Implementing Interoperability Infrastructures: Issues and Challenges from the Citizens’ Base Registry in Greece

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Abstract

As the need for interoperability infrastructures and services is more and more stressed by researchers and practitioners in e-Government, Base Registries, as fully electronic, centralized repositories of information for classes of entities, pose as an infrastructure that can support aggregate electronic services delivery.

In the presented approach, a Base Registry storing the citizen records is designed to integrate the legacy databases of 1,034 municipalities and is opened up to support the provision of electronic services towards governmental organizations.

Discussion on the results is targeting at best practice examples that can be drawn at scientific and organizational level, but also at the key difficulties that have to be tackled in such public sector information reuse approaches – in relevance with the administrations and industry readiness in each country, in order to fulfill one of the principal conditions for pan-European Public Services.

1. Introduction

Electronic Government has radically changed the way the public administration operates and delivers its services to citizens and enterprises [16], [24]. Today, public organizations have indeed deployed web portals providing electronic services based on the information stored in their internal back-office systems [4], but such infrastructures are rarely interconnected, integrated and coordinated among organizations in order to provide one-stop, proactive services oriented towards the real citizens’ needs [38].

In an effort to provide more and more focused electronic services, interoperability remains a key issue to be tackled [34], [35]. eGovernment Interoperability Frameworks and Government Systems Architectures prescribe Interoperability Registries as infrastructures assisting the definition of truly interoperable, one-stop services [4], [8] or even guiding the transformation and re-engineering efforts in the public sector [6]. However, such infrastructures typically define e-Government knowledge related to services [37] and do not interfere with the actual data exchanged during service provision.

In this context, Base Registries emerge as centralized and, in some sense, authoritative repositories of information for a class of entities. This information may be of value in and of itself, but a defining feature of a Base Registry is its utility as the hub of an information architecture that links with other distinct databases, and reduces the data requirements of services that build from those secondary databases [3].

According to the European Interoperability Framework draft version 2.0 [20], Base Registries represent data, which can be coming from legacy systems, under the legal control of MS or EU institution, but made available for wider reuse. Such repositories contain relevant information (albeit not necessarily all information) about an entity or a facet of an entity that is believed to be correct. The information is stored for a particular purpose and only the amount of information needed to achieve that purpose is stored.

Based on recent analysts reports [16], [20], [27], [34], Base Registries have to play a more active role in composite service execution within the oncoming landscape of cross-country eGovernment aggregate services. Since research efforts have already provided the necessary standards for interconnection via Web Services [29] and guidelines on how to create reusable data structures [6], Base Registries can utilize their results at a technical and (partly) semantic level. The main issues that remain to be solved on a per case basis are associated with organizational, legal and political (strategic) barriers.
In the present paper, the rationale behind a Base Registry is presented and an approach for designing and implementing a Citizen Base Registry combining the citizen records from the back-office heterogeneous legacy databases of 1,034 municipalities is visited. The core ingredients of the approach lie in the utilization of a centralized Base Citizen Registry as the cornerstone of information storage, to be constantly available within the whole public sector, while on the municipalities’ side, middleware infrastructures have been developed in each of them for achieving loose coupling with their legacy applications. In this way, it was achieved not to face the gigantic burden of a transition to a web-enabled Citizen Base Registry application, but to enable application-to-application interoperability whenever possible.

The structure of the present paper is as following: Section 2 describes the current state of the art in eGovernment Base Registries, analyzing the main elements contained in most implementations worldwide. Section 3 presents the Citizen Base Registry leading to discussions on its key results, impact and lessons learnt in Section 4. Conclusions upon the merits and limitations of the approach, as well as next challenges to be tackled are contained in Section 5.

2. Background on Base Registries

The need for Base Registries has been long recognized in the public sector in various EU Policies, i.e. the Public Sector Information Directive (2003/98/EC) [15], the European Interoperability Framework [20] and the Services Directive (2006/128/EC) [14]. Such policies invite Member States to open up basic public services, to establish “authentic sources” of information and to coordinate national legislation and standardization efforts necessary to enable sharing of public services across national borders. Interoperability Services on such Base Registries for information brokerage, language translation and/or standards conversion, as well as standardized interfaces across all Member States are principal preconditions for delivering pan-European e-Government Services (PEGS). The research community has also investigated the back-office integration through base registries in [1], [2], [3], [9], [22], [23], [31], [32], [36].

Every country has several base registries e.g. Persons, Businesses, Buildings, Roads, Vehicles, Drivers Licences, etc. and many special purpose registries e.g. Social Security, Pensions, Traffic. Such Base registries can be thus classified in various categories along two dimensions:

- **Type of a Base Registry** referring to the type of “entity” about which information is stored. It includes: Citizen Registries, Enterprise Registries and Asset Registries. Each of these types can be further elicited into Social Insurance Registry and Social Insurance Registry, for example, in the case of Citizen Registries, and Land Registry and Vehicle Registry in the case of Asset Registries.

- **Scope of a Base Registry** on the basis of the International, European or National (Central, Regional or Municipal) perspective it may have.

Typical examples of such registries have been implemented across the EU, as indicated in the following table.

<table>
<thead>
<tr>
<th>Type of Registry</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Citizen Registry</td>
<td>My File: consulting personal data in the National Register, Belgium [28]</td>
</tr>
<tr>
<td></td>
<td>German Administration Services Directory (DVDV) [18]</td>
</tr>
<tr>
<td>Enterprises Registry</td>
<td>Italian Signed Electronic Filing for Business Entities [21]</td>
</tr>
<tr>
<td></td>
<td>Estonian eNotary and GOV registers [10]</td>
</tr>
<tr>
<td>Land Registry</td>
<td>Estonian Digital Land Register [12]</td>
</tr>
<tr>
<td>Vehicle Registry</td>
<td>EUCARIS, the European car and driving licence [13]</td>
</tr>
<tr>
<td>Social Insurance Registry</td>
<td>Automatic granting of complementary benefits, Belgium</td>
</tr>
</tbody>
</table>

Generally, the contents of a Base Registry extend over:

- **Core Registry Elements** including the entity records, together with historical data. For example, in the case of a Vehicle Base Registry every record for a vehicle contains temporal information, apart from the vehicle’s features in order to capture the whole vehicle’s lifecycle: who bought it for the first time, when he sold it to whom, what features have changed, etc.
• **Common Codelists** that include predefined values to be communicated and be mutually understood among information systems. Such codelists originate: a) from international standardization organizations, such as the ISO 3166-1 country codes, the ISO-4217 as the currency code list, the UNECE Units of Measure used in International Trade, b) from national standardization efforts, targeting, for example, at public entities or geographic regions, c) from vertical standards in sectors, such as finance, justice, health, education and defense.

• **Common Interfaces or Web Services Definitions** with the functionality of importing or exporting contents of the Base Registry form or to other interested authorized public organizations.

As depicted in Figure 1, a Base Registry that can support aggregate digital public services provision should be conceptually placed on top of the back-office systems, since it operates as the mechanism that integrates all the necessary information from various sources. With the help of workflow engines and identification and authentication mechanisms that exist in most Member States’ portals, Base Registries contribute in the simple and aggregate public services provision at national and at pan-European context.

In fact, such base registries have recently started to be placed in the broader context of an Enterprise Service Bus (ESB-like) infrastructure [29] for the public sector [33].

The present state of the art analysis indicates that Base Registries have still a long way to go in order to provide complete electronic records in every country. Although the major technical issues have successfully been resolved by research initiatives, the organizational and legal aspects have been dealt with on an opportunity-based, country-flavored basis and are not connected with reusable guidelines and patterns for other relevant initiatives.

![Figure 1: A Base Registry in the broader e-Government context](image-url)
3. The Citizens’ Base Registry Approach in Greece

3.1 Context

In Greece, the citizens-related data represent a set of information around profiling, citizenship and family or military status (in the case of a male person), which is most frequently retrieved from municipalities. In most cases, such information is obtained either from a registered citizen in the municipality or a competent public authority in order to use it as a supplementary document in e-Government services, as indicated in the following use case scenarios (in Figure 2).

![Figure 2: Use Case Scenarios of Citizen Records in the Greek Public Sector](image)

As far as the country dimension for the Citizen Registry is concerned, the structure of the Public Administration in Greece is depicted in the following table. As indicated, there is indeed a vast number of public organizations that can be placed in the use case scenarios of the Citizen Records, which are effective through conventional means (i.e. submitting queries and receiving responses via mail or fax). Such organizations exchange information on an ad-hoc basis, since there are organizational or even legal issues that prevent them to electronically exchange data and cultural / political barriers that prevent their processes’ alignment. Furthermore, the majority of the public organizations have deployed heterogeneous legacy systems infrastructures built on different technologies, rarely following a common denominator of standards – as the Greek e-Government standardization effort [19] providing clear interoperability guidelines is present only during the last 2,5 years.

<table>
<thead>
<tr>
<th>Public Administration</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ministries</td>
<td>17</td>
</tr>
<tr>
<td>Regions</td>
<td>13</td>
</tr>
<tr>
<td>Prefectures</td>
<td>54</td>
</tr>
<tr>
<td>Municipalities</td>
<td>1,034</td>
</tr>
<tr>
<td>Public Organizations</td>
<td>691</td>
</tr>
<tr>
<td>Citizens Service Centers (KEP)</td>
<td>1,065</td>
</tr>
</tbody>
</table>

3.2 Methodology

In the broader context of reducing the administrative burden and providing more user-oriented services to their beneficiaries, the need for resolving a multi-facet problem of sharing data (as identified in Section 3.1) emerges. The methodology during the conceptualization, design and implementation of a Base Registry aggregating specific public information from various data sources bears four phases: Preparation, Design, Implementation and Maintenance.
Initially, a preparatory analysis is conducted in order to recognize the stakeholders of interest in the public sector, define their role in creating, storing or retrieving data around citizenship and understand their IT maturity. A first attempt to bring them all in the table in order to share the vision of the Registry and state their initial position can also be taken by the public organization which is institutionally responsible for its implementation and operation (i.e. in Greece this role belongs to the Greek Ministry of Interior).

During the preparation phase, the advancements in the e-Government domain across the EU, as indicated in Section 2 and in relevant literature, are also studied. The benefits gained and the lessons learnt from such experiences urge the corresponding public sector to examine under which conditions and circumstances such an infrastructure could be applicable:

- Are there any information systems already in place in order to seamlessly exchange electronic data?
- Have the mechanisms for cooperation among the public organizations been already established?
- Is there a specific organizational procedure to be followed in order to achieve their alignment?
- Are there any cultural issues that remain to be solved?
- Is the legal framework properly adapted or does it need any modifications?

During the design phase, a detailed analysis of the requirements of the various stakeholders is conducted through questionnaires, onsite interviews and consultation meetings. The underlying infrastructure in the public organizations, their maturity in using a Base Registry and the exact information needs they have can thus be defined. In case a modification is required in the legal framework (as in Greece), preparations on the legal act that will accompany it need to start as soon as possible since it is a time-consuming procedure.

Furthermore, the design phase decides for the overall Service-Oriented Architecture (SOA) of the system, its exact components and their functionality for each user group, as well as the standards, the technologies and the platforms that will be used during the implementation. Achieving a common understanding of semantics for the governmental information exchanges around citizens needs to be put high on the agenda due to a disagreement about the meaning, interpretation, or intended use of the same data among the involved public organizations. In this end, in the Greek Citizens’ Base Registry, a template Citizen Record has been depicted in XML Schema, while a set of codelists has emerged as a result of standardizing values within common fields.

In the implementation phase, the required interfaces, APIs and system components are implemented as prescribed in the Design Phase. In Greece, upon building the system and before populating with data, an extensive period of testing with real municipal data and 5 municipal back-office systems took place in order to validate the approach followed.

Finally, in the maintenance phase, the Base Registry is fine-tuned with appropriate modifications whenever necessary and runs the “cycle” defined in its Business Operational Model (see Section 3.4).

### 3.3 Architecture

The Citizen Base Registry consists of two layers:

- The Storage Layer which contains and manipulates the physical storage for the complete lifecycle of the Citizen-related data.
- The Access Layer providing all the necessary mechanisms in order to open up the Registry to all the Greek public sector.

Specifically, the Storage Layer includes 1 Base Registry and 3 Management Information System, as following:

- The Centralized Citizen Base Registry contains all the citizen-related records kept in municipalities. According to the relevant national laws, such data provide a person’s profile (name, family name, father name, etc.), citizenship, residence, family status and military status for military recruitment purposes in case of a male citizen.

- The Electoral Catalogues Management Information Systems that creates and manages the electoral catalogues for the citizens which are eligible to vote. Such Electoral Data alterations are sent to Ministry of Interior every 2 months.

- The Expatriate Management Information System is related to the records of the
citizens coming from Greece but living abroad in another country.

- The Foreigner Management Information System containing the information gathered about foreigners that live and work in Greece.

As far as the Access Layer is concerned, today, there are two alternative access options:

- Web Services for the technologically mature public organizations.
- Web Interface for the public organizations that do not have the required infrastructures to exploit the Web Services functionality.

The basic access layer for back-office systems via Web Services and Service-Oriented Architecture (SOA) complies with the underlying standards stack, such as Simple Object Access Protocol (SOAP) for data encapsulation and transport, Web Service and Definition Language (WSDL) for service descriptions.

The Citizen Base Registry is further supported by:
- a Business Intelligence module in order to provide reporting and overall management tools and a Security and Authentication module supporting secure data exchanges with the help of LDAP directory services.

It needs to be noted that the implementation is based on J2EE platforms and technologies: Oracle Database and Oracle Application Server. The security and authentication mechanisms are based on the national PKI ID-cards for the public employees, while the network infrastructure for data transmission is SYZEFXIS, the National Network of Public Administration.

### 3.4 Business Operational model

In order to put the Citizen Base Registry into production, a business operational model was defined in order to monitor all the transition and population parameters, i.e. the procedure for cleaning and incorporating data in the Registry, the appropriate timeplan and milestones. Such a model contains 4 phases:

- Phase A: Initial (1st Stage) Accreditation
- Phase B: 2nd Stage Accreditation
- Phase C: 3rd Stage Accreditation
- Phase D: Final (4th Stage) Accreditation

In Phase A, the Initial (1st Stage) Accreditation is awarded upon concluding that all check points related to data completeness (obligatory fields) and data quality (contextual checks against each and every field as well as co-related contextual checks) are validated. At this stage, diminishing duplicate records within the Municipality’s back-office Registry is a prerequisite that needs to be fulfilled.

In the meantime of Phase A, all Municipal Registry data is forwarded to the National Registry. Upon the end of this phase, encapsulation of Municipal Registry in the National Registry is permitted and only changed records are communicated between the Central Repository and the municipalities’ back-end repositories.

As the 2nd Stage Accreditation, Phase B has a similar functionality with Phase A with the difference that only changed records fall into the scope of this phase.

Then, Phase C (3rd Stage Accreditation) begins as soon as the previous two phases have completed. At this phase, each Municipal Registry which has succeeded in “Phase B” further undergoes a sequence of combinational controls, such as:

- Duplicate records checks against active records
• Cross-checking of records already inserted in the Citizen Base Registry and marked as “transferred resident”, since all records from the Municipality of Origin should have been deleted.

• Duplicate records checks against military status data for male citizens, taking into account the fact that a male resident of a Municipality can be either enlisted in the Municipality of his residence or in another Municipal registry.

• Duplicate records checks in the Citizen Base Registry and in the Electoral Catalogues Management Information System.

It is noted that as far as the Municipalities, whose data are populated in the Citizen Base Registry, are concerned, a file of changed records (i.e. corrected records that were tracked due to the Registry’s validation-correction procedures or due to changes in the municipal status of the citizen) is send to the Base Registry on a daily basis.

Indicatively, a set of operational data from this stage concerning 100,000 family rolls municipalities is depicted in the following table.

Table 3: Operational Data for Family Rolls

<table>
<thead>
<tr>
<th>Transaction</th>
<th>Average Volume per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issuance of Certificates</td>
<td>300</td>
</tr>
<tr>
<td>Registration of new family roles</td>
<td>25</td>
</tr>
<tr>
<td>Changes in records</td>
<td>38</td>
</tr>
<tr>
<td>Citizens transfer among municipalities</td>
<td>23</td>
</tr>
<tr>
<td>Deletion of a record</td>
<td>23</td>
</tr>
</tbody>
</table>

Finally, the Base Registry transitions to Phase D: Final (4th Stage) Accreditation as soon as Phase C has been completed for all the 1,034 Municipalities and all of the inconsistencies tracked in Phase C have been completed.

4. Discussion

The Citizens Base Registry is a simple, sufficiently transparent and security enhancing system for the Greek Public sector. However, creating a Base Registry that manages the lifecycle of the records, even for specific life events as the citizen-related data stored in municipalities, is definitely not a trivial task, but requires a lot of coordinated effort among many stakeholders holding their own agenda. In this context, a well-defined governance model for such a Registry needs to be envisioned and put in place with a clear long-term perspective. The absence of demonstrable commitment to such an initiative by senior government officials proves to be counterproductive. Therefore, providing political support and sponsorship to the development and implementation process of a Base Registry, which needs to be considered as a permanent activity and not as a limited-duration project, is a key factor to its success.

In Greece, persuading autonomous entities, such as the municipalities, which may be public organizations, but respect only their own agenda according to their legal status, to cooperate and incorporate their data to a centralized Base Registry proved a really time-consuming task. Since they tended to safeguard their data at all costs, enforcing a legal act obliging them to respect and contribute to the role of the Citizens’ Base Registry was necessary.

In certain cases, a governmental agency needs to be nonetheless established in order to be assigned with the Base Registry management and maintenance. Such an agency should have the legal authority to persuade and oblige the public authorities to create the necessary infrastructures in order to exchange data with the Registry.

As far as the implementation aspects are concerned, the ICT companies / providers of the legacy back-office systems have definitely a word to say when it comes to populating and updating the Base Registry via web services. They need to be on the same page and understand the ends sought. One of the most efficient ways to achieve this is to assign them, as a part of the implementation project, the implementation of a middleware layer above the different and often outdated back-office systems.

In the maintenance phase, a business operational model, that creates a set of population and maturity milestones and takes into account the context and the particularities of the public sector, needs to be determined. In fact, the effort required for the population of a Base Registry goes far beyond the one needed for the design and implementation, since achieving a certain degree of data quality encounters many difficulties, such as:
• Providing data records in an electronic format (in the case of technologically immature municipalities).

• Cross-checking of records on the basis of selected criteria with which the compliance may loosen from time to time in order to speed up the process and repeat it again at a later point of time.

• Resolving cases of citizens’ records that do not abide to the law due to misinterpretation of specific articles.

• Cleaning duplicate records existing both at the Base Registry and the back-office repositories.

• Adapting Registry contents according to recent socio-economical changes and transformations in Greek families (that may not be supported by law).

• Avoiding ending up with a Base Registry of great unbalanced family trees.

When deploying a Base Registry, it is equally important to define metrics of success associated to each phase of implementation and to assess such metrics to evaluate progress. Time frames for measurable changes though depend on the technological maturity of the municipalities and may stretch out from days into months.

In this direction, it should be beared in mind that answers to questions, such as: “When a Municipal Registry is considered as an Accredited Registry and thus accepted in the Citizen Base Registry?” and “When do we reach Project completion?” may not be obvious at all and create controversial discussions and negotiations with the various stakeholders.

Finally, particular emphasis needs to be laid on education schemes around the new ways of delivering and accessing the citizen-related data. Competencies of the public servants should be cultivated with the help of appropriate education schemes since knowledge and capabilities are necessary to understand the functionality of the Citizens’ Base Registry in its full spectrum.

5. Conclusions and Next Steps

In the effort to move towards more citizen-oriented one-stop governmental services and to achieve the resolution of interoperability issues, Base Registries pose as prerequisite infrastructures. The present approach focused on the design, implementation and population issues of the Citizens’ Base Registry in Greece, providing a sound collection of best practices and lessons learnt through this initiative.

The initial application of the Citizens’ Base Registry in Greece revealed important lessons that can be re-used in similar cases, such as:

• The most critical technical infrastructure does not lie in the Base Registry system itself. The need for a flexible middleware infrastructure that will have to communicate bi-directionally with a multiplicity of municipal legacy systems through standardized XML messaging at real time is far more crucial.

• Even more important is the issue of Data Quality, revealed in the process of removing human interaction from the issuance of various certificates and citizenship registry management. Every attempt for a centralised Base Registry must have a well-planned strategy and tools support for ensuring timely Data Quality improvement and management.

• As systems and ICT strategies in the public sector evolve, a Citizens’ Base Registry has to have a change management and evolution plan, as well. This evolution plan has to ensure sustainable development of the Base Registry in a changing landscape of merging municipalities, updated back-office municipal systems or completely new ways of service provision – to mention only Web 2.0 applications and participative digital public services creation.

After 4 years of ongoing effort, as of July 2009, the Citizens’ Base Registry is at the Operational Phase C, since 204 municipalities (19.73% of the municipalities) have already incorporated their 9.500.000 records which correspond to 3.700.000 citizens (33.75% of the population). Every day 40.000 transactions among the Registry and the municipalities legacy systems are executed and 8.500 citizens apply for services that use the Citizen Registry data, out of which 414 citizens (4.87%) fail to be served due to incomplete records. The public organizations that currently interoperate with the Citizens Registry through the Web Services Access Layer are: the one-stop governmental portal ERMIS (http://www.ermis.gov.gr), the Citizen Service Centres, the Ministry of Justice, the Perfeectures, two
Insurance Public Organizations and the Police Department.

The need for future steps for the Greek Citizens’ Base Registry has already started to emerge and includes:

- Definition and implementation of base interoperability services seamlessly interconnecting any public organization in full compliance with the directions of the Greek e-Government Interoperability Framework. Today, the base interoperability services provide support for the exchange of data among the Citizens’ Base Registry and the legacy back-office applications in certain public organizations. However, such services are not in full compliance with the e-GIF, which published its specifications when part of the Registry was already implemented, and changes need to continue to be gradually introduced in the direction of more open and reusable services.

- Interconnection and federation among Base Registry infrastructures at national and international level with a view to supporting pan-European e-Government Services. Such base registries, properly solving their maintenance challenge through content syndication, will soon become the key enablers of automated process execution, or executable interoperability.

As far as core future research directions for e-Government [10], [34] and Base Registries are concerned, the design and adoption of a Government Service Bus (in the direction of Enterprise Service Buses from the eBusiness domain) provides a fruitful field for research. Creating methodologies and solutions that provide end-to-end interoperability (like a service utility) and incorporate capabilities for semantically enriched service composition, brokering, negotiation, mediation and evolution on-the-fly [23] also appear as a worthwhile track for research on governmental electronic services. Finally, taking into account that legal rules regulate the services provision, approaches that combine service modeling [23] and execution with business rules management [29] can be targeted at future research.

6. References

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