eGIF4M: eGovernment Interoperability Framework for Mozambique

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Abstract. Harmonizing decentralized development of ICT solutions with centralized strategies, e.g., meant to favor reuse and optimization of resources, is a complex technical and organizational challenge. The problem, shared by virtually all the governments, is becoming a priority also for countries, such as Mozambique, that have started their ICT policy relatively recently and for which it is now evident that — if no particular attention is devoted to the interoperability of the solutions being developed — the result will rapidly become a patchwork of solutions incompatible with each other. The focus of the paper is on formulation of eGIF4M: eGovernment Interoperability Framework for Mozambique. The framework is based on a holistic approach. It builds on top of the existing experiences in eGIFs all over the world and it addresses some specific needs and peculiarities of developing countries, like Mozambique. The result is a comprehensive framework based on: (*i*) a reference architecture along with technical standards, (*ii*) a standardization life cycle, (*iii*) a maturity model, and (*iv*) some key actions meant to make the initiative sustainable in the longer term.

1 Introduction

The government of Mozambique initiated the development of a national ICT policy in 1998, by establishing the ICT Policy Commission, whose work resulted in the release of the national ICT Policy in 2000 and, subsequently, its implementation plan. The plan, approved in 2002 identifies eGovernance as a strategic area for the development of the country. One of the final goals here is to switch to a *citizen-centric* government, that is, to a state of affairs in which the government delivers integrated services focused on the needs of citizens and private sector and where these are able to interact with government in a manner, time and place of their choice [5,11,21,30].

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Having adopted a comprehensive approach in the implementation of this vision, many government departments started, since 2000, implementing various ICT initiatives (e.g., Public Servants Information System, State Financial Information System, Enterprise Licensing and Cadastre Information System, Information System of the Administrative Tribunal, eLand Registry and Management Information System) and several projects related to a functional analysis and process re-engineering of government departments. It became clear quite soon that without proper governance and guidance, and without the definition of a proper interoperability framework, eGovernment services in Mozambique would soon be based on a patchwork of incompatible and closed systems, not differently to what happened to other countries.

Several interoperability frameworks have been defined in the world. We mention Australia, Germany, UK, New Zealand, Greece, EU, Ghana, and South Africa [2,3,7,8,22,23], to name a few. The works in [25,26,27] provided a concise comparative survey of some selected eGIFs and a general guidance on implementing an interoperability framework. Notice that common to nearly all eGIFs is the definition of standards to adopt (see, e.g., [3]). Slightly less common is the definition of a reference architecture to achieve interoperability, typically based on service oriented architectures (see, e.g., [28]), and addressed only by a part of the eGIFs are organizational, managerial, and technical aspects related to maintenance in the longer term of the frameworks (see, e.g., [8]). Finally, it is worth noting that the work in [18] has been selected by EU as a good practice case for eGovernment interoperability at local and regional levels.

By building on top of the achievements from the various eGIFs in the world and as a part of implementation of the eGovernment strategy of Mozambique, we propose a systematic and comprehensive approach to interoperability in Mozambique, called eGIF4M. The approach is devised to facilitate its early adoption and to be sustainable in the longer term. We achieve this by addressing specific risks and opportunities of Mozambique, which are also shared by other developing countries. The contributions of the paper include: (*i*) the service delivery architecture along with technical standards, (*ii*) a standardization lifecycle, (*iii*) an interoperability maturity model, and (*iv*) a set of support actions needed to ensure sustainability of eGIF4M. Notice that the uniqueness of the eGIF4M approach (compared to the other eGIFs mentioned above) is due to both: the consideration of all technical, organizational and process aspects, which in our opinion are needed to effectively and successfully deal with interoperability in the public sector along with supporting the development of the country, and the novelty of some of the support actions, such as the Maputo Living Lab.

The remainder of the paper is organized as follows. Section 2 provides the objectives of the work. Sections 3-8 elaborate in detail the various aspects of eGIF4M, including: the approach (Section 3), the service delivery architecture (Section 4) and its feasibility (Section 5), a standardization lifecycle (Section 6), an interoperability maturity model (Section 7), and the support actions (Section 8). Finally, Section 9 reports the major findings of the paper and outlines future work.

2 Fostering Interoperability in Mozambique

The objective of eGIF4M is the definition of the concrete steps to enable interoperability across the Mozambique's public administration. By *interoperability* we mean here the capability of (two or more) systems to exchange seamlessly data, information, and knowledge. eGIF4M, therefore, is a central milestone for improving efficiency and effectiveness of government services and it is a key-enabler for switching the government to a citizen centric approach, a strategic goal of the country.

Besides the criticalities experienced by many countries all over the world in implementing their eGIFs (see, e.g., [28], for an overview), eGIF4M also needs to take into account some specific issues and opportunities, typical of countries experiencing a fast development, among which:

Governance: ICT projects are often supported by international donors and the resulting governance process is more complicated than that of other projects. The possibility to enforce common architectural solutions and standards on these projects, for instance, is limited, requires strong political commitment and clearly defined organizational roles.

Skills: the limited availability of specialized technical ICT and managerial skills in the country implies a strong dependence on external support to implement and manage the ICT projects. Without establishing a transition path to provide the necessary competencies to the local context and to gradually increase and enlarge the base of ICT skills, there is a risk of not becoming able to control the convergence of eGovernment projects on the interoperability framework.

Sustainability: The traditional approach of setting up specific projects to respond to the needs of government agencies is not suited for a long term initiative like eGIF, while most of the results are envisioned from three to five years. Hence, management of eGIF4M requires the setup of conditions that allow for operation in a multi-year perspective.

At the same time the implementation of an interoperability framework can reduce some of the typical barriers faced by small and medium enterprisers (SMEs) in ICT projects. For instance, by having governments' solutions based on open standards, SMEs have more possibilities to compete or cooperate with bigger players. Thus, eGIF4M can be an opportunity for local companies to join the development of the eGovernment framework and in strengthening international connections and networking.

3 eGIF4M: The Approach

The risks and opportunities mentioned above require setting up a framework that refines existing approaches to be tailored to the specific needs and constraints of Mozambique. eGIF4M is therefore based on the following key actions:

Technical implementation, organized in two key areas:

- Implementation of an architectural framework (the eGIF4M *service delivery architecture*) based on a government service bus, where all the systems will converge to interoperate. We envisage the development of the architecture to be guided by a specific government unit. This helps drastically simplify the interoperability implementation process and reduce the dependencies, the expectations, and the needs for strong coordination with donor funded projects.
- Specification of the *standards* to be adopted at each level of the architecture, if applicable, and definition of a *life cycle for the standards*, to accommodate evolving eGovernment projects and innovation in technologies. Notice that the life cycle is an essential aspect to favor maintenance of the framework in the long run.

Organizational implementation, structured in:

- Definition of an *interoperability maturity model*, which measures the level of compliance and of adoption of eGIF. This information is essential to quantify and make visible the benefits (or disadvantages) of eGIF and can be used as an important tool for the setup of incentivation mechanisms for the more virtuous projects.
- Setup of an *organizational structure* and of the decision processes to manage eGIF4M, to monitor its execution, and to maintain and enforce it in the longer term.

Systemic support actions, meant as the set of activities to favour the growth of local skills and capabilities, to help create and disseminate a culture of interoperability, to help increase international networking of local companies and universities, and to create a virtuous cycle among public institutions, higher education, and private companies.

4 The eGIF4M Service Delivery Architecture

Figure 1 describes the eGIF4M service delivery architecture. It will serve as the basis for interoperation of data, systems, and processes. The architecture is based on a Government Service Bus and follows the standard SOA (service-oriented architecture) and EDA (event-driven architecture) approaches. We distinguish:

- *Users*, who are the actual service recipients that can be individuals, representatives of a private sector, such as SMEs, state agents, and so on.
- *Channels* that deliver the services, e.g., one-stop-shop, telephone, Internet.
- *Services* that are offered by eGovernment, such as legal entity services and civil identification services. Notice that access to the services offered either via a government portal or application interfaces might require authentication and authorization procedures.
- *Government service bus* is the core of the interoperability. It is constituted by two main components, the common information platform (providing interoperability of data and processes), and the common communication platform (that provides network and infrastructure). Of these two components,

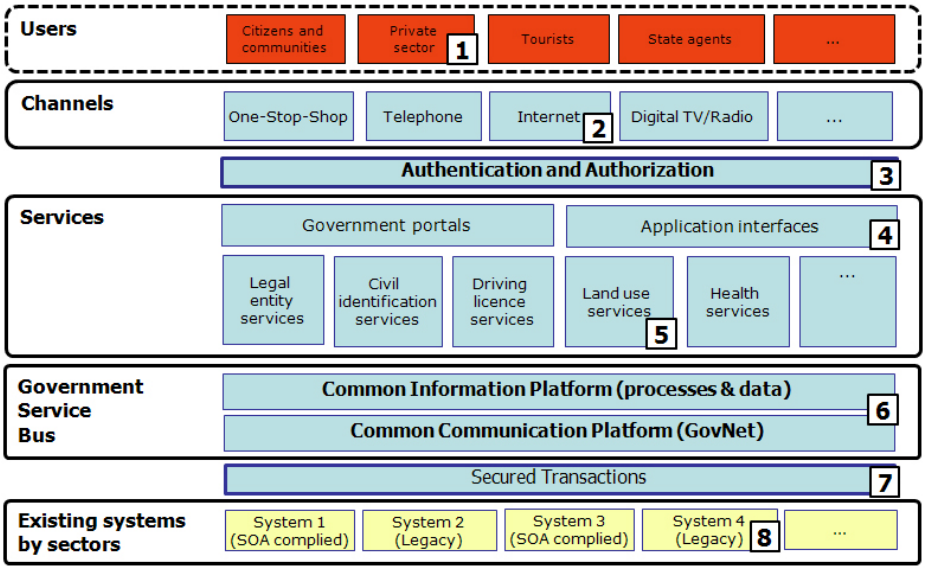


Fig. 1. The eGIF4M service delivery architecture

the latter has already been implemented. As a matter of fact, within the GovNet project, in its fifth year of operation, more than 140 government institutions from central (ministries), provincial, and district levels are now interconnected [6,17].

– *Existing systems by sectors* represent existing information systems. Some examples include: Enterprise Licensing and Cadastre Information System, State Financial Information System, eLand Registry and Land Management Information System.

The implementation of the architecture described in Figure 1 relies upon the identification and allocation of standards to the various architectural components. eGIF4M, therefore, starts from a taxonomy illustrated in Figure 2, which organizes standards in: (*i*) networks and infrastructures, (*ii*) process interoperability, and (*iii*) semantic data interoperability and allocates them to the architectural components. These areas are then further developed according to the seven layers covered by UNDP [27]. In parenthesis we indicate the number of standards considered in each area (only a subset of which is shown in Figure 2).

We now consider a scenario from the land management application following the path of eight items marked by numbers in rectangles in Figure 1. Notice that items 1-5 can be grouped under the front-office heading, while items 6-8 represent back-office. Suppose there is a private company that provides mediator services for renting land parcels, and there is a farmer that wants to rent one for agricultural use with the help of this company (item 1). The farmer has several choices among various land parcels, and, hence, asks the company first

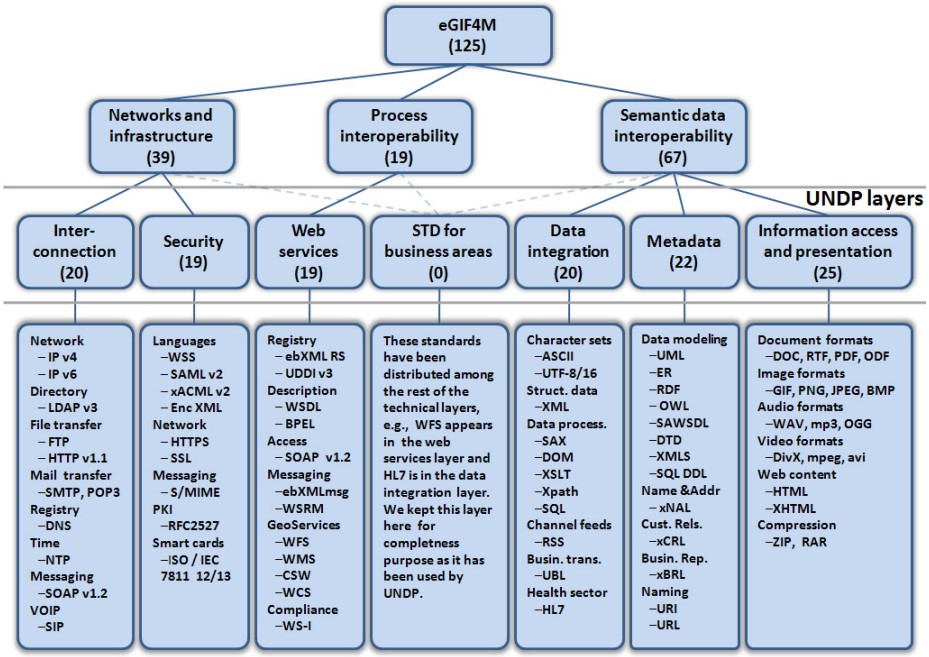


Fig. 2. Overview of the eGIF4M standards

to provide the maps of the identified areas to study them in order to make an informed decision with respect to which land parcel to rent. To process the request of the farmer, the company uses internet (item 2: IP v4[1]), passes through the necessary authentication and authorization procedures (item 3: LDAP[2]) and interacts in a secured way (item 7: SAML[3]) via the exposed application interfaces (item 4: SOAP[4], WMS[5]) of the land use services of the government (item 5) with the eLand Registry system (item 8). In turn, item 6 provides the interoperability glue at the process, data, and infrastructure levels that is necessary to process the request. For example, to describe metadata about geo-data it is used ISO 19115[6], while for describing metadata about geo-services it is used ISO 19119[7] (as required by CSW[8]), a map request is handled with WMS, etc. This request

[1] http://www.ietf.org/rfc/rfc0791.txt
[2] http://www.ietf.org/rfc/rfc1777.txt
[3] http://www.oasis-open.org/committees/tc_home.php?wg_abbrev=security
[4] http://www.w3.org/TR/2007/REC-soap12-part1-20070427/
[5] http://www.opengeospatial.org/standards/wms
[6] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=26020
[7] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=39890
[8] http://www.opengeospatial.org/standards/cat

requires integrating data from some other systems beside eLand Registry, such as the forestry cadaster. This is needed to check if the land parcel under consideration is in the forest area, which cannot be exploited for agricultural use. Finally notice that for each legacy system the adaptors have to be developed in order to use these systems under the government service bus. Some further technical details concerning: geo-service integration can be found in [31], and semantic heterogeneity reduction needed to establish adapters in [9,10].

5 Making the Service Delivery Architecture Possible

The implementation of the eGIF4M service delivery architecture represents a key milestone in the implementation of the interoperability framework. We envisage the following risks and mitigation actions in its implementation:

Scope: full top-down implementation of the architecture requires a significant effort. We envisage, instead, an incremental approach, through the definition of a few (one or two) significant case studies, whose selection is driven by Mozambique's strategic priorities (e.g., civil identification and land use services), and whose implementation will be based on a few selected delivery channels, such as Internet and one-stop shop. This should facilitate the early adoption of the framework.

Coherence of the architecture: keeping coherence, simplicity and efficiency of the architecture requires clear ownership in the setting up of the vision and in the definition of the strategic lines of development. For this reason a specific task force within a suitable government unit has to be responsible and accountable for its development.

Migration: in order to be of any use, legacy systems will have to converge (technically, e.g., via adaptors) on the government service bus. The framework uses the maturity model as a tool to measure compliance of the projects with the vision; defines technical standards to which projects migrate and proposes managerial standards (e.g., minimal technical documentation) that will also allow to have third parties migrate solutions, if necessary.

6 Keeping the eGIF4M Healthy

In the longer term the standards that we have allocated to the various components of the architecture will have to evolve, e.g., to better accommodate changing requirements of the government and changing technologies, while, at the same time, to maintain some control.

This is achieved in eGIF4M by defining a life cycle for standards, coherently to what also has been proposed by several other eGIFs. The life cycle builds on top of the work in [28] and includes the following states:

Emerging: it includes all the standards that the government is considering for introduction.

- *Future.* It encompasses all the standards that are not in use in the government (and not included in any of the states below) - no matter what the reason is (not needed, future consideration, and so on).
- *Assessed.* The standard has been evaluated and approved by the eGIF4M task force (§5) for experimental introduction, though is not yet in use.
- *Experimented.* An assessed standard has been deployed and it is in use in a controlled environment (e.g., in the scope of a new project; by some government agencies). The experimentation has the goal of assessing usefulness of the standard. The standard runs in parallel with other *Current* standards. A deadline is defined for a final assessment and evaluation, which will lead to a change of state (e.g., from *Experimented* to *Future*; from *Experimented* to *Current*).

Current: it includes all the standards that the government is currently using. We distinguish two levels that encode the prescription for the standard.

- *Possible.* It refers to a standard that can be used for data and services. Adoption is not compulsory. A standard can be kept in this state to, e.g., improve flexibility (not all the agencies have the possibility of switching to a corresponding mandatory standard, or it might not make sense for them to switch to the standard), while, at the same time, moving towards a common reference framework.
- *Mandatory.* The standard is officially adopted. Government bodies are required to deliver services and documents using the mandatory format.

Fading: it includes all the standards that are not in use anymore. When a format is in the *fading* state, no new document or service can be produced in the *faded* format. Furthermore, we distinguish two sub-cases, according to the policy chosen for historical data:

- *Disappearing.* Government bodies are required to migrate all data to the new format. A deadline is set for the migration.
- *Remaining.* Old data does not need to be migrated. The government ensures the readability of the format by maintaining support for the applications that handle the data.

7 eGIF4M Interoperability Maturity Model

One important aspect of eGIF4M is providing the ability to measure the level of adoption and diffusion of the interoperability framework. Such capability, in fact, allows decision makers and program managers to understand more precisely the level of adoption, the impact, and the success of eGIF4M. Moreover, it allows to plan actions meant to improve the delivery of services through the adoption of the interoperability framework.

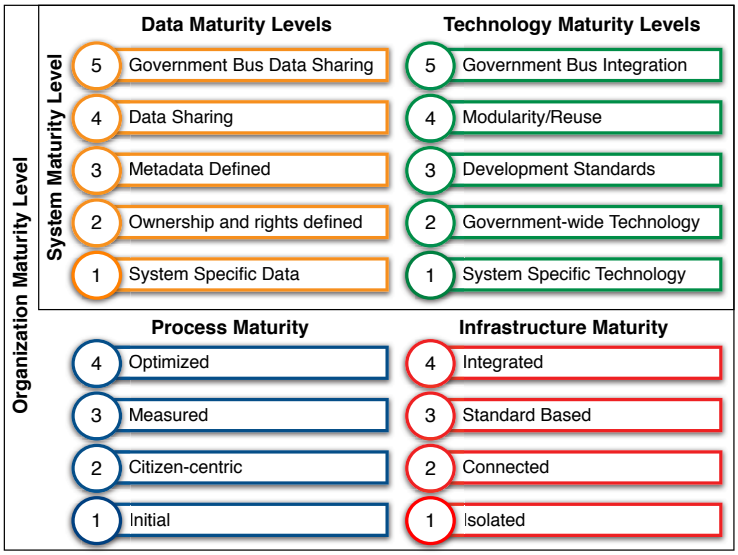
Various models exist to measure the maturity of organizations in developing systems (e.g., CMMI [13], ISO/IEC 15504 [1], Bootstrap [16], Trillium [4]) and, more specifically, to measure the level of interoperability, see, e.g., [20,29]; see also the family of standards identified by SEI [12,19,24] as well as the works in [14,15] for surveys. All models share a common approach which is based on:

- identification of the *targets of evaluations*, for which the maturity level has to be determined (for instance, an organization or a system);
- a set of *maturity levels* (for instance, initial, managed, defined, measured, and optimized);
- a *set of goals*, that defines what has to be measured (for instance, procedures, applications, infrastructures, and data).
- a *method* to determine the maturity level. This can be accomplished, for instance, by assigning the maturity level demonstrated by the target of evaluation in achieving each goal. A transformation function, e.g., as a (weighted) average of the scores, can be used to determine the total level of maturity.

The approach we propose in eGIF4M, see Table 1, is based on an adaptation of some of the models described above to provide a measurement system which is closer to the needs of Mozambique. Specifically, the model has two targets of evaluation: (*i*) organizations, and (*ii*) software development (system) projects. Notice that targeting projects is a peculiarity of eGIF4M, which allows to more easily manage inter-departmental projects and to raise awareness of interoperability as early as possible in the development cycle.

The assessment of (software development) projects is performed on the most recent artifacts (e.g., requirements, design, prototype, implementation) and is meant to measure two dimensions: level of data interoperability (for which we revised the Conceptual Interoperability levels of the LISI approach [24]) and technical maturity, meant as the level of adoption of standard technologies for the development (for which we devised specific goals, being loosely inspired by the work in [20]).

Table 1. eGIF4M Interoperability Maturity Model



The assessment of organizations is based on the PAID attributes (Process, Applications, Infrastructure, and Data) of the LISI model. For the process and the infrastructure we adapted the LISI model, whereas for the applications and the data attributes we reused the model adopted for projects.

We expect various benefits from the adoption of the model, among which the possibility of measuring the penetration of interoperability at different levels of granularity (government, agency, and systems), the identification of criticalities in the implementation of the framework, and raising awareness on interoperability opportunities and advantages.

8 Support Actions

Organizational structure for the whole initiative. eGIF4M includes a complex set of initiatives, which needs a well defined cross-departmental organization and clear horizontal processes to be managed and coordinated. To achieve that, two kinds of organizations need to be established. The first is an inter-agency and inter-ministry committee, responsible for defining the enforcement policies and incentives for the diffusion of standards, and to monitor the eGIF4M implementation and impact. The second is an operational group in charge of the execution of the framework and in charge of the implementation of eGIF4M (§5).

Dissemination, networking and higher education. One of the key issues in implementing a sustainable eGIF initiative in a developing country like Mozambique is to grow the skills of the local players, both in the public and private sector, and to better connect them with international initiatives. The plan for dissemination, higher education, and mobility initiatives in eGIF4M therefore includes aspects related to increasing national and international visibility of eGIF4M and the definition of exchange programs between Mozambique's and international universities.

***Living lab* to connect user institutions, research centers and local companies.** To combine some of the actions previously described and to create a stable infrastructure in which public initiatives, education, and private companies can exchange experiences, eGIF4M is strongly tied to the Maputo Living Lab (LLM) initiative, that has recently become part of the European network of Living Labs[9]. This is a system for building future economy in which real-life user-centric research and innovation will be a normal co-creation technique for new products, services and societal infrastructure. We expect LLM to become the reference point for the strengthening of national and international networking of local companies and the place for the exchange of best practices.

9 Conclusions

Several frameworks have been proposed and adopted by different countries to address issues and costs due to the lack of interoperability in public agencies

[9] `http://www.openlivinglabs.eu/`

and in government's ICT systems. Approaches and scope vary quite a bit, to reflect the different allocation of responsibilities between central and peripheral agencies, the level of automation, and the maturity of eGovernment services. In this paper we have discussed the main actions we envisage for the implementation of eGIF4M, part of a wider eGovernment initiative whose implementation started in 1998. The framework is based on several key actions (implementation of the government service bus, monitoring and control through the interoperability maturity levels) and on a set of wider-scope actions, such as living labs. All actions are based on the definition of the standards to adopt and of their life cycle, coherently with what happens in various other eGIFs.

We expect various benefits from the adoption of the framework, among which the main is governing a transition to more interoperable solutions, while, at the same time, allowing for a certain independence in the choice and development of ICT solutions, which is one of the priorities of the country. The possibility of measuring the penetration of interoperability at different levels of granularity (government, agency, etc.) and using the information to guide decision making, the increased efficiency coming from the implementation of a citizen-centric government (for whose implementation interoperability is essential), together with the broader actions suggested in the framework, constitute a further opportunity to sustain and accelerate the growth of the country which, in the last ten years, has experienced a steady economical growth in the two digits range.

Future work includes at least: (*i*) actual implementation of the framework proposed in order to obtain practical evidence of the eGIF4M strong and weak aspects, and (*ii*) drawing general implications from the empirical eGIF4M experiences which can be useful also for the other similar initiatives in the world.

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References

1. ISO/IEC 15504: Information technology - software process assessment part 7: Guide for use in process improvement (1998)
2. Australian government technical interoperability framework, `http://www.agimo.gov.au/publications/2005/04/agtifv2/#Australian20Technical20Framework` (2005)
3. New Zealand e-government interoperability framework (2008), `http://www.e.govt.nz/standards/e-gif/e-gif-v-3/e-gif-v-3-total.pdf`
4. Bell Canada. The trillium model (1994), `http://www2.umassd.edu/swpi/BellCanada/trillium-html/trillium.html`
5. cc:eGov. A Handbook for Citizen-centric eGovernment (2007), `http://www.epractice.eu/document/4227`
6. Chemane, L., Taula, R., Carrilho, S.: MCDM framework and the selection of network topology – GovNet case study. In: Proc. of IST-Africa (2006)

[10] `http://www.italcoopmoz.com/`

7. Bundesministerium des Innern. Standards and architectures for e-government applications, vol. 59. KBSt Publication Series (2003). ISSN 0179-7263, http://www.apdip.net/projects/gif/country/GE-GIF.pdf
8. eGovernment Unit. e-government interoperability framework version 6.1 (2005), http://www.govtalk.gov.uk/documents/eGIF%20v6_1%281%29.pdf
9. Euzenat, J., Shvaiko, P.: Ontology matching. Springer, Heidelberg (2007)
10. Giunchiglia, F., Yatskevich, M., McNeill, F., Pane, J., Besana, P., Shvaiko, P.: Approximate structure preserving semantic matching. In: Proc. of ODBASE (2008)
11. Gov3. Citizen Centric Government – Global Best Practices in Delivering Agile Public services to Citizen and Business (2006), http://www.intel.com/business/bss/industry/government/citizen_wp.pdf
12. C4ISR Interoperability Working Group. Levels of Information Systems Interoperability (LISI). Department of Defense (1998)
13. Software Engineering Institute. Capability maturity model integration (2009), http://www.sei.cmu.edu/cmmi/
14. Software Engineering Institute. Guide to Interoperability (2009), http://www.sei.cmu.edu/isis/guide/index.htm
15. Kasunic, M., Anderson, W.: Measuring systems interoperability: Challenges and opportunities. Technical Report CMU/SEI-2004-TN-003, Software Engineering Institute (2004)
16. Kuvaja, P., Simila, J., Krzanik, L., Bicego, A., Koch, G., Saukonen, S.: Software Process Assessment and Improvement: the BOOTSTRAP approach. Blackwell Publishers, Oxford (1994)
17. Mapsanganhe, S., Chemane, L.: GovNet e-mail system capacity planning. In: Proc. of IST-Africa (2007)
18. Marcucci, L., Kluzer, S., Nicolini, A., Cimander, R.: ICAR - a system for e- enabled cooperation among regional, local and national administrations in Italy. European Commission (2006), http://www.egov-iop.ifib.de/downloads/GPC_ICAR_Italy.pdf
19. Morris, E., Levine, L., Meyers, C., Plakosh, D., Place, P.: Systems of systems interoperability. Technical Report CMU/SEI-2004-TR-004, ESC-TR-2004-004, Software Engineering Institute, Carnegie Mellon University (2004)
20. NETHA. Interoperability Maturity Model. National E-Health Transition Authority Ltd. (2007)
21. Council of Ministers. Public sector reform strategy. Council of Ministers Publication, Maputo, Mozambique (2006)
22. Government of South Africa. Minimum interoperability standards (MIOS) for information systems in government (2007), http://www.i-gov.org/images/articles/4760/MIOS_V4.1_final.pdf
23. Papadakis, A., Rantos, K., Stasis, A.: The realization of the greek e-gif. Presented at Secondo Vertice Europeo sull'Interoperabilit a nell'iGovernment (2008)
24. Tolk, A., Muguira, J.A.: The levels of conceptual interoperability model. In: Fall Simulation Interoperability Workshop, Orlando, Florida (2003)
25. United Nations Development Programme (UNDP). e-Government Interoperability: A Review of Government Interoperability Frameworks in Selected Countries. UNDP Regional Centre in Bangkok (2007)
26. United Nations Development Programme (UNDP). e-Government Interoperability: Guide. UNDP Regional Centre in Bangkok (2007)
27. United Nations Development Programme (UNDP). e-Government Interoperability: Overview. UNDP Regional Centre in Bangkok (2007)

28. United Nations Development Programme (UNDP). e-Government Interoperability: e-Primers for the Information Economy, Society and Policy. UNDP Regional Centre in Bangkok (2008)
29. University of Albany. Sharing Justice Information: A Capability Assessment Toolkit (2005)
30. UTICT. Estratégia da política de informática em Moçambique. UTICT Publication, Government of Mozambique, Maputo, Mozambique (2000)
31. Vaccari, L., Shvaiko, P., Marchese, M.: A geo-service semantic integration in spatial data infrastructures. International Journal of Spatial Data Infrastructures Research (2009)