An Approach to Transform Public Administration into SOA-based Organizations

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Abstract: Nowadays, Service-Oriented Architectures (SOA) is widely spread in private organizations. However, when transferring this knowledge to Public Administration, it is realized that it has not been transformed in terms of its legal nature into organizations capable to operate under the SOA paradigm. This fact prevents public administration bodies from offering the efficient services they have been provided by different boards of governments. A high-level framework to perform this transformation is proposed. Taking it as starting point, an instance of a SOA Target Meta-Model can be obtained by means of an iterative and incremental process based on the analysis of imperatives and focused on the particular business context of each local public administration. This paper briefly presents a practical experience consisting in applying this process to a Spanish regional public administration.

1 INTRODUCTION

Nowadays, SOA is widely spread in private organizations environments both in practice and theory. However, when we want to transfer this body of knowledge to Public Administration, implementations of the SOA paradigm are commonly reduced to implementations of Web Services, orchestration of processes or governance only based on rules of technical character that prevent public organizations from supplying the different public services efficiently and effectively.

Regarding the experience of implementing a SOA architecture and government in the Ministry of Education, Culture and Sport of the Andalusia Regional Government, which is a leading project which applies the usual methodologies of SOA modelling (Arsanjani, 2004) (Marks, 2008) to Public Administration (Sedeño, 2013), we have observed that an alignment with the Public Administration business is required to optimize the aforementioned administration's medium and long-term profits.

We propose a high-level framework to drive this transformation throughout the organization, covering all aspects related to the Public Administration business context. These operations sequences are initiated when certain events take place within this context.

A key point in this process are imperatives-understood either as duty or inexcusable requirements-, than can be defined for Public Administration as those that being overcome, may allow reaching excellence in providing citizens with services that inherently correspond to them, as well as in managing internal processes supporting them.

2 SOA PUBLIC BACKGROUND

The implementation of SOA is a complex technological, organizational and business undertaking. It requires being aware of the process theory and knowing it, as well as a deep understanding of the processes within the organization.

However, implementations in Public Administration demand cognitive and practical studies. There are major differences between private organizations and Public Administration. Therefore, solutions successfully used in private environments, could not apply to Public Administration**.**

This paper deals with providing an approach to transform Public Administration into SOA-based organizations. Thus, it is necessary to understand the business context differences between a public and a private organization.

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Unlike private organizations, focused on their profitability and stakeholders' value, public administration bodies have the public interest at heart. Their success goes along with their reaching of social goals. Simultaneously, these organizations have to cope with social and political demands, which are not the regard of the private sector. To compound the problem, public administration bodies create policies or policy advises which are more difficult to identify than private sector organizations' physical output or financial results (Tregear and Jenkins, 2007).

Processes in Public Administration are more complex than in private organizations (Repa, 2006). This is due to the fact that Public Administration is a closely set organizational structure, where processes are formalized and decision-making is slow. This is compounded by the decision-making independence of individual departments, which often pursue their own goals regardless of the whole board of government. The process flow across departments is much more complex and depends on the task scope of individual employees. In addition, all government actions are hedged around with a great number of legal regulations. These make the modification or improvement of processes a hard task to perform. They often require the introduction of changes in the law, which is a lengthy process.

Hence, creating an efficient Administration is impeded by factors (Hall, 2007) such as:

- Increasing bureaucracy (larger number of documents, statements and reports. Spain is organized into four administration levels).
- Complex and frequently changing administrative procedures (Each Administration in our country rules its own laws by adapting official central laws).
- Law inflation (establishment of new laws and regulations by the legislators. In Spain several Administrations duplicate their competencies, either at local or regional level).
- Competition for financial resources (budget item justification, application for EU funds).

Public Administration uses SOA solutions based on web services implantations (Goudos el al, 2007), policies orchestration (Popescu et al, 2012), or business rule compliance (Castellano et al, 2005) without the aim of becoming a reference model to them (Galster et al, 2013), so that it can overcome these barriers and become more competitive.

In contrast, there are methods based on understanding the organizational elements and their relationships and, also, the drive goals analysis (Delgado et al, 2013). In the same way there are several approaches about IT government such as ITIL, COBIT or TOGAF interrelated to the delivery of service. However, these methods do not specify how to transform Public Administrations' nature that is the aim of our paper -the transformation of the Public Administrations in terms of its legal nature into organizations capable to operate under the SOA paradigm-.

Nevertheless, the own administration must be transformed to operate in SOA environments incorporating its own legal and human barriers as part of the methodology. Many Enterprise Architecture (EA) Frameworks for private organizations about reference models based on SOA (Ruas de Oliveira et al, 2010) (Alwadain et al, 2013) are gathered after a literature review, whereas little information about critical success factors (CFS) in Public Administrations is found (Abdul-Manan & Hyland, 2013) (Koumaditis et al, 2013). EA implementation involves products and services that are both in business and industry domains, the technical infrastructure based on open system building blocks, the definition of EA that includes business process architecture, the application architecture and data and technology architectures (McSweeney, 2000). In fact, we have not achieved any generic framework designed specifically to support any kind of public environment.

All concepts exposed, regulatory framework, organizational structure and government processes as a service and bureaucracy, are included in the "business context" step, as part of the imperatives analysis described in section 3.

3 A HIGH-LEVEL FRAMEWORK APPROACH

Analysing imperatives method represents the previous step towards the transformation of an administration body into a SOA-based organization.

We start from Public Administration business context to carry out this process of analysis.

This context shows the organization's business, its functional areas and its organic structure, so as to identify its situation regarding the future government model.

Services supplied by Public Administration to citizens constitute an essential part of this business context. In the same way, we can also observe the determining factors conditioning the organization from both points of view, business and ICT (corporative policy defined at IT level).

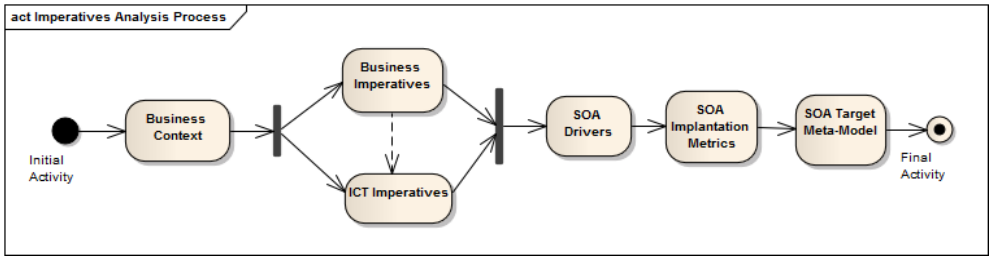

Figure 1: Imperatives Analysis Method.

Once the foundations of the business are laid, we proceed to identify the business imperatives. These refer to the business and service challenges addressed to citizens that Public Administration must face up. We get the ICT imperatives (the translation of the target business into a technical language), after identifying the aforementioned business imperatives, through a deductive process that relates the business challenges to possible initiatives that can be carried out from the ICT area, in order to face them successfully.

These ICT imperatives keep a certain level of abstraction since they define what to do, but not how to do it. In a next step, and, based on ICT imperatives, we will set out the concrete implementations that SOA can do regarding such ICT imperatives. These implementations are called SOA Drivers. This way we can realize the value that a SOA implementation can provide at corporative level, in relation to the need of facing up the established challenges outlined by ICT imperatives, and by extension, by business imperatives.

Therefore, once the relation between SOA Drivers and the own business imperatives has been defined -shown through the different traceability matrices-, we clearly observe that SOA Drivers must act as an engine when implementing SOA. A traceability matrix is a document, usually in a table form, that correlates any two baseline documents that require a many-to-many relationship to determine the completeness of the relationship. It is often applied to high-level requirements and detailed requirements of the product to match parts of high-level design, detailed design, test plan, and test cases. SOA implementation metrics will be defined, after identifying SOA Drivers. The definition and implementation of these metrics are carried out with the aim of evaluating whether the organization is transformed to operate under a SOA paradigm. Each SOA metric represents how efficiency is measured within each SOA Driver. Finally, we will arrive to instantiate the SOA Target Meta-model, once the SOA Drivers cluster has been executed. (Figure 1)

3.1 Business Context

Public Administration, due to its public nature and the service provided to citizens, is defined as *"the set of elements around which the Public Administration defines a global model for the providing of services to citizens, and establishes some strategic targets that determine the shape and minimum levels of providing such services"*.

There is a set of legal and structural elements in Public Administration that will make up the *"core business"* of the administration business context, which must constitute the starting point of our imperative analysis strategy. These common elements to all public administration will be more deeply explained below:

Regulatory Framework. Public Administration is set under a common regulatory framework that not only controls its own operation (internal management), but also the service provided to citizens. Besides, as the public administrative law is especially oriented towards the procedure and it is deeply guaranteed, some of the business procedures of administration bodies do not follow the principles of efficacy and efficiency. Consequently, their re-engineering draws a competitive line when providing these services. For example, in Spain, there are a group of laws that have direct influence on the way services are provided to citizens, such as *Law 11/2007, of 22 June, on electronic access to Public Services for members of the public*, that recognizes the right of citizens to have access to Public Administration by electronic means and regulates the basic points on the use of information technologies within the administrative activity.

All designs associated with services, processes and procedures must be framed within this regulatory background to be implemented, according to the most important concepts these laws point out: service provision, transparency, interoperability and citizens' empowerment.

Charter of Services. They are defined as documents whose purpose is to inform citizens of

the public services. The administration body manages the conditions in which they are provided their rights in relation to these services and the quality commitments offered in terms of its providing. This document is crucial, since it directly frames services that the relevant public administration body supplies and also its real aim as administration, delimiting the business context.

Structure Decrees. Each public administration body is regulated by a structure decree that determines a set of key elements affecting and configuring the SOA Component Diagram. This decree establishes **the competences** to develop the business process (which in turn will become the base of analysis of business imperatives) and the organizational structure that covers these competences (that will determine the Domain Model).

Strategic Plans. They are formal documents approved by the board of government, written to materialize public policies in order to provide citizens with a right. They do not answer to a legal duty, but each administration office should commonly be ruled by one or more strategic or action plans.

The Master Plan for Information Systems. It aims to get a reference framework for the IT development in response to Public Administration's strategic goals.

3.2 Identification of Imperatives

It will be necessary to identify imperatives within the strategy or imperative analysis. It means that we must get imperatives, understood as duty or inexcusable requirements, from the previous business context. Business imperatives can be defined for Public Administration as those that being overcome, may allow reaching excellence in providing citizens with services that inherently correspond to them, as well as in managing internal processes supporting them.

Starting from the analysis of the System Plans and the Competence Plans that Public Administration has been assuming by means of the corresponding decrees of structure and the particular regulatory framework, and, based on the current situation**,** the following business imperatives can be identified in general:

- Fulfilment of operative guidelines that entail measurement, analysis and continuous improvement of the public services offered.
- Checking the current level of administrative procedures by telematics means. It is necessary to perform the foreseen review of telematics procedures that involve the laws
- Existence of not computerized business processes, reengineering and automation of these processes, establishing the degree of agility when computerizing business projects are necessary. It is essential to implement the mechanisms to speed up the business processes computerization in the SOA paradigm.

Once the business imperatives have been established, the next step consists in identifying the ICT imperatives linked to each business imperative. These ICT imperatives are defined as the solutions that the ICT area of the administration body offers to face up the identified business imperatives.

As a result of the business imperatives analysis, and related to them, the next ICT imperatives will be identified, and a traceability matrix will represent the coherence of this identification.

This point is crucial since ICT imperatives will be those that, once translated into the SOA paradigm, will start creating the necessary base for the effective implementation of the architecture in such administration office.

3.3 SOA Drivers

SOA Drivers are initiatives that, under the SOA paradigm, help Public Administration tackle business and ICT imperatives. Therefore, SOA Drivers are the elements that should head the implementation of this architecture and, therefore, carry out the transformation.

A SOA Driver, that is a possible solution associated with each imperative under the SOA paradigm, will be recommended to identify these SOA Drivers for each identified ICT imperative.

To sum up, SOA Drivers will be the tools that aligned with the business context, will provide the organization with different ways of operating, leading to the effective implementation of SOA by instantiating the SOA Target Meta-model.

3.4 SOA Implantation Metrics

SOA implementation metrics (Brow et al, 2008) are the elements used to assess the degree of implementation of the SOA paradigm in the organization. These metrics are defined with the purpose of being able to evaluate the evolution of SOA Drivers in relation to the objective they intend to fulfil. Due to this relation, they are useful to evaluate the SOA implementation state together with its progression along the time.

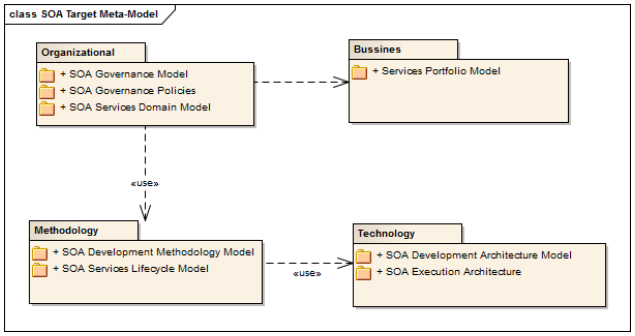

Figure 2: SOA Component Diagram.

Two concepts that will allow us to frame the concept of metrics and their relationship with an organization's KPI and SLA are defined below:

- **KPI** (Key Performance Indicators). It is an element that enables analysing any organization's business processes, making it possible to evaluate the level of achievement regarding the outlined objectives.
- **SLA** (Service Level Agreement). It is an agreement established between the service provider and the consumer by specifying the expected quality of that service.

It is crucial to define a set of implementation metrics that can assess the fulfilment of the identified business goals, in order to carry out a correct implementation of SOA.

The definition of these metrics is planned in the SOA implementation project, included within the activity of defining the SOA Government Model.

The aforementioned definition of metrics must consider the imperative analysis stated in SOA implementation strategy and, particularly, in the SOA Drivers identified.

With regard to the selection of the best metrics and indicators, they must be defined according to, at least, the following criteria:

- Alignment with both, the SOA Drivers identified and the business and ICT imperatives that lie beneath them.
- Possibility of doing homogeneous measurements on metrics, which enable making different comparisons to show how the implementation is evolving.

SOA metrics must be adapted to the main objectives of SOA implementations, so that they will verify the degree of achievement of these objectives.

SOA will define metrics, through its technological infrastructure and its governance policies and procedures, for monitoring services deployed in execution as well as evaluating the degree of implementation of the SOA paradigm into the organization.

The metrics that will allow checking how SOA has been implemented (in a company) can be classified in two different typologies:

- These concerning controlling activities linked to the lifecycle; revision of documentation, additions, versions, detection and use of the existing services, and revision of the accomplishment in the testing phase of the SLA defined.
- These concerning controlling administrative activities and management; tasks related to manage the registry (definition of a service property and maintenance of the registry) and define communication and distribution services policies.

3.5 SOA Target Meta-model (SOA-TM)

We propose a SOA Target Meta-model (Figure 2) for Public Administration that represents the necessary structure of components to start with the operation phase under a SOA paradigm.

This meta-model must be understood both, as part of the definition of the high-level framework and as its own result. That means that it is necessary to define first a set of components that, after executing the imperatives analysis and applying the iterative method proposed, shows the objective final state of the organization, which will operate under a SOA paradigm. This Component Diagram comprises four elements, which refer to the organization (government), business (functional), methodology and technology:

Organizational Components. At this level, policies and procedures that shall structure the SOA government will be defined. They will constitute a set of rules, restrictions and requisites to monitor the behaviour and actions within SOA services, so that

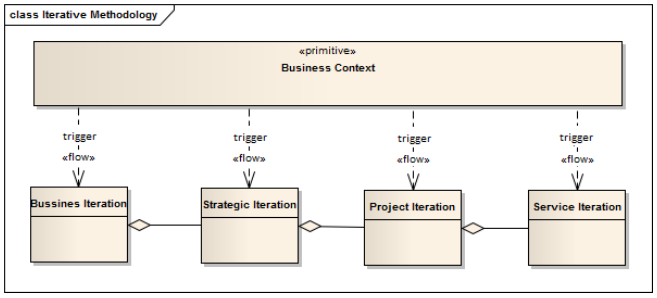

Figure 3: Iterative Strategy.

they can be aligned with the business needs obtaining a successful result after adapting the SOA paradigm. This government model will deal with the definition of SOA Service Domains, based on the legal organic structure of Public Administration. Definition of SOA Service Domain Model.

- Definition of SOA Government Model.
- Definition of SOA Government Policies through the formal definition (Parejo et al, 2011).

Business Components (Functional). This component is based on the analysis of the organization's business processes, obtaining as deliverable:

- Definition of the Services Portfolio.

Methodological Components. This root of the meta-model refers to the need of establishing the methodological bases that allow providing a common development framework.

- Definition of the SOA Services Lifecycle.
- Definition of the development methodology for SOA adaptation, making changes to the lifecycle development. The Ministry of Culture and Sport, for instance, works with methodology focused on the Model-Driven Engineering paradigm, called NDT (Escalona et al, 2008). It covers all aspects regarding the lifecycle development.

Technological Components. At this level, the technological components suitable for the service-oriented development must be selected, giving priority to those that maximize software and platform interoperability reuse.

- Definition of SOA Development Architecture.
- Definition and implantation of SOA Execution Architecture.

4 ITERATIVE STRATEGY

The implementation of a SOA must be considered an incremental process, which cannot be focused on information technologies, but on its own business processes. The strategy for an organization to succeed with this initiative must consist in establishing a time and progression line, where different iterations occur, assuring that technology is aligned with the cultural, organizational and governmental aspects of such organization. Four kinds of iterations must take place (Figure 3) to reach the target of this SOA transformation. These iterations will be part of a lifecycle that will influence the organization in a multidimensional way, will have a periodicity recommended, but not defined and will re-launch the imperatives analysis in different context switches.

This will depend on the business context shooters, which will re-launch the lifecycle according to the level where the event will take place. Each iteration is in turn made up of n-iterations at the next level.

Business Iterations. They constitute a cycle of business analysis that must allow detecting any change of relevance within the organization. From the point of view of PA, the business deals with providing services supplied by executive orders.

Strategic Iterations. They particularly focus on the SOA transformation strategy point defined in the analysis of business and ICT imperatives. This kind of iteration is the result of carrying out multiple initiatives or SOA projects within the framework. As a consequence of this process, technology itself acts as a SOA transformational element. In the same way, it is the opportunity to execute the government policies defined, broaden their acceptance, taking them as organizational and cultural base, and the last targets of each individual project**.**

Project Iterations. The degree of implementation reached on the proposed SOA projects and, therefore, the degree of transformation of the related body will increase in these iterations. They mean a cycle of analysis of the group of SOA projects necessary to fulfil the SOA transformation strategy process of the PA.

Service Iterations. SOA services iterations are implementations of business or technological requirements carried out by the organization, which finally conform the SOA paradigm. This iteration must follow the corporative process defined for the PA in relation to the lifecycle of services as part of SOA methodological definition of development.

5 A PRACTICAL EXPERIENCE

The project presented in this paper was developed by Junta de Andalucía, the regional government of Andalusia, a region located in the south of Spain, counting with more than 200,000 employees. This project was developed by the regional Ministry of Education, Culture and Sport, which is in charge of developing and coordinating public policies both in cultural and sports areas. Among its tasks, this ministry manages public museums, archives, sports clubs, art galleries and theatres. It is also responsible for supporting regional cultural and sports industries, together with other public and private stakeholders. The ICT Department of the Ministry is in charge of running this project, being responsible for all Information Technology policies in the Ministry.

The project started in January 2008 and finished the first complete iteration in June 2009, after instantiating all components of the SOA Target Meta-Model.

Since this moment, the Ministry has executed the iterative methodology in all changes that occurred in the last years, re-launching the lifecycle in relation to the level at which the event takes place, according to the business context shooters.

The results of applying this method to the business context of the Ministry of Culture and Sport shows that the imperative analysis on the e-government services are part of the business context composed by the strategic plan of Andalusia's Culture, the structure decree of Ministry, the Decree 317/2003, November 18th that regulates the Charter of Services and the Open Source decree of Andalusia.

The main conclusion and principal business imperative towards e-government was "*expand the current level of administrative processing by telematics means*". The ICT imperatives associated were "*implementing an administrative procedure engine that allows incorporating of new administrative procedures electronically*". The SOA Drivers defined to fill this deal with "*defining these e-government processes as a set of SOA services that can orchestrate with the aim to compose more complex procedures*".

It is not possible, since it is out of the scope of this paper, to describe all policies, artefacts, processes, roles or actors involved in governance according to the SOA Conformance Office.

The elements of the SOA Target Mata-Model have been created along the process of applying this methodology to all business imperatives. Finally, this model was instantiated. Particularly, 14 domains, 20 processes (governance model and governance policies), a service lifecycle model, a service portfolio definition and new activities for the software development lifecycle, were generated.

From a technological point of view it has changed the software lifecycle based on NDT. A UML element interface type to service modeling was created and activity diagrams corresponding to DAS and DRS were modified. Additionally, a services repository (supported by Enterprise Architect) that is used to identify existing services in the process of analysis was also created.

6 CONCLUSIONS AND FUTURE WORK

This approach will allow us to trace a roadmap towards transforming Public Administration (PA) progressively, beginning with its legal framework and led by the IT, and ending with a model that covers all the required components in SOA.

The results of applying this high-level framework concern the transformation of PA into an organization capable of operating under the SOA paradigm. The ultimate goal of PA regards services provision, especially those related to e-Government and citizen's transparency and empowerment (European Commission, 2010).

Transforming the administration using this method shall ensure that services are provided with the proper level of quality, and that such services are those that should be actually supplied, due to the analysis of imperatives and the correct identification of the business context. Besides, technology will lead the civil servants through SOA Drivers towards the structural change in administration itself in a clear way. This process has proven to be a valuable ally to overcome the human component, integrating technologies and political profiles in the same direction. We have successfully identified the triggers that affect business context and require adapting the organization, through the iterative strategy. The transformation of PA through this

high-level framework will enhance the level of maturity of service provision. Therefore, we can consider levels of maturity in e-government and open government services provision, from the transformation of the organization and the instantiation of this SOA Target Meta-Model.

This will entail, as a future work, the analysis and quantification of the meta-model components that more effectively contribute to reach such level of maturity.

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