to take place, as is described in section 3.3.1. of the current Guide.

In the case of Greece, the development of the e-GIF was initiated by Information Society S.A., the government agency responsible for public ICT projects management under the supervision of the Greek Ministry of Interior. Information Society S.A. performed a study on the strategies deployed in other European countries in terms of interoperability and developed the proposal for the establishment of a national interoperability framework, which details the rationale for a new standard and its expected content and application.

The e-GIF Development Group was established through an open bidding process in March 2006 and originally consisted of members of the consortium Planet S.A., National Technical University of Athens and Athens Technology Centre S.A. Figure 1 shows the organizational structure, consisting of the Project Coordination Committee (the GIF Secretariat in the terms of UNDP) responsible for project coordination and the approval of new versions of the framework, and the Executive Team (i.e. the GIF Working Group) which functions as the technical body that works on standards selection and develops the content of the e-GIF.

The Executive Team consists of the Expert Group which supports all development activities in an advisory capacity; the e-Government Services Group responsible for defining the guidelines and specifications of the e-GIF; the XML Schemas and Metadata Design Group which defines the presentation form and semantics for data exchange; the Dissemination and Training Group responsible for the development of training and promotional material; the Coordination Group responsible for the coordination of the various Groups and involved government agencies.

The Greek e-GIF gradually reached sufficient maturity to gain official recognition as a formal standard in November 2008, with the release of the 3rd version of the Framework. Compliance has become mandatory by law for all public IT systems and services since 1/1/2009 and further maintenance of the specifications, as well as compliance monitoring, has become the responsibility of the Informatics Development Agency, which falls under the jurisdiction of the Greek Ministry of Interior.

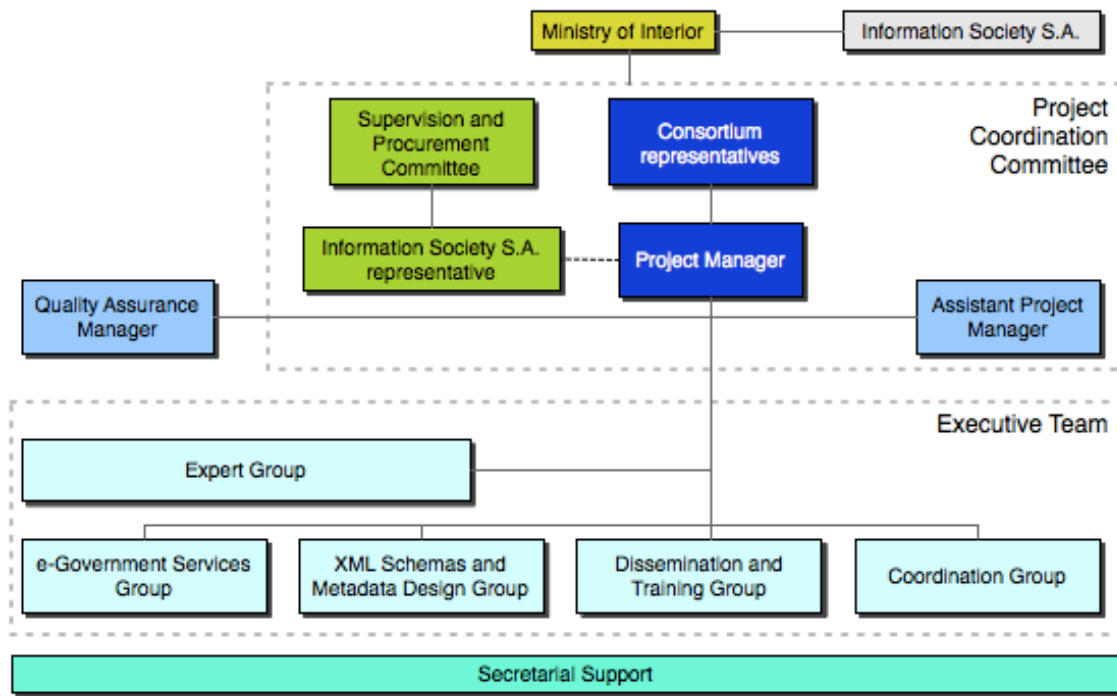


Figure 1: Organizational structure of the Greek e-GIF Management Authority

3 e-GIF Contents

According to the European Interoperability Framework [12], an Interoperability Framework describes the way in which organizations have agreed, or should agree, to interact with each other, and how standards should be used. In other words, it provides policies and guidelines that form the basis for selection of standards and may be contextualized (i.e. adapted) according to the socio-economic, political, cultural, linguistic, historical and geographical situation of its scope of applicability in a specific circumstance/situation (a constituency, a country, a set of countries, etc).

Typically, an e-GIF includes the following sections [22]:

- Context with definitions, aims, objectives, principles, background, audience, benefits and relationship with other initiatives.
- Technical content that mentions key technical policy statements, architectures, standards, standards categories, standards selection criteria and standards status.
- Development process that describes the development and revision process, actors and responsibilities, and mechanisms for consultation.
- Implementation that prescribes support tools, such as a dedicated website.
- Compliance regimes, such as interoperability indicators, responsibility for compliance, stakeholders, guide tools and noncompliance.

According to a more generic classification [18], the levels of analysis upon which national e-GIFs may be examined additionally extend over:

- The “*Standards & Specifications*” Level, which includes the paper-based specifications. It formulates the rules and directions for resolving organizational, semantic and technical interoperability issues, designing web portals and information systems, creating security and authentication mechanisms. It also states the data, technical, authentication, web portal and multi-channel access standards that will prevent vendor lock-in when procuring information technology (IT) infrastructure and will make integration of application and tools in the public sector easier.
- The “*Systems*” Level, consisting of:
 - Certification Tools for examining compliance with the Framework and providing specific guidelines for amendments when a certification of a public site or information system fails.
 - Repositories for storing services and processes models, XML Schemas and their Core Components, web services descriptions and system reference definitions (which include explicit definitions for systems and their topology).
 - Access and Collaboration Tools ensuring access to the distinct Repositories and providing the potential for bidirectional communication by seeking and retrieving the e-GIF specifications and posting change requests and comments.

- The “*Coordination*” *Level*, which mainly deals with winning ‘hearts and minds’. It includes theoretical and practical training of the public administration employees, marketing and dissemination plans for increasing awareness on the Framework, and coordination activities planning among the various stakeholders in order to ensure acceptance of the Framework.

Based on this classification, the rest of the chapter details the fundamental components an e-GIF is expected to consist of, in order to provide a thorough understanding of the role of the e-GIF and guide the development process.

3.1 Standards and Specifications Level

3.1.1 Public Administration Information Systems

An e-Government Interoperability Framework owes to define the basic principles and the general strategy to be followed by the public agencies, when developing e-Government information systems. In this context, the Framework provides legal, organizational and semantic interoperability guidelines, as well as the technical specifications and standards that should be used for the communication and the efficient exchange of information between e-government systems, aiming to the provision of integrated and interoperable e-government services. The e-GIF intends to:

- Resolve existing **interoperability** problems between underlying Public Information Systems, ensuring the smooth information flow between citizens, enterprises and the public sector.
- Adopt an **open philosophy** for implementing Public Information Systems, which consists of compliance with open technological standards and specifications for the design and implementation of public administration applications, systems and websites.
- Align the national ICT strategy with **international initiatives**, in order to ensure the provision of cross-border services. This is especially important for European countries who need to align with the European Interoperability Framework (EIF) and other EU initiatives, in order to deliver Pan-European e-Government Services (PEGS).

The guidelines for the design and implementation of public organizations’ information systems for the provision of electronic services towards citizens, enterprises and other organizations should take into account the following directions:

- **Transparency and Extroversion** through explicitly defined and well-documented interfaces, in order to provide easier integration with and access from other systems.
- **Reusability** as a key issue in achieving Public Systems’ Interoperability at its full spectrum
- **Flexibility** since Public Sector Information Systems have to allow for relatively simple and cost effective adaptation to new conditions and operational requirements, prioritising tasks that deal with the transaction volume, the response time and the service provision security.

- **Standards:** The design and implementation of Public Information Systems has to be based on widespread standards, in accordance with Interoperability Framework.
- **Scalability:** The services provided by a Public Information System might be required by a large amount of other Public Sector Organizations, therefore scalability and extensibility capabilities, through the hardware/ software addition/ upgrade, have to be provided, in order to accommodate for the increase of Data Transfer Requirements.
- **Performance and Response:** Public Information Systems have to be capable of minimising the response time for service requests, irrespective of the volume of data and complexity of processing required each operation.
- **User Friendliness:** Public Information Systems have to provide a user friendly interface for their services.
- **Availability:** Public Information Systems, which provide electronic services have to be always available and without any errors.
- **Fault Tolerance:** In case that software or hardware failures are presented, fast recovery and data integrity have to be ensured.
- **Maintenance and Updating:** Public Information Systems have to be designed and implemented bearing in mind that the use, maintenance and upgrade will be performed/ supervised by organizations/ individuals who were not involved in their implementation.
- **Security:** System reliability depends heavily on the data/ process security of the Public Information System.

Therefore, the technical standards to be adopted cover the following aspects of interoperability [22]:

- **Interconnection** – standards related to networks and system development, which layer enables communications between systems.
- **Data integration** – standards for the description of data that enables exchange between disparate systems.
- **Content management and metadata** – standards for retrieving and managing government information.
- **Information access and presentation** – presentation of data to the user in the various means of access to e-government services.
- **Business services** – standards to support data exchange in particular business areas such as e-learning, e-health, etc.
- **Web-based services** – standards to connect and integrate web-based applications over the Internet.

- **Security** – standards that ensure safe access and exchange of information in public services.

3.1.2 Public Administration Web sites and Portals

One of the main goals of an e-Government Interoperability Framework has to be the specification of the directions and standards to be followed by public agencies at central or local level, when designing, developing and deploying e-government portals and supporting e-government services.

Public websites and portals are traditionally the alternative entry point to the services and content provided by a public organization instead of visiting its premises. The information and service content provided in public web sites has to be correct, error and ambiguity free, full and constantly updated through predefined processes and by the appropriate roles and characterized by the smallest amount of limitations referring to the technological means by which the website can be accessed. A portal, run by a public organization has to cultivate a sense of trust between the organization and its users, using security policies for their registration, identification and authentication, ensuring privacy and publishing the terms of use of its content and services. More importantly, the funds spent for a public website have to reflect the expected benefits from its use, taking into account the speed by which the online services are provided, the quality and the simplification of the electronic service provision, the improvement of the organization's image and the extent by which the website interacts with back-office systems and information systems belonging to other organizations in the most cost-effective fashion.

In this context, an e-Government Interoperability Framework comes to contribute to the prospective homogenization (aesthetical and functional) of the Public Administration by identifying and addressing a set of barriers, erected not only by technology insufficiencies, but by the inability of public organizations to offer electronic services of appropriate quality and content as well, by enabling citizens and businesses to search and effectively utilize publicly available information, and efficiently supporting e-Government service provision through public web sites and portals. The directives, standards and specifications to be covered by an e-Government Interoperability Framework with regard to Public Administration web sites and portals can possibly be classified in the following categories:

- **Website Management.** This category includes guidelines on the organizational procedures for proper development and maintenance of public sites (Service Level Agreements – SLAs, risk management plans, advertisement policies, integration at presentation level with third party sites), as well as recommendations on the organizational schema of the website, the roles and responsibilities for managing its contents and overall function.
- **Website Structure.** Specifications and standards in this case touch upon the structure, categorization and presentation of the web site content based on multi-faceted classification schemes (e.g. life events and business episodes lists), in order to make it more accessible and user-friendly. Further individual axes of interest in this category include:

- **Domain Naming** setting out the rules and principles for registering and managing a governmental domain name, i.e. for determining the website's name, language, writing style and name size.
- **Ergonomics and Visual Style** providing recommendations on the colors and color combinations, text fonts, icons, links, writing styles, web pages' extent and size, content presentation and special presentation formats usage (such as multimedia content or attached documents) to be deployed in the context of a public web site.
- **Structure and Content** of the first and total pages in a website, specifying an indicative content structure with the necessary components, such as the organization logo and contact details, a search engine, a site map, browsing capabilities.
- **Accessibility**, promoting compliance with web content accessibility guidelines, as issued by relevant standardization initiatives.
- **Multiple websites**
- **Electronic Services and Interoperability** with back-office systems, encompassing standards and specifications that fall more specifically within the scope of the following categories:
 - **Electronic Services**, defining the necessary information to appear in a website as well as the requirements for electronic transactions progress monitoring and "offline" capabilities (i.e. printing and local storage).
 - **Added Value Services**, specifying the requirements for newsletters, forums and RSS feeds to be available to users through appropriate mechanisms.
 - **Interoperability**, listing the rules and standards for achieving the interoperation of a public website with the supporting back-office systems and other websites
- **Assessment of a Website's Content, Electronic Services and Functionality**, aiming at collecting and exploiting data from the site's everyday operation in order to enhance the services offered.
- **Security & Privacy**, including guidelines that touch upon security policies, access and authentication, propagation, storage, transaction integrity, system availability and performance, hosting to private sector organizations facilities and Service level Agreements (SLA) required terms.
- **Public Websites' Users**, providing recommendations on the users' categorization, corresponding rights and sign-up procedures.
- **Legal Issues**, setting the baseline for ensuring users' privacy protection and notification for the underlying legal framework that governs the website, such as privacy, copyright, terms of use and disclaimers.
- **Public Website Dissemination**, indicating an overall dissemination strategy to promote a public web site or portal that may extend from search engines' registration and links from relevant websites to further dissemination actions, such as workshops organization.

3.1.3 Documentation Model for Public Administration Processes and Services

Beside its former functionalities, an e-Government Interoperability Framework owes to define a Documentation Model that describes the notation, the rules and the specifications that must guide the design and implementation of process and data models. As figure 2 illustrates, the Documentation Model has to lay the naming and design rules and the configuration management procedures for processes and documents as well as the methodologies and procedures for designing and implementing web services. The target group of the Documentation Model includes, but is not restricted to, business modelers and analysts, business process reengineers, XML Schema designers and Web Services programmers for the public sector, as well as anyone else seeking modeling guidelines.

Through the adoption of the proposed standards, rules and guidelines, the purpose of the Documentation Model is to allow for:

- Understanding better the services provided by the public sector and the information exchanged in a common context.
- Maximizing information reuse (through the use of process and XML Schema components) in order to contribute to the resolution of organizational and semantic interoperability issues in the public sector.
- Homogenizing and harmonizing the process and data models for all public organizations.

The Documentation Model can be based on open specifications and modeling standards maintained by international standardization bodies, which have gained wide market support. For instance, in the case of the Greek e-GIF, process and data model design is

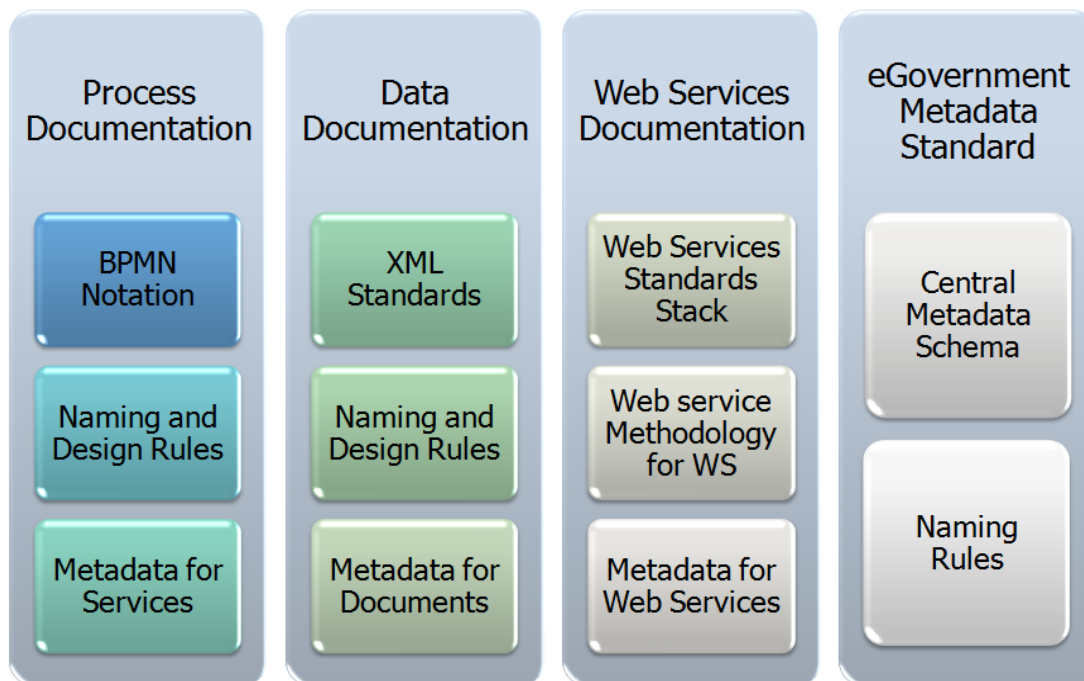


Figure 2: Documentation Model for Public Administration Processes and Services

based on BPMN and UML activity diagrams for processes, and XML Schemas and UN/CEFACT CCTS for documents and data. The Documentation Model of the Greek e-GIF lays the naming and design rules and the configuration management procedures, while it represents guidelines for performing a compatible customization of released XML Schemas to the requirements of specific public administrations, accompanied with suggestions on how to proceed when a compatible customization is not possible.

The Greek e-GIF proposes an e-Government Metadata Standard (GR eGMS) for describing any governmental web resource based on existing metadata standards, such as Dublin Core, MiReq, MoREG and e-Government Metadata Standards in the UK, Australia and New Zealand. Furthermore, the eGMS has been extended in order to cover the specific requirements for describing conventional and electronic services and the document fields appearing in a document. The metadata for XML Schemas, Core Components and Data Types adopted by the UN/CEFACT CCTS have been customized and incorporated to the Documentation Model, accompanied with a metadata set for code lists.

The main principles defined by the Documentation Model that should guide the implementation of a Public Information System can be summarized as follows:

- *Every service provided by a public organization has to be typically documented and modelled.* The service metadata and the models that emerge have to be published in an Interoperability Registry, as described in section 3.2.1., so as to allow their use to recognize the interoperability points between different organizations.
- *Every document exchanged within the provision of a service must be as well analyzed and modeled in an XML Schema.*
- *Every web resource, such as web site or electronic document, has to be published.*
- *Every web service, which allows for the electronic communication between organizations on the interoperability points already defined, must comply with the standards and the methodology set by the e-GIF.* The WSDL file that defines the Web Service functionality has to be published in the Interoperability Registry Prototype together with the service metadata and model to which context it belongs, as well as the XML Schemas for the data or the documents that are being exchanged during the service provision, in order to facilitate the reuse of the web service by organizations.

More details on the frameworks, methods and tools for Business Process Modeling can be found in the 3rd version of the Interoperability Guide.

3.1.4 Digital Authentication

To date, the electronic services provided by the majority of public organizations in most countries apply usernames and passwords as their preferred method for identifying and authenticating their users. This method however, often does not take into account the critical importance of certain services with regard to the possible consequences of a security breach and questions the suitability and reliability of the equivalent registration and identification procedures. Yet, the more critical the consequences from an

unauthorized access or transformation of data for an electronic service are, the stronger the authentication mechanisms that should be deployed.

The purpose of an e-Government Interoperability Framework with regard to digital authentication is to support public organizations that provide e-government services to choose the most appropriate authentication mechanisms and to define the necessary procedures for the registration and identification of their users, and thus promote a safe and trustworthy environment for efficient online public service provision.

Within the frame of developing a national e-Government Interoperability Framework it is strongly recommended that firstly a review of the current legal framework for the protection of privacy and personal sensitive information and of the underlying authentication methods and infrastructures of the country is conducted in order to recognize the registration, identification and authentication requirements as well as the threats associated with each service under consideration, and to perform a relevant risk and privacy impact assessment. The main aspects to be covered then by the e-Government Interoperability Framework through appropriate rules and specifications include:

- The **Categorization of personal data** in compliance with the country's data protection legislation as well as the European Data Protection Framework Directive. Personal data to be processed by an electronic service are to be indicatively classified as "Simple", "Sensitive" or "Economic" on the basis of whether they relate directly to an individual or pertain to the racial or ethnic origin, political opinions, etc. or disclose financial data.
- The definition of a series of "**Levels of Trust**" for electronic services, conceived as the levels of confidence in end-user's electronic identity along with the assurance that the security measures and procedures deployed to safeguard the access, processing and transmission of data are adequate.
- The correlation between each "Level of Trust" with an appropriate "**Level of Authentication**" that specifies the appropriate authentication mechanisms and systems, i.e. username / password, soft or hard certificates that are to be utilized.
- The correlation between the combination of the "Level of trust" and the "Level of Authentication" with a suitable "**Registration Process**" for the service users depending on the required identity assurance.
- The definition of a unified architecture providing the required level of security and trust for successfully completing a specific transaction.

Provided that such specifications are available, public organizations that design and develop electronic services can then potentially:

- Determine the "**Level of Trust**" in which their service belongs, upon precisely defining the categories of data that are exchanged during the service provision.
- Select the appropriate **Authentication Mechanism** based on the identified "Level of Trust".
- Adopt the necessary **User Registration Processes** on the basis of the identified "Levels of Trust and Authentication".
- Develop the complete service architecture.

Further aspects to be dealt with within the e-Government Interoperability Framework involve the development of coherent policies for digital certificates and Public Key Infrastructures.

3.1.5 Levels of maturity for rules and standards

In a fundamental level, the e-GIF consists of rules and guidelines, which set the requirements for interoperability and define the policies public organisations should adopt for framework compliance, as well as a collection of organisational and technical standards that specify how interoperability is implemented.

While rules and guidelines set policies which must be applied to the whole spectrum of the public sector, the e-GIF should account for practical issues which may arise due to the heterogeneity in requirements among public services. Furthermore, as detailed in section 3.3.1., the e-GIF is subject to revisions in order to adapt to changes in the technological environment and adjust to new e-Government requirements and initiatives. Therefore, the rules and guidelines set by the e-GIF adhere to the following classification scheme, based on the expected level of compliance:

- **Obligatory:** rules and guidelines are classified as obligatory when compliance is an absolute requirement of the specifications.
- **Recommended:** rules and guidelines which are mandatory and expected to be followed, however there may exist valid reasons in particular circumstances where their application is unsuitable or problematic. Recommended rules can be ignored, as long as a valid and well documented justification for such an action is provided.
- **Under Consideration:** rules and guidelines which are under review and may appear in future versions of the framework. While there is no expectation for compliance, they may serve as an orientation aid when no competing mandatory or recommended rules exist.

Standards selection follows a similar approach which allows the e-GIF to be flexible in adapting to changes in the market, through an ongoing process of standards re-evaluation. Generally, standards follow a lifecycle of emergence to obsolescence, as new standards are developed and gain wide market support and use, while at the same time older standards are deprecated for better, more effective solutions. UNDP [22] divides the lifecycle of standards within the context of interoperability frameworks in three phases: *emerging standards*, which have the potential to be adopted and are under development or evaluation; *current standards*, which have been formally approved and adopted; *fading standards*, which have become obsolete and abandoned for better solutions.

The case of Germany's interoperability framework, SAGA [26], serves as a good illustration on how standards are classified in a way which reflects both their maturity for application and their lifecycle. In regards to their maturity and market value, standards are divided as follows:

- **Mandatory:** Standards which have proven their value on the market and are considered the preferred solution. These standards do not necessarily have to be used in every e-government project, as the diversity of technological and

functional requirements prohibits the universal application of a single standard. However, they should be observed and applied with priority.

- **Recommended:** Tried-and-tested standards with market support that can be considered as alternatives in cases where no mandatory standards are applicable.
- **Under observation:** Emerging standards that have not yet proven their value on the market or are not mature enough to be classified as mandatory or recommended. Although not preferred, these standards can be considered as valid solutions when no mandatory or recommended standards apply.

While the classification above assists public organisations in the selection of technical standards, an extended classification was specified for a complete representation of the life cycle of standards. The lifecycle of a standard within the SAGA framework is illustrated in figure 3. The extended classification introduces the following three maturity lists, which facilitate the process of evaluation of new standards and determine how fading standards should be handled:

- **List of Suggestions:** Standards that have been submitted for inclusion and are currently under review for classification.
- **Right of Continuance List:** Standards that used to be classified as recommended or mandatory but have been deprecated in the current version of the framework. However, due to their widespread market support in the past, they may still be maintained in effect and used further.
- **Black List:** Standards that have been rejected or have become obsolete and should no longer be used.

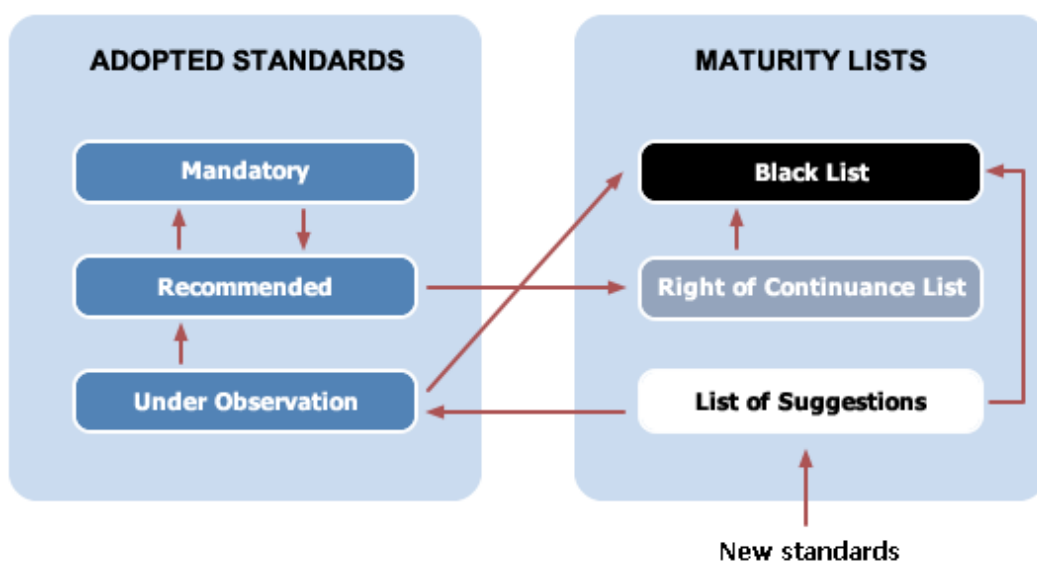


Figure 3: SAGA Standards lifecycle

3.2 Systems and Tools Level

3.2.1 Interoperability Registries

The Interoperability Registry is a web-based repository of service and document metadata, services process models in BPMN and standardised XML schemas for government documents, as well as codelists for the most common information elements within governmental service provision. The Interoperability Registry can enhance the delivery and access to governmental knowledge, information and services to the public and other governmental agencies, and improve the effectiveness, efficiency and service quality to governmental operations. The intent of the Interoperability Registry is to provide a methodological process modelling framework for e-government services via an ontology-based intelligent web information system with simple procedures in data entry and management. Furthermore, it enables different user groups to be aware of the public sector administration and services provision through a wide range of statistical reports.

In this context, the architecture of the Interoperability Registry consists of three layers:

- The **Front-end Platform Components Layer** which includes:
 - The Interoperability Framework Web site, which publishes the various documents of the eGovernment Framework and provides citizens and businesses with publicly available data.
 - The Services Registry, accessible to authorised users, which gives access to metadata management, process and data modelling tools.
 - The registry UDDI interface where administrators can publish their web services or locate existing web services which can interact with their information systems, thus constructing truly interoperable, one-stop services.
- The **Tools Layer** incorporates the Process Modelling facilities, XML management facilities and the ontology management, data entry and reporting tools that integrate all representations and models.
- The **Data Storage Layer** incorporates the ontology instances as eGovernment elements, Web Service descriptions, the process model and the XML schema.

As an example, the architecture of the Greek e-GIF's Interoperability Registry is illustrated in figure 4, integrated through a relational database engine and common access control and application engine integrating the tools level with the various interfaces.

Furthermore, the Registry should provide statistical reports, as well as allow users to produce several types of reports through simplified forms or advanced query combinations. The Registry should provide four types of reports:

- **Main Elements Reports:** simple or advanced reports related to the main elements of the Registry, representing requested properties, relations, etc.

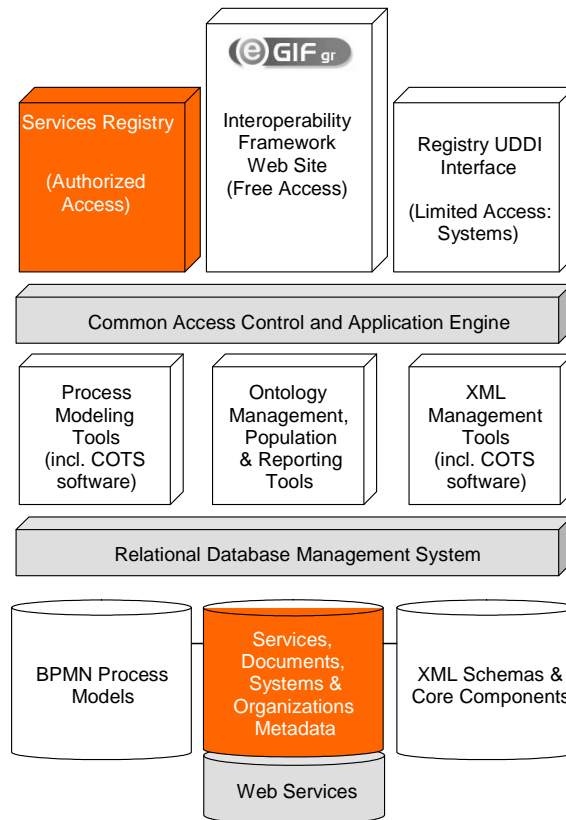


Figure 4: Greek e-GIF Interoperability Registry architecture

- Integrity Control Reports: a specific type of reports which inform about the integrity and completeness of data, relations and constraints stored and represented in the Registry.
- Sophisticated Reports: complex reports representing indirectly derived results and statistical information crucial to data utilisation and the development and improvement of public sector services.
- Attached Elements Reports: reports accumulating and presenting separately the attached files in the services, documents and web services.

3.2.2 XML Schemas Libraries

The e-GIF owes to define a common basis for data exchange and, to this end, the eXtensible Markup Language (XML) [34] has been an integral part of e-GIFs internationally and is widely recognised as a key technology for the exchange of data between heterogenous hardware and software platforms, in a way that enables the description of the meaning and structure of the underlying data.

However, while a common language such as XML for data description fulfills the requirements of technical interoperability, XML does not, and cannot by itself, guarantee or deliver semantic interoperability without the establishment of uniform presentation form and semantics for the elements of the XML files being exchanged [26]. In order to facilitate semantic information retrieval, the Web Ontology Language (OWL) and RDF Schemas provide XML-based notation to describe concepts related to the content of resources and relationships between the concepts [35].

In order to enable technical and semantic interoperability, the **XML Schemas Library** functions as a central, publicly accessible repository of XML Schema Definitions and related artifacts (metadata, ontologies, etc.), which ensures that all data elements are presented and interpreted in a uniform manner, in order to make it possible to integrate services that were developed with different vocabularies and with different perspectives on the data [11]. Furthermore, the e-GIF should provide the business process and data modelling methodology that standardises and harmonizes governmental documents, which can rely on XML-based open standards such as the ebXML Business Process modelling approach [35]. Such a methodology needs to follow a long-term perspective, encourage creation, dissemination and reuse of existing components and schemas and ensure a proper evolution path and the reuse of internationally accepted standards. In summary, the e-GIF owes to achieve the following goals:

- Create a repository for semantics in terms of common data dictionaries and core components for the commonly used and service-independent structures, such as Address, Person and Organization.
- Develop semantically enriched XML-based Governmental Documents to be issued and exchanged electronically. The modelling process can either be the responsibility of a central agency such as the e-GIF Management Authority, as was the case in Greece, or developed by the individual public organisations and ICT contractors, as is the case in Hong Kong.
- Issue guidelines for performing a compatible customization of the released XML Schemas to the specific public organization requirements, together with suggestions for how to proceed when a compatible customization is not possible.

As an example, the Hong Kong Special Administrative Region Government (HKSARG) Interoperability Framework [29] provides Common Schemas for reusable components (addresses, personal info, etc.) which are centrally standardized in the government and shared publicly in the Central Registry, as well as the XML Schema Design Guide which provides analysts and developers with an end-to-end and seamlessly integrated schema design methodology consisting of four core sections [30]:

- A. The **Schema Design Process** guides a project team to develop the XML data interface, i.e. XSD, for a government system to exchange data with other government or business systems. If the project team anticipates some data elements in the developed schema are generic enough for reuse by other projects and public organisations in the future, they can propose these data elements for central standardization as Common Schemas.
- B. The **Business Process Modelling Methodology** sets a common specification for the understanding and modelling of business processes, with the primary intent to identify the document flow between different parties.
- C. The **Business Information Modelling Process** gathers the requirements for the business documents identified in the business process modelling.
- D. The **XML Schema Definition Development** provides a comprehensive specification to standardize the conversion from an information model into XML Schema Definitions. This standardization allows the XSD generation to be automated by software.

3.2.3 Access and collaboration tools

Collaboration tools aim to ensure access to the distinct repositories and provide the potential for bi-directional communication by seeking and retrieving the eGIF specifications and posting change requests and comments. Collaboration improves the effectiveness of public administrations by encouraging the exchange and reuse of data, as well as encouraging feedback to keep the e-GIF current and relevant to the actual needs of the public sector.

To this end, for instance, Denmark has taken a collaborative approach to the development of the various XML schemas and related technologies for data exchange. InfoStructureBase [36] has been developed as a collaborative tool that allows public institutions to find out what data exists in public databases and how they can be accessed [37]. Furthermore, ISB facilitates the open involvement of both public and private experts in the development process and allows open use for all, both public and private, as well as Danish and non-Danish users [36]. The aim is to ensure that this aspect of the Danish National Enterprise Architecture reflects the real-world operating environment of the organisations that implement it. It also provides a good opportunity for the development and exchange of knowledge and expertise in this area of e-government [37].

As a representative case of the common tools a National Interoperability Frameworks offer, figure 5 illustrates the components which constitute the collaboration tools for the Greek e-Government Interoperability Framework [27]:

1. **The eGIF Website:** A web platform functions as a centralised source of information, where the various documents of the eGovernment Framework are published, and provide access to collaboration services.
2. **The eGIF Collaboration Platform:** A web platform which is accessible through the eGIF Website for navigating through the process models, searching through the catalogues for Core Components, XML Schemas, proposals for Schemas and Process Models that satisfy the given criteria and for posting change requests.

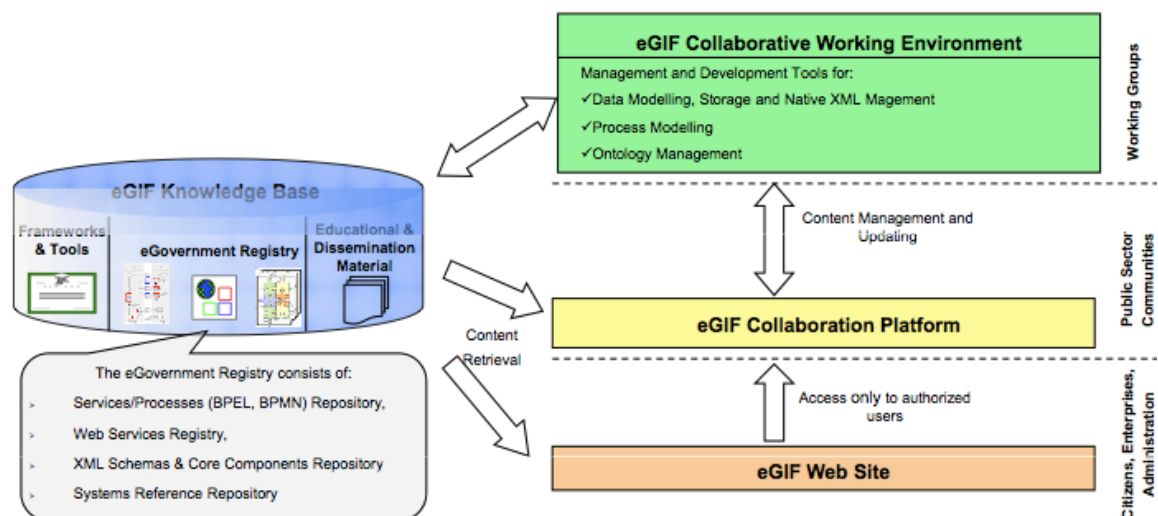


Figure 5: Access and collaboration tools

3. **A Collaborative Working Environment:** A platform that consists of tools for Data Modelling and Management, Process Modelling and Ontology Management and each member of the Working Groups is given access to these tools according to the access rights designated to them.
4. **The eGIF Knowledge Base:** An integrated knowledge space that unifies different perspectives and interpretations of knowledge resources. The Knowledge Base consists of the Frameworks Repository, which contains the Certification Framework for Public Sites and Portals (CFPSP), the Interoperability and Services Framework (ISP), the Digital Authentication Framework (DAF) and the Interoperability Standards Documentation (ISD) in various versions. It also consists of the eGIF Interoperability Registry Platform, which contains the (a) UDDI (Universal Description, Discovery and Integration) Registry with files describing the fundamental web services, the (b) tools layer, containing the Process Repository, with the workflow models and a populated taxonomy of the services and the (c) Information Repository with interconnected Data Elements, Process Models, XML Schemas and Web Service descriptions, at the core of the Registry. Finally, the eGIF Knowledge Base consists of the Educational and Dissemination Material Repository, which contains presentations, SCORM-based e-Learning material and dissemination material.

3.3 Coordination Level

3.3.1 e-GIF Maintenance Procedures

Achievement of interoperability cannot be expected to occur in a single step, but is rather an iterative process that leads to greater levels of maturity. During the development of interoperable services and processes, practical issues and difficulties may arise that require corrections in the specifications and standards set by the e-GIF. Furthermore, the e-GIF must remain relevant to the technological environment, as new technologies and standards emerge and are adopted by the industry, as well as adapt to changes in national eGovernment and ICT development strategy or organisational changes that affect the operation of public institutions. Therefore, a maintenance procedure should be established that allows the e-GIF to evolve and adapt to changing circumstances, through new releases of the framework.

However, constant changes to the framework introduce a heavy burden in public administrators, as updating public information systems to adopt new standards and specifications is a gradual, time-consuming process. This fact dictates limits on the frequency that revisions to the e-GIF may take place, so as to guarantee that public administrators have sufficient time to implement and comply with new versions of the framework. A steady release lifecycle and proper documentation greatly assist in this task. Figure 6 illustrates the maintenance process for UK's e-GIF which follows an annual review that determines the need for an update [31].

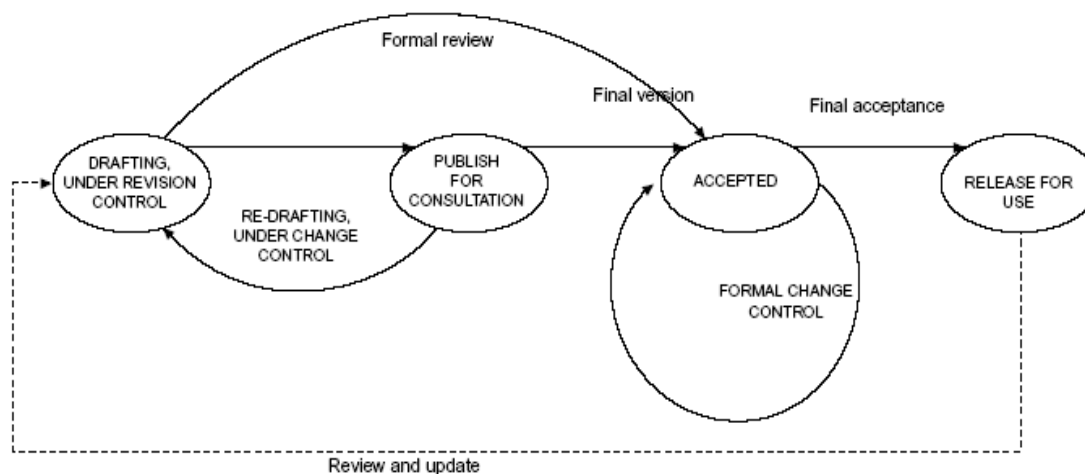


Figure 6: UK e-GIF Change Management

Releasing a new version of the e-GIF generally involves the following steps:

- The e-GIF Management Authority evaluates new strategic plans in eGovernment and governmental policies, the emergence of new standards and technologies, the extent and priority of previously submitted and approved proposals, as well as any reported issues with the implementation of the current version of the Framework, and determines the contents of the revision.
- A release schedule is determined and stakeholders are informed about the revision process and the forthcoming changes, in order to assist in their evaluation and take preliminary steps for their adoption.
- Stakeholders participate in the process, by commenting on suggested revisions, as well as submitting their own proposals. The received feedback is evaluated and proposals may either be approved for inclusion in the current revision, be put on hold to be considered for inclusion in later revisions, or be rejected for lack of proper documentation or validity.
- Submission and evaluation of proposals freezes and the contents of the revision are finalised.
- The new version is published and actions for the dissemination of the new version are implemented.

Each new version of the framework should be accompanied by documentation of all changes, as well as guidelines and action plans on the transition to the new version, and the timeframe in which public administrations should comply with the new release.

3.3.2 e-GIF Training Material

The successful application of an e-Government Interoperability Framework in the full spectrum of the public sector is reliant on the provision of knowledge in the design and implementation of interoperable information systems and processes, as well as on the cultivation of the appropriate culture that facilitates the collaboration and seamless exchange of information across public authorities.

The e-GIF should play a crucial role in this regard, by specifying a formal approach to the education and training of government personnel, which aims to guarantee the effective use of training resources, the educational and scientific validity of the training material, the utilisation of modern educational methods and the adaptation of the training material to the characteristics and needs of the target audience.

In order to cover the entire spectrum of the public sector and accommodate the fast dissemination of information, training should be provided to public employees and officials who have the ability and means to undertake the role of instructors themselves within their respective organisation or sector. Trainees can be divided in three categories, each with a distinct perspective and role in eGovernment services:

- **Public Servants specialised in Information Science**, who need to be informed on the technical specifications set by the Framework, the means by which the organisational structure and application of Public Information Systems is affected and the method by which the eGIF is applied.
- **Administrative Employees** who require familiarisation with eGovernment and Interoperability principles for operating Public Sector processes.
- **High Ranking Public Officials** with decision making roles, in order to realise the necessity to adopt the rules defined by the Framework, so as to improve the organisational structure of the Public Sector processes.

The education scheme should take into account that interoperability requires a broad spectrum of knowledge in eGovernment, information systems and security. The training material should cover the following subjects:

1. e-Government services.
2. Project Management, focusing on public sector IT projects.
3. Interoperability in e-Government and electronic transactions.
4. Information Systems Security, Web Services Security and Digital Authentication.
5. Documentation models, data schemas and interoperability registries.
6. Compliance tools and certification.

3.3.3 e-GIF Dissemination Mechanisms

A dissemination strategy refers to the planning, coordination and implementation of activities that aim to increase awareness of the project and help stakeholders understand the purpose of an e-GIF within the context of eGovernment services, as well as understand the benefits that emanate from its application. Dissemination is an important tool for the adoption of the e-GIF in the public sector and assists in generating interest in the active participation and involvement of stakeholders in the development process. Furthermore, as explained in section 3.3.1., the e-GIF is subject to revisions that involve community feedback and participation, and require public administrations to comply to new specifications and standards. Therefore, a need arises for regular communication and coordination between the e-GIF Management Authority and stakeholders, as the

latter should be kept informed on changes or new initiatives concerning governmental ICT infrastructure and services.

Dissemination should start in the early steps of development, in order to maximise visibility and impact, encourage active participation of stakeholders and utilize the skills and resources of research institutions and private ICT companies who may be interested to get involved in the development process. Early awareness of the project will allow public administrations to take preliminary steps towards the adoption of the framework and adjust their plans for eGovernment service delivery.

The dissemination material is addressed to all stakeholders involved in the development and support of eGovernment services. Specifically, the following target groups are connected to the application of the framework:

- **High-ranking Executives of the Public Administrations and the Private Sector**, who are responsible for defining the strategy, the fundamental principles and the directions to be adopted for efficient e-Government service delivery to businesses, citizens and other public authorities.
- **Business Executives within the Public Administrations**, who manage and optimize the administrative processes, as well as other organizational and operational issues, relevant to the allocation of roles and responsibilities for the support of e-government services' provision.
- **ICT Executives within the Public Administrations**, who are responsible for designing, developing and monitoring e-Government portals and information systems.
- **ICT companies**, such as e-government project contractors, software vendors, ICT service providers and ICT consultants.

To keep stakeholders interested and involved, it is important that they are not overwhelmed with information they are not necessarily interested in, therefore focus should not be placed on the quantity of promotional material. Instead, the dissemination plan should aim to customise the promotional material to the needs and perspective of each target group. To this end, utilising multiple channels of dissemination allows for better and more specific approach to each target group, while maximising visibility and awareness. A dissemination plan involves the following channels:

- A website can function as a persistent source of information which ensures that any interested party can find relevant information regarding the framework and keep up to date with latest developments. Furthermore, the website may be used a two-way communication channel which allows users to submit their opinions and proposals.
- A newsletter published in regular intervals can summarize actions involving the framework, in order to keep the target audience informed on progress and stimulate interest.
- Press releases and briefings aim to provide immediate information on new action plans and the outcomes of the application of the e-GIF.

- Conferences and small group workshops provide a direct avenue to address the academic community and ICT specialists. Furthermore, participation in conferences provides the opportunity for person-to-person contact, which is a very effective means of encouraging participation.
- Mass media promotion allows citizens and businesses to become aware and understand the rationale and benefits of government actions in the application of an interoperability framework and the eGovernment strategy in general, as well as establish an environment of trust in eGovernment services.

3.3.4 e-GIF Compliance Control and Certification Procedures

In order to enforce a culture of e-GIF compliance, procedures should be established that detect the degree to which projects, systems and organisations comply with the rules and guidelines set by the framework, as well as assist public organisations in procuring and maintaining interoperable ICT systems. A certification framework specifies the directions and standards to be followed for e-GIF compliance and is addressed to public organisations, who need to benchmark their activities against the framework, as well as public sector ICT suppliers who need to appraise their competencies and identify areas for skills development.

Public organisations cannot be expected to comply with the framework in a single step, especially when considering the case of legacy systems which need to be updated. Rather, the certification process should reflect the gradual evolution of a public organisation's ICT infrastructure towards full compliance to the framework, by allowing public organisations to certify individual components or certify against specific aspects of the framework. For instance, the Greek e-GIF provides separate certifications for public administration sites and portals, compliance to the security procedures detailed in the Digital Authentication Framework, compliance to the Documentation Model for Public Administration Processes and Data, etc. Thus, the certification process should be viewed as an opportunity for public organisations to cooperate with experts in order to improve their infrastructure and services and devise action plans towards full compliance.

Compliance control should not be viewed merely as an assessment of the final product, as deviations from the framework's specifications may prove costly and time-consuming to rectify. Instead, compliance tools should encompass all phases of development, from the initial specifications and procurement phase to the operation and maintenance of public sector systems and services. In this context, compliance control and certification procedures consist of:

- An accreditation system which allows suppliers to certify their competency and credibility in providing framework-compliant systems.
- Tools and guidelines which enable public organisations to ask for framework compliance in procurement, as well as evaluate whether it has actually been delivered.
- Self-assessment tools which allow public organisations to assess the current status of their systems and processes concerning eGovernment interoperability and the steps that need to be taken to improve their positioning in respect to system implementation and services provision to citizens and businesses.

- An accreditation system for public information systems and processes, which allows public organisations to cooperate with expert groups in order to rectify deviations from the specifications set by the e-GIF.

While the certification infrastructure is an essential step for compliance assurance, its success relies in the active interest of both suppliers and public organisations to participate. Relevant policies should be implemented that encourage public organisations to comply to the framework, such as linking the funding of projects with framework compliance and certification or instituting penalties for non-compliance. Furthermore, preference for certified suppliers in procurements can incentivise suppliers to acquire certification in order to gain a competitive advantage.

3.3.5 Evaluation of outcomes

Evaluation involves the definition of metrics by which the success of the e-GIF, or the deviation from its goals, can be measured. The application of an e-GIF is a complex undertaking that faces a variety of challenges, such as legal constraints, the lack of cooperation between public administrations, governance issues and inadequate information dissemination [22,24]. For the e-GIF to gradually mature and overcome these obstacles, evaluation procedures that ascertain the level of compliance to the e-GIF should be established, in order to identify and assess factors that may slow its adoption, identify practical issues that arise in its application and take appropriate steps to address those issues.

This evaluation is not limited to assessing the compliance of individual systems and processes, as that issue is covered by the provision of compliance and certification tools. Instead, its purpose is to assess how the interoperability of government services matures over time and define new goals and strategies for improved organisational interoperability and collaboration between public administrations.

Defining metrics for interoperability is a complex process [25] and a full analysis would fall outside the scope of the current guide. However, it should be mentioned that certain indicators require special attention, as they play a fundamental role in understanding the key issues that affect the framework's adoption:

- The number of certified public information systems and services helps determine how widespread the adoption of the framework is. This should be further specialised to individual sectors of public administration, so as to evaluate the areas where technical, operational or organisational interoperability may be lagging behind and the reasons this occurs.
- The ability of public services to adapt to new versions of the framework should be evaluated, so as to assess how often revisions of the e-GIF should occur without setting unrealistic expectations of compliance.
- The flow of feedback and participation in proposing and developing new standards and technologies, as well as participation in maintenance of the e-GIF, helps determine the level of engagement and interest in interoperable systems and processes by public administration and private ICT contractors.
- The ability of public administrations to ask for framework compliance in bidding processes for public information systems projects, as well as their ability to

determine whether it has actually been delivered is a key indicator of the maturity of interoperability.

- The level of awareness of public officials, their understanding of the goals and requirements of the e-GIF and its importance in the context of eGovernment services, determines the level of support and commitment to the adoption of the framework.
- The response of the private sector to the framework should be taken into account. It should be determined whether the candidates for public sector projects have incentives to seek certification and develop their strategy for the delivery of framework-compliant systems.

The expected final result of the evaluation process is the formulation of an action plan towards universal compliance and improved interoperability. This may involve revisions to the e-GIF, changes in administrative processes regarding the maintenance of the framework, proposals for better enforcement of compliance, or new strategies for better dissemination of information and increased awareness.

4 e-GIF Management Authority and Stakeholders

4.1 The need for an administrative framework

As already described in Section 3, an e-Government Interoperability Framework is in fact a comprehensive administrative system that summarizes and enables the management of the principles, standards and specifications that owe to guide the design and development of public administrations web sites, information systems, organizational procedures and services. As a result, beside the definition of the former elements, its development presupposes as well the establishment of appropriate instruments, roles and procedures to ensure its management, maintenance and application. To this aim, in the following paragraphs this practical guide suggests the establishment of an e-GIF Management Authority and presents its competences and proposed organizational structure. A set of stakeholders that are involved in the management, maintenance and application of the e-GIF are also identified and their role in the aforementioned procedures is clarified.

4.2 The e-GIF Management Authority

The existence of a central e-GIF Management Authority is considered necessary as a result of the e-GIF scope of application that covers a great number of public organizations as well as the fact that the e-GIF update procedure may include feedback actions and amendment requests from multiple stakeholders involved. The competences of such an authority may indicatively include:

- The definition of a strategy for the design and implementation of public administration web sites and information systems and the delivery of electronic services by public organizations.
- The determination of the specifications, guidelines and standards to be included in the e-Government Interoperability Framework.
- The constant updating and maintenance of the e-Government Interoperability Framework.
- The dissemination of the benefits deriving from its use.
- The provision of practical support to public bodies on the application of the framework.
- The monitoring of the e-GIF application by public institutions.
- The conduction of e-GIF consultation activities, collecting and evaluating proposals to update the framework and incorporating approved proposals in subsequent e-GIF versions.

The following paragraphs expose the competences and organizational structure of such an authority at greater detail.

4.3 Competences

4.3.1 Strategy Definition

The e-GIF Management Authority owes to be primarily responsible for the definition of a strategy on the design and implementation of public administration web sites and information systems and the provision of electronic services by public organizations. Such a strategy has to encompass:

- the goals to be pursued by public institutions through the development of web sites and information systems in order to enable the provision of electronic services to citizens, businesses and other stakeholders.
- the objectives to be fulfilled with regard to the registration, identification and authentication procedures, adopted by public institutions in the frame of electronic service provisioning toward the aforementioned stakeholders.
- the main lines of action to be followed by public organizations in order to accomplish the strategic objectives set.
- strategic decision making on the potential adoption and incorporation of standards and guidelines on e-Government issues.
- follow-up and critical assessment of technological developments in other countries.

Attention has to be drawn to the fact that the strategic objectives set have to concern the medium- and long-term planning of the Public Administration.

4.3.2 Guidelines and Standards Specification

The guidelines and standards included in the e-GIF owe to reflect and materialize the goals outlined in the former strategy. Yet, contrary to the latter, they are to be subject to constant revisions and updating. In this context, the individual competences of the e-GIF Management Authority have to include:

- the specification of the requirements, rules and standards that have to guide the development and maintenance of, and the provision of operational support to public web sites.
- the definition of the main principles that have to be followed during the design and development of information systems for public institutions, so as to provide efficient electronic services and to guarantee interoperability, communication and data exchange among diverse information systems of the same or different organizations.
- the specialization of the main principles set, through specification of the information systems' design and development requirements in terms of the system architecture and standards to be adopted.
- the implementation of the necessary actions in order to guarantee information systems' interoperability at all organizational, semantic and technical levels.
- the specification of guidelines and standards to be adopted in the frame of the registration, identification and authentication procedures, required in order to provide to citizens and business access to electronic services.

- the management of complementary mechanisms and tools (e.g. registries, libraries, etc.) that facilitate the discovery and maintenance of the e-GIF specifications and standards.
- the classification (if applicable) of the aforementioned specifications, rules and standards in different compliance levels, depending on the severity of the public institutions' obligation to comply with the latter.
- the potential classification of the e-GIF technical standards in maturity lists, according to the framework's objectives and the management and maintenance of the former lists.

4.3.3 e-GIF Compliance Control

Apart from the definition of the e-GIF strategy and actual guidelines, the e-GIF Management Authority is anticipated to be responsible as well for the monitoring of the web sites', information systems' and electronic services' compliance to the requirements of the framework. In this area the work of the e-GIF Management Authority shall have to encompass:

- the definition (if applicable) of compliance levels to the framework.
- the specification of the public administration web sites', information systems' and electronic services' compliance requirements to the e-GIF.
- The determination of the e-GIF compliance requirements to be followed by other certification institutions.
- the determination of the compliance control procedures.
- the specification (if applicable) of the techniques and tools to be deployed in the context of compliance control procedures.
- the actual realization of compliance controls, along with the reporting and record keeping of their outcomes.
- the certification (in case of compliance to the e-GIF) of web sites, information systems and electronic services or other institutions to perform compliance controls.

4.3.4 e-GIF Dissemination

In order to fulfill its objectives an e-Government Interoperability Framework must be accompanied by specific dissemination activities. The aim of the latter is to enlighten the target audience of the e-GIF on the potential benefits from its application, the activities that owe to be carried out for the framework's objectives to be reached etc. The e-GIF dissemination activities may differ according to the particular target audience group, to which they are addressed (public organizations, software development enterprises, citizens etc.) and may be either carried out by the e-GIF Management Authority itself or be assigned to other contractors. In all cases the relevant competences shall have to involve:

- the development of the e-GIF dissemination plan.
- the development of appropriate dissemination material.

- the implementation of the dissemination plan and the realization of the dissemination activities foreseen.
- the monitoring and coordination of the dissemination activities.

It is recommended moreover that each release of the e-Government Interoperability Framework is also accompanied by a specific dissemination plan, covering the time period until the next release of the framework.

4.3.5 Supporting the application of the e-GIF

The adoption of the e-Government Interoperability Framework by public institutions is likely to raise requests for the provision of clarifications and further guidelines. Thus, it is important that the e-GIF Management Authority establishes a proper communication mechanism to support public organizations on the application of the e-GIF. To this aim, the e-GIF Management Authority has to:

- specify the ways and communication procedures for the stakeholders involved to get in contact with the e-GIF Management Authority.
- collect, investigate and respond to requests on the provision of support for the application of the e-GIF.
- file and statistically process such requests.

4.3.6 Monitoring the application of the e-GIF

The competences of the e-GIF Management Authority owe to further encompass the monitoring of the e-GIF application by public institutions. In this area, the following tasks are included:

- monitoring of the number of public institutions, information systems and services that are conformant to the e-GIF.
- collection and assessment of reported e-GIF compliance problems
- updating the e-GIF using revision proposals, generated as a result of the e-GIF compliance problems reported by public organizations.

4.3.7 e-GIF Maintenance and Updating

The e-Government Interoperability Framework has to be constantly adapted to large-scale organizational and business changes affecting the operation of public institutions and thus the operation of their information systems and web sites, and updated according to the latest technological developments in the field of electronic governance at both national and international levels. As a result, in this area the individual competences of the e-GIF Management Authority owe to involve:

- the specification of mechanisms and communication procedures enabling to submit proposals for revising the e-Government Interoperability Framework.
- the collection, assessment and approval or rejection of e-GIF revision proposals.
- the incorporation of approved proposals in the subsequent release of the framework.

- record keeping and statistics maintenance with regard to the submission of e-GIF revision proposals and their evaluation outcomes.
- the specification of the mechanisms, procedures and the terms to use the e-GIF supportive systems and tools (e.g. registries, libraries, etc.), in order to record potential amendments.
- assurance that any revisions and updates to the framework are communicated to the stakeholders interested.

4.4 Organizational Structure

In order for the competences outlined above to be accomplished, it is suggested that the e-GIF Management Authority comprises the following organizational units:

- An **e-GIF Management Unit**, covering the tasks of guidelines' and standards' specification and e-GIF updating and maintenance.
- An **e-GIF Compliance Control Unit**, being responsible for carrying out the required e-GIF compliance control and application evaluation procedures.
- An **e-GIF Dissemination and Support Unit**, undertaking the organization of the necessary e-GIF dissemination activities and supporting public institutions on the application of the framework.
- A **Legal Support Office**, underpinning the operation of the former units and contributing in particular to the work of the e-GIF Management Unit with regard to the e-GIF's legal requirements' definition and maintenance (e.g. personal data protection, privacy issues) as well as the e-GIF Compliance Unit by supporting electronic services compliance control procedures with regard to digital authentication issues.
- An **Administrative Support Unit** covering the rest of the administrative procedures (e.g. financial management, human resources, supplies management, secretarial support etc.) that are necessary for the operation of the e-GIF Management Authority.

4.5 The stakeholders involved

4.5.1 Public Administration Institutions

The development and ratification of an e-Government Interoperability Framework imposes for public organizations certain requirements and creates relevant competences. These include:

- the adoption by the public administration institutions of the specifications, rules and standards, defined by the e-GIF for the design and implementation of their web sites, information systems and electronic services.
- the implementation of the roles and procedures, specified by the framework.
- the specification of their registration, identification and authentication procedures (for citizens, businesses and other stakeholders) and policies in accordance with the e-GIF's requirements and specifications.

- ensuring that their processes, documents, web services and information systems are in compliance with the e-GIF.
- the development, incorporation in the framework and maintenance of codelists concerning issues that fall within their jurisdiction.
- their compliance to the terms and outcomes of the relevant conformity control procedures.
- the submission of requests or proposals to revise the e-GIF.
- the dissemination of the framework toward supervised institutions and the provision of support on its application by the latter.

4.5.2 Public Sector Project Contractors

This group of stakeholders includes private companies that undertake information systems or web sites development projects or provide public administration organizations with relevant services. The role of this category of stakeholders is particularly important, as public sector project contractors may act as a means of testing the applicability of the e-GIF's guidelines in practice and verifying whether the latter are well applicable or susceptible to cause problems and malfunctions. In this context, public sector project contractors:

- are obliged to follow the specifications and to use the standards, defined by the e-GIF, provided that such an obligation is foreseen in the contract according to which they are committed.
- owe to inform the beneficiary public institution on any deviations appearing with regard to the framework's requirements.
- are committed to cooperate with the beneficiary institution as well as with the e-GIF Management Authority along the course of compliance control procedures providing the required information.
- may forward to the beneficiary organization revision requests, to be then submitted by the latter as e-GIF revision proposals to the e-GIF Management Authority.

4.5.3 Software Development Enterprises

This category of stakeholders encompasses enterprises that develop and provide software products and solutions. Such enterprises are closely following the technological developments in the field of software engineering (web technologies, communication protocols, security solutions etc.) and can therefore act as a valuable source of feedback on the content of the e-GIF. Thus, software development enterprises may be granted the right to submit revision proposals for the e-GIF.

4.5.4 Consulting Institutions

This category of stakeholders enumerates enterprises, institutes and individuals, activated in the area of providing consulting services to public organizations on their preparation for complying with the e-Government Interoperability Framework. This group of stakeholders is as well in place to collect comments and proposals on the application of the e-GIF guidelines in practice. It is suggested that such proposals are

forwarded to the beneficiary public organization and submitted by the latter to the e-GIF Management Authority.

4.5.5 Certification Institutions

Apart from the e-GIF Management Authority, specific competences with regard to the certification of compliance to the e-GIF can possibly be assigned to private institutions (enterprises, institutes, individuals). Provided that they have been accredited by the e-GIF Management Authority, such institutions may conduct compliance controls of public organizations web sites and information systems as well as submit proposals to revise the e-GIF standards and guidelines.

5 Conclusions

The effort to set up an e-Government interoperability framework, to be applied in national and local level, plays a crucial role in ensuring interoperability among public administrations and their beneficiaries, and allowing for the deployment of joined-up information systems and the provision of one-stop, fully electronic services to citizens and businesses. Interoperability allows public organisations to benefit in effectiveness and cost-efficiency from reusable service components and data structures, while at the same time enhances a culture of collaboration and information sharing in the public sector in order to provide better services to citizens and businesses.

The development of a national interoperability strategy can rely on international experience and practice, in order to analyse interoperability good practice cases and recognise the common pitfalls and mistakes that should be avoided. Thus, the first step towards an e-GIF requires the examination and extended review of related research and standardization efforts in other countries. Common principles have emerged which guide the development and application of the e-GIF: Interoperability, scalability, maintainability, reusability, openness and preference for open standards, market support, security, privacy, accessibility and transparency. Furthermore, XML and formal specifications of uniform data presentation and interpretation, supported by a central XML Schemas repository, has been the common practice to support data exchange between heterogeneous systems [32].

However, the successful application of an interoperability framework is not contingent on the technical specifications. Focusing on the technical aspects of interoperability, usually at the expense of resolving broader business and organizational issues, has been a common pitfall [22] that hinders the adoption of the framework. Mandating framework compliance has also proven to be insufficient in this respect. Even in the case of the UK, one of the first countries to develop an e-GIF and mandate its application, it has become apparent that the wide adoption of the framework is reliant on the framework's governance policy [33]. Public administrations need to realise the benefits of interoperability and actively seek framework compliance in procurements, as well as embrace a culture of cross-agency collaboration.

Such issues highlight the crucial role of a central agency, the e-GIF Management Authority, whose purpose is not restricted to the development and maintenance of interoperability standards for the public sector. Instead, the e-GIF Management Authority aims to define a strategy that encourages and supports the application of the framework and coordinate the efforts for framework compliance throughout the public sector. In order to achieve this goal, the responsibilities of the e-GIF Management Authority extend to the development of a dissemination strategy, certification procedures and compliance control mechanisms, as well as establish communication channels to collect, investigate and respond to requests on the provision of support for the application of the e-GIF. Furthermore, the development process should embrace an open and collaborative approach that encourages stakeholders to take interest in the development and application of interoperability standards.

Conclusively, achieving interoperability in the public sector is primarily a matter of formulating a strong policy which focuses on organizational interoperability and encourages the coordination and cooperation among public organizations in order to transform e-Government towards user-centric services.

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