Proposal of an Interoperability Model for Social Security Information Systems

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Abstract: The paper presents the most important concepts of interoperability and analyse the problems to apply interoperability in Social Security information systems. A model for apply interoperability between Social Security Institutions is presented and is proved in some scenarios. The goal is to develop standardize specifications promoting reusability and enabling to address the issues of cost and complexity in social security systems implementation. The main contributions of this paper are the proposition of an interoperability model based on the EIF's model and taking into account characteristics and application scenarios of the Social Security domain.

1 INTRODUCTION

Interoperability techniques for the integration of computer and information systems play an increasingly important role in the implementation of social security systems. Institutions need to use interoperability techniques to integrate the information systems of individual social programmes if they are to put into practice current trends towards the integration of social policies and programmes now appearing in all areas of social security, as well as to construct information services and systems to be shared between the different institutions or bodies which operate social policies. In the same way, applying these interoperability techniques internally within institutions can bring improvements in the quality of their internal management.

A number of attempts have been made to classify and define the models applicable in the area of interoperability, in order to categorize and also measure the impact of the different environments where interoperability can be established. This report describes a specific model designed for social security information systems.

The model is generic in the sense that it is applicable to the provision of public services at any level, from local to international. The model can also be used to clarify and rationalise the relationships among entities that work together (in the various levels of government, in different sectors or both) to deliver better public services.

To summarise, the aim of the model is to introduce practical benefits by establishing public services in such a way as to clearly define the functions of the services and their interfaces and thus enable their reuse. In this way we can avoid duplication of work and try to use the existing services to the best advantage, automating a wide range of basic practices and their use.

This proposal has been developed in the context of a project developed by the International Social Security Association (ISSA) aiming at supporting social security institutions worldwide to improve the effectives and efficiency in implementing interoperable systems (ISSA, 2012).

The paper is organized as follows. In section 2 the more important concepts of interoperability are explained, section 3 describes the interoperability in Social Security information systems, section 4 describes the model for the implementation of interoperability in social security, section 5 expose some application scenarios of interoperability in Social Security. The paper finishes with some conclusions and future work.

2 INTEROPERABILITY CONCEPT, DIMENSIONS AND MODELS

The European Interoperability Framework (EIF) for Pan-European e-Government Services (European Commission, 2004), a reference document for the development of the common standards and infrastructures required for the implementation of interoperability in the field of European electronic administration published by the European IDABC programme (Interoperable Delivery of European e-Government Services to public Administrations, Businesses and Citizens), considers that "interoperability is the ability of ICT systems and the business processes they support, to exchange data and to share information and knowledge".

Interoperability can be approached from different angles which determine the types, aspects, focus and dimensions of interoperability.

Interoperability, whether applied to e-government as in defence and strategy systems, or in digital libraries and information services, is characterized by the following dimensions:

- Political: Collaborators must have visions which are compatible, priorities which are in line with each other and must focus on the same objectives.
- Legal: Adequate synchronization of the legislation in collaborating countries must include the fact that the electronic data generated in one country must be properly recognized when used by the receiving country.
- Organizational: This refers to the definition of business objectives based on business procedures and tries to facilitate collaboration between administrations or institutions which wish to exchange information and which may have different structures and internal procedures.
- Semantic: Ensures that the precise significance of the information exchanged is comprehensible for any other application not initially developed for this purpose.
- Technical: Addresses critical aspects of linking computer and service systems.

In particular, this is the approach of the European ISA Programme (Interoperability Solutions for European Public Administrations) and thus the approach of electronic public administrations. The following diagram, Figure 1, is taken from the reference document European Interoperability Framework v 2.0 (EIF) (European Commission, 2010).
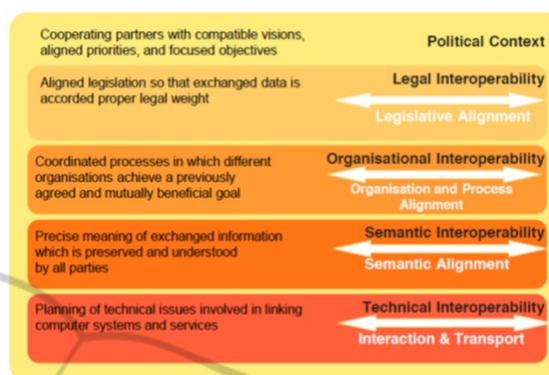

Figure 1: Interoperability Dimensions EIF v2.0.

A number of attempts have been made to classify and define the models applicable in the area of interoperability, in order to categorize and also measure the impact of the different environments where interoperability can be established. For example, the Software Engineering Institute of the Carnegie Mellon University has provided us with an article entitled "Interoperability in the e-Government Context" (Novakouski, 2012) in which they propose a model to understand interoperability in the area of e-government. The model they propose is based on models such as LISI, OIMM, LCIM, NATO C3, EIF and GIF, which lead them to the conclusion that all of them can be defined in terms of objectives, types and levels of interoperability. The starting point of the model they propose is the definition of the general objectives of interoperability and they go on to locate them in given levels of interoperability and finally add a series of influencing factors.

3 INTEROPERABILITY IN SOCIAL SECURITY INFORMATION SYSTEMS

The implementation of Interoperable social security programmes, like integrating social programmes managed by different institutions, usually has institutional implications. Therefore, the application of Interoperability requires strong political support in favour of cooperation, and the generation of compatible institutional approaches focusing on similar objectives in terms of the implementation of social security programmes.

Legal interoperability must be used wherever possible to give formal structure to the political approaches which affect the application of interoperability in the implementation of social security systems.

As social security programmes are strongly based on laws and regulations, addressing the Legal dimension implies adequate synchronisation of the standards on which cooperation is based to ensure that the jurisdictions, competencies and responsibilities of the organisms participating in projects involving interoperability are clearly defined, and that the electronic data from any one of them is given its proper legal weight and recognition.

Organizational interoperability refers to the definition of compatible administrative and procedural models, in order to create collaboration between the parties who propose to exchange or share information and services, regardless of their internal organization and structure. Aspects of organizational interoperability is understood to mean those elements that make it possible to know and understand policies concerning access to data and/or services and their use, personal and institutional responsibilities, and the objectives and aims pursued by the organization in creating data or providing a service.

In Social Security community, business process lack of standardisation and similar administrative functions may be carried out in very different ways. Moreover, formal process modelling is not yet a generalized practice. In order to address these issues, carrying out Organizational interoperability in this domain should include flexible tools and practices capable of coordinating heterogeneous processes.

The fact that the information generated by a computer must be processed by another system which must interpret its meaning correctly, leads to a series of additional complications which affect both the source of the information and its recipient, and constitutes the central theme of semantic interoperability. Achieving it requires agreement, for example, on the way in which information is represented and its context. This is what will enable automatic tools to share and process the information, even when it has been registered independently. The objective of semantic interoperability is not only to enable the interconnection of information resources, but also to enable them to be understood automatically and as a result to be reused by computer applications not involved in their creation.

In the context of Social Security systems, semantic interoperability is fundamental in the development of joint definitions and interpretations concerning the data which is to be processed by various organisms. Social security operations involve a wide range of concepts which in spite of having the same name, may be interpreted differently (e.g. family group, members of the same household, unemployed person, old age pension, health benefits, social security contributions, etc.). Thus, in order to improve understanding of the concepts it is useful to be able to represent the relations between them, principally those of "sub-groups" (e.g. rural workers are a sub- group of workers, etc.).

An essential requirement for information exchange is a single language to describe the meaning and structure of the subjacent data, for example a mark-up language. In the current technological and market environment, this language is XML (W3C, 2008). However, XML alone cannot guarantee or provide semantic interoperability. It requires joint semantic development initiatives based on XML. The subsequent introduction of XML schemas and related artefacts (metadata, anthologies, etc.) enables the integration of services developed using different vocabularies and with different perspectives on data.

Technical interoperability usually covers the technical aspects of connection and communication between teams, computer measures, applications and services. It includes key aspects such as open interfaces, interconnection services, the integration of data and middleware, the presentation and exchange of data, localization and recovery of resources, accessibility, security and the integration of applications and services. Different standards and extended use specifications can be identified.

Summarizing, all the Interoperability Dimensions are relevant when implementing interoperable Social Security systems. Furthermore, business-oriented staff should have an active participation in the definition of the aspects concerning the Political, Legal, Organizational and Semantic dimensions.

4 MODEL FOR THE IMPLEMENTATION OF INTEROPERABILITY IN SOCIAL SECURITY

In the following sections we present a generic model for the implementation of interoperability which suggests ways in which the establishment and

functioning of public services could be organized in social security institutions. The model is based on the EIF v2.0 proposal within the European Union Framework which studies its implementation in the public services of member states. The model helps to develop a conceptual model and a common vocabulary to improve the understanding of all the member states of the basic principles behind the implementation of an inter-institutional public service.

The model uses a "building-block" approach to setting up European public services, using interconnecting and reusable service components to build new services. The model is highly focused on the implementation of future services, so not all existing services are included in it.

The model is generic in the sense that it is applicable to the provision of public services at any level, from local to international. The model can also be used to clarify and rationalise the relationships among entities that work together (in the various levels of government, in different sectors or both) to deliver better public services.

4.1 Key Concepts

The model promotes the reuse of information, concepts, models, patterns, solutions, and specifications in each one of the social security institutions. Their public services are based on information from various sources located at different levels of the administration in different states. We should be able to combine basic public services which are constructed independently by social security institutions in different states.

The model highlights the need for a modular infrastructure with loosely coupled service components which can be interconnected to deliver European public services. It calls for the adoption of service orientated architectures (SOA) for the design and development of institutional systems in order to package business processes as services.

The social security institutions should reconfigure their systems and applications in order to increase reuse and satisfy new user requirements. They should also integrate agreements for a component-based model at the service and operational policy level, which will also require an agreement for a joint scheme to interconnect the loosely coupled service components, and introduce the necessary infrastructure for the establishment of their public services.

4.2 Model Layers

The model (Figure 2) has been divided into three layers: Basic public services, secure data exchange and aggregate public services, as shown in the figure below.
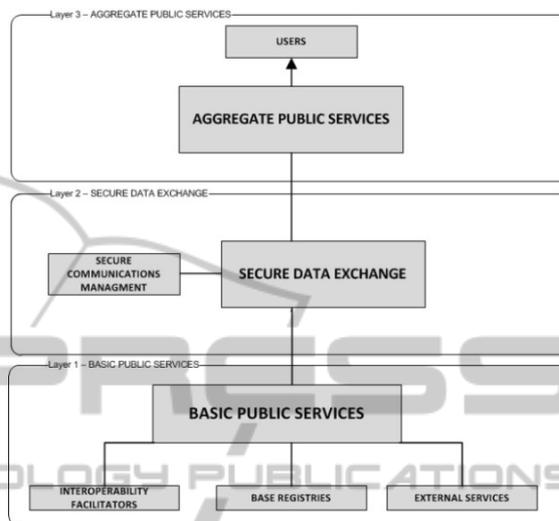

Figure 2: Conceptual model for social security interoperability

4.2.1 Layer 1: Basic Public Services

The lowest layer of the model deals with the most basic service components from which social security public services can be built. It groups three types of components, namely services based on base registries, interoperability facilitators, and external services.

Some basic public services have been developed primarily for direct use by the public administration that created them or their direct customers, i.e. businesses and citizens, but are made available for reuse elsewhere in order to provide aggregate public services. Others are generic and/or infrastructural by nature, while the remainder represent external services, i.e. services provided by third parties. The following sections describe each type of basic public service in more detail.

Base Registries or Shared Data Sources.
The basic registries or shared data sources (reliable sources of basic data) represent the "core" data of the social security sector. Such registries are under the legal control of the social security institutions and are maintained by them, but the information could be made available for reuse with the appropriate security and privacy measures.

The basic registries can take various forms, but their main characteristic is that they validated and authorized by the corresponding administration. This means that such data registries contain pertinent reference data (not necessarily all the data) concerning citizens, businesses, beneficiaries etc. which is considered valid. Generally speaking their content is not static; they reflect the information lifecycle which in the context of shared data, represents a challenge.

Access to authentic data sources between different administrations will be facilitated if the interfaces to these sources are published and harmonised at both the semantic and technical levels. This data may come from legacy systems, which may constitute an obstacle to adopting the model since these systems, and their data repositories have specific characteristics limiting the possibilities for reuse (e.g. lack of published interfaces), and they may require extensive reengineering in order to make their information available for public services.

In order to construct this type of information source, the institutions must evaluate their existing services (and the associated business processes) in order to identify and document the existing service components or business processes, including the business functions provided by the applications; the data used by the processes, the services provided by the systems and the functions carried out by individuals.

Adopting the modular approach described in the model for the construction of services means the implementation of building blocks and implies the establishment of secure levels of confidence for specific interactive activities, alongside the introduction of negotiated agreements between administrations which may take the form of memoranda of understanding and SLA (Service Level Agreement), associated with the concept of well-defined interfaces in which other components (users of the service) can have confidence.

Interoperability Facilitators.
These are the basic mechanisms which provide services or act as information brokers to meet the needs of interoperability. In concrete terms, they consist of: service interconnection protocols (e.g. SOAP Web Services, REST, and RMI), protocol translators (gateways), format translators (e.g. XSLT), integration platforms (e.g. Integration Brokers, Queue management systems and Enterprise Service Bus) and using databases as data exchange mechanism, among others.

External Services.
These include services provided by external parties such as businesses or organizations which may be included in the provision of services such as: at information level – data concerning the civil status of individuals provided by other state departments; — at business level — payment services provided by financial institutions; or — at infrastructure level — connectivity services provided by telecommunications providers.

4.2.2 Layer 2: Secure Data Exchange

This layer is central to the conceptual model since all access to basic public services passes through it.

From a business point of view, administrations and other entities exchange official information that may involve access to base registries. This should go through a secure, harmonised and controlled layer allowing information exchanges between administrations, businesses and citizens that are:

- signed and certified – both sender and receiver have been identified and authenticated through agreed mechanisms,
- encrypted – the confidentiality of the exchanged data is ensured,
- logged – the electronic records are logged and archived to ensure a legal audit trail.

In the proposed conceptual model, these functions are grouped in the 'secure data exchange' layer. This layer should allow the secure exchange of certified messages, records, forms and other kinds of information between the different systems. In addition to transporting data, this layer should also handle specific security requirements such as electronic signatures, certification, encryption and time stamping. Security is potentially one of the main barriers to interoperability if it is not applied in a harmonised and agreed way among organisations.

The conceptual model calls on all service providers to: consider the security questions; cooperate on a common framework to meet their respective security needs via compatible mechanisms and commonly agreed specifications; reach a common understanding on essential characteristics such as levels of protection and levels of authorisation and authentication. Therefore, public administrations should agree on a common security framework when establishing a public service.

One of the key prerequisites for implementing the functionality expected in secure data exchange involves leveraging national identification and authentication infrastructures within the

administrations. This scheme should establish which ICT architectures and data are needed in an interoperable context to make existing electronic infrastructures interoperable.

4.2.3 Layer 3: Aggregate Public Services

Aggregate public services are constructed by grouping a number of basic public services that can be accessed in a secure and controlled way. They can be provided by several administrations at any level, i.e. local, regional, national or international.

A typical aggregate service should appear to its users (administrations, businesses or citizens) as a single service while transactions may be between different administrative units. Aggregation is accomplished via mechanisms tailored to specific business requirements, for example through orchestration or workflow engines.

Nowadays, users expect to access public services not solely through government portals or websites but also via intermediaries with whom they are in contact on a regular basis. Therefore, public services should be developed in such a way that they can easily be integrated in intermediaries' websites through mechanisms such as mash-ups and widgets, without government losing responsibility for the services themselves and with clear indications enabling users to tell the difference between private and public services.

If aggregate public services are provided by intermediaries, public administrations should establish:

- an authorisation procedure to determine which basic public services may be disclosed to which intermediary, and
- a procedure for certifying intermediaries to establish trust between users and service providers.

5 APPLICATION SCENARIOS

5.1 Overview of Application Scenarios: Integrated Social Security Systems

The implementation of large-scale and integrated social security programmes has become a key trend worldwide. By integrating social security programmes, the effectiveness and efficiency of social policies can be improved and the scope of programmes covered can be expanded. Some relevant examples are the conditioned benefit and household centred programs, the integrated health

systems, the integrated contribution collection systems and the implementation of social security international agreements (Duran, 2012) (Kounowski, 2012).

Interoperability techniques constitute a key element to implement integrated social security systems. This section summarizes some main findings, a complete description can be found in (Kounowski, 2012).

In Integrated Health Insurance systems, interoperability application includes the integration of different information systems involved in the determination of eligibility to health benefits. Similarly to the previous scenario, it strongly relies on Basic Registries with beneficiaries' data and Web services as "interoperability facilitator". In addition, Secure Data Exchange is required to comply with data protection regulations.

The implementation of compliance and contribution collection systems involves interoperability operations consisting of data exchange and access to external services (based on Web services). The main interactions are with employers (to receive declarations, payroll data and payment), with taxes authorities (data exchange and sharing); and with banks (to receive payment conformations).

International social security agreements generally have a dual focus. First, they seek to allow workers to total up their periods of activity in different countries when calculating their pension entitlement. Second, the agreements establish favourable conditions so that workers on temporary assignment in a country that has signed the agreement with the worker's country of origin may be covered by the host country's social security system without a waiting period. The agreements also provide for the payment of pensions independent of the beneficiary's country of residence and ease the formalities associated with obtaining and managing benefits.

Implementing these agreements involve an intensive application of interoperability techniques, mainly data exchange. Section 5.2 describes the case of the European Union social security agreement.

Finally, interoperability frameworks and platforms have been implemented in some countries to improve effectiveness and efficiency in social security operations.

France has developed an interoperability standard (INTEROPS) (OPS, 2010) for all French social protection organizations. INTEROPS provides two modes of exchange: (i) application-to-application, or exchange via Web services, which

allows a client organization's application to request services from a supplier organization; and, (ii) portal-to-portal, in which the client organization's staff may consult a supplier organization's Web applications after identification/authentication in their local infrastructure.

INTEROPS is based on international technical standards: SAML, for the input of identification and authorization data into an identification vector; SSLV3, to secure the transport layer and ensure the integrity and confidentiality of the exchanges; SOAP and WS-Security for Web service exchanges; and, XML, to describe interoperability agreements and the trace interchange format.

In Belgium, Crossroads Bank for Social Security (CBSS, 2012), serves as an "integrator" for Belgian social security. This institution is at the centre of a system that exchanges data among all institutions, employers and foreign institutions and manages the receipt and routing of the data transmitted, which are coded in XML using standard schemas (XML schemas). The data exchanged involve all functions related to social security affiliation, return-to-work statements and changes in circumstances that affect beneficiaries.

5.2 The Case of the European Social Security Agreement

In the European Union social protection is one of the elements of the right to free movement of persons. When a person who has worked in various Member States of the European Union applies for a pension, indicating that he/she has worked in various countries, it sparks off an exchange of information between social security institutions.

The application is normally submitted to the appropriate institution in the home state. The first task of this institution is to compile the necessary data to complete the application and initiate an inquiry. An inquiry will then be carried out into the insured member's rights, based on contribution periods in the state to which the institution belongs. The next step consists of what is called the interconnection phase: compilation of a list of the appropriate institutions in the states where the insured says he/she has worked.

The definition of rights is based on the exchange of a significant number of data. In accordance with new Regulations (883/2004 - 987/2009), paper is no longer a valid support for such exchanges, and electronic data exchange is in the process of becoming the only recognized medium. Structured electronic documents (SED) have been introduced

for this purpose and architecture is being created to provide a basis for the electronic exchange of social security information (EESSI) (European Commission, 2012). The implementation of this new scenario in all the social security institutions of the European Union means solving a series of interoperability problems which we will use as an example of the application of the guidelines.

The Model for Social Security Interoperability enables to specify and to implement the different interoperability requirements involved in this case.

In Layer 1, interoperability facilitators play a key role by providing the basic mechanism to exchange and transform data formatted in XML. They consist of: (i) SOAP Web services to implement interoperability with institutions, (ii) a central Integration Broker platform that interacts with the institutions and provides message translation services.

Using External services to obtain information about the civil status and living situation of the individuals is currently under discussion in the EESSI working group.

Unlike national scenarios, using Basic Registries and Shared Data Services is limited to a Master Directory of institution's contact data. Basically, it consists of a centrally maintained data base (with a coordination hub in Brussels) which issues local replicas at the points of access. In this way all the institutions share the information used to address messages. The transfer of messages is guaranteed through a Master Directory which contains the codes of all the institutions.

Layer 2 (Secure Data Exchange) also plays a key role by providing the means to comply with data protection and data security regulations when exchanging data between different countries. All information messages are signed and encrypted using Digital Certificates delivered by EESSI. In addition, the networking is based on s-Testa, which is a private European Union network.

Layer 3 (Aggregate public services) in the EESSI consists of the implementation of the business processes described above, which carry out the administrative operations starting with a benefit claim and finishing with the benefit delivery or refusal decision. However, institutions with a lower development level may use a common system (called "WeblC"), which consists of a presentation layer and a data base already installed at the point of access and provided by the European Commission as an additional component of EESSI.

Summarizing, the proposed model for Interoperability in Social Security matches with this

very large and complex project.

6 CONCLUSIONS

This paper presented a conceptual model for applying interoperability in social security systems. While the benefits of building more integrated and interoperable social security systems are widely recognized, the cost and complexity of social security systems pose serious challenges to institutions. This proposition aims at providing a standardized tool to facilitate the implementation of interoperable social security systems.

Following the European ISA Programme recommendations, institutions should establish their interoperability framework and define a model to guide the application of interoperability for implementing integrated social security systems. The here presented proposition follows the same approach.

The generic model proposed in this article includes pre-defined components, aims at reducing the complexity of developing the institutional model as well as providing a common tool for social security institutions all over the world.

It is important to highlight that this model aims at promoting the development of standardized specifications and practices, but leaving implementation flexibility to institutions.

The feasibility of the approach is shown through the presented application scenarios. On one hand, the analysis of scenarios describes the interoperability requirements of a wide variety of applications in social security. On the other hand, a number of proposed techniques have been applied in different countries worldwide.

The main contributions of this paper are the proposition of an interoperability model based on the EIF's model and taking into account characteristics and application scenarios of the Social Security domain.

Current and future work consist in the ISSA project for developing Guidelines and further technical support to assist Social Security in the implementation of interoperable social programmes through the application of this model. The development of software packages, jointly with IT industry, following these specifications was proposed during the Conference of Brasilia 2012.

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