An approach to extend NDT in the development of Web Applications into Services based organizations

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Abstract. Public administrations are providing citizens with online services. Organizations that have implemented governance based on Service Oriented Architecture (SOA), with a certain degree of maturity, must incorporate software development methodologies that enhance working with services in the early stages of Web development that means, during Requirements and Analysis phases. The use of Model-driven Web Engineering paradigm (MDWE) in Web engineering appears to have yielded very good results. We will focus on NDT proposal (Navigational Development Techniques), incorporating activities in order to complete the SOA Target Meta-Model. These activities integrate the development lifecycle into SOA Governance Policies and SOA Services lifecycle. This will create a natural and automatic use of SOA Services at public administrations in the early stages of Web development.

Keywords: Model-Driven Web Engineering, SOA, Governance, NDT, Public Administration, Services.

1   Problem

One of the key elements in the SOA (Service Oriented Architecture) Target Meta-Model at public organizations capable of operating under the SOA paradigm [5, 6, 7] is the reference to the methodological component, especially regarding the SOA Development Methodology Model. This methodology aims in the integration of Web applications development with SOA Governance Policies in the early stages of development.

As the government must provide citizens with public services by means of telematics processes [1, 2], the natural way of providing these processes to citizenship is using Web applications. Thus the Web engineering paradigm will best suit the integration between SOA Governance and these services development.

We have chosen the NDT approach (Navigational Development Techniques) [4] among the methodological solutions included in the Model-driven Web Engineering paradigm (MDWE) [3], which has been shown to be effective for Web development, in order to extend its activities with the aim to incorporate the necessary activities for

services development during the Requirement and Analysis phases. This methodology has been selected for three main reasons:

- It has already succeeded in several public administrations [10,9].
- It matches with one of the research lines of the IWT2 Research Group (Web Engineering and Early Testing) [14], focused on MDWE. IWT2 is a research group referenced in the Andalusian Research Plan (Group PAIDI TIC021), the Fidetia (Foundation for the Investigation and Development of Information Technologies in Andalucía) and FIUS (Research Foundation of the University of Seville).
- It has a set of tools that applies NDT Methodology, called NDT-Suite [9,11]

Therefore, the objective of this research is to extend a method pertaining to the MDWE paradigm. For this purpose we have chosen NDT methodology, as it is capable of fitting in, from the early stages of development and later in the NDT transformations, the SOA Services framed within an organization that has a SOA Governance, through the modeling of a set of activities that extends the NDT model.

In the present study we have identified three key challenges that will conform de core of the problem:

- The Services formal description. It is necessary to be discovered and used early at the requirements phase of new applications. We need a formal description of the functionality of each service.
- A formal high-level description of the new Web Application requirements is demanded. We can represent the requirements at the initial phase of the development through a meta-model as close as possible to natural language, using metadata, phrases or keywords, among other items.
- We would need an Information Retrieval System that can have the capability to index the Service Portfolio, accept queries given by the high-level requirements and show the services that agree, in a certain degree of similarity, with those requirements.

This approach fills in the existing gap in the Web Applications development with an intensive use of Services to allow running the work in Services-based environments using MDWE paradigms.

Hence, the main target audiences of this research are SOA-based organizations, particularly public administrations that offer their services through Web applications, as owners of such Services. They are empowered to make changes on them (legislatively and operationally).

2 Related Work

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

As [6] presents, a SOA Target Meta-Model (Figure 1) for Public Administration represents the necessary structure of packages to start with the operation phase under

a SOA paradigm. This set of metamodels 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 imperative analysis and applying the iterative method proposed, shows the objective final state of the organization, which will operate under a SOA paradigm. This paper shows how the SOA Development Methodology is integrated with SOA Governance Policies.
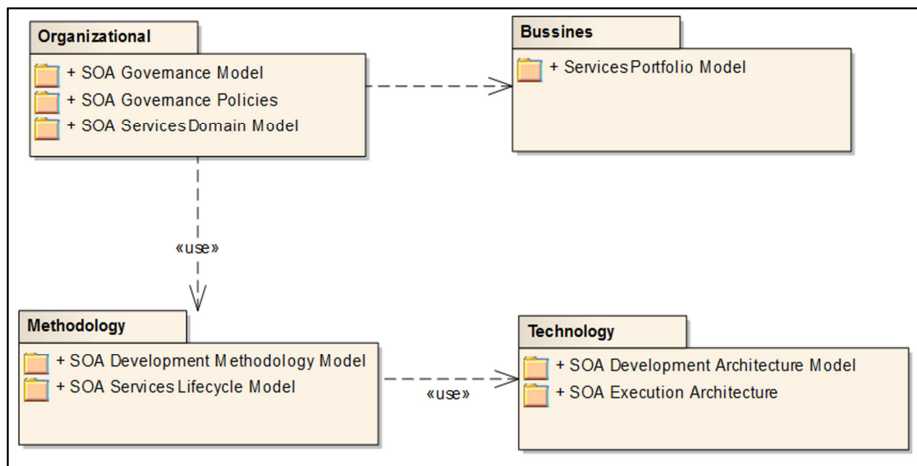

Fig. 1. Package Diagram of the SOA Target Meta-Model

2.1 NDT and MDWE

Both, Web engineering [8] and the new Model-driven engineering paradigm [3] have been defined as suitable solutions for companies and Web development in research environment. New Web system development techniques introduced by Web engineering together with the application of Model-driven engineering in this area provide relevant high quality solutions and reduced cost.

NDT [4] is an approach to define and analyze Web systems as well as to capture their requirements. The practical version of this approach is oriented to offer a suitable methodological environment for Web development.

NDT supports all phases of the software life cycle: the Feasibility Study Phase, the Requirements Phase, the Analysis Phase, the Design Phase, the Implementation Phase, the Testing Phase, and finally, the Maintenance Phase. All concepts in every phase of NDT are meta-modelled and formally related to other concepts by means of associations and/or OCL constraints.

NDT proposes a set of QVT (Query/View/Transformation) transformations that enables deriving one phase results from the previous one. These transformations are identified by the stereotype «QVTTransformation». The transition from the Requirements Phase to the Analysis models is standardized and automated. It focused on QVT transformations, which translate the concepts of requirements metamodels into the first versions of the analysis models. These models are known in NDT as

basic models of analysis. For example, the Basic Navigation Model of analysis is obtained from the Interaction Requirements, some of the requirements defined in NDT, which in turn, describe how user roles can navigate through the system. IRs also describes future access permissions of these roles. Thereafter, the team of analysts can transform these basic models to enrich and complete the final model of analysis. As soon as these transformations are carried out systematically, NDT allows analysts to perform then in order to enrich and complete this basic model. These transformations are represented through the stereotype «NDTSupport».

2.2   MDWE and SOA

We have found many research papers focused on the relationship between SOA and Web Engineering [12] in the current literature, as well as some others regarding Web Engineering Development Services [13] and Model-driven architectures in SOA environments. However, neither paradigm modified to work with services at a SOA-based organization based on mature SOA Governance, nor a Web development paradigm of this type applied to public administrations, have been found.

In short, it will be necessary a MDWE paradigm, ready to be part of services from the early stages of development.

3   Proposed Solution

The proposed solution to integrate MDWE with SOA in terms of the exposed problem intends to add several activities to NDT lifecycle that incorporates the connection with SOA Services Lifecycle.

These activities join requirements with services to develop Web applications by means of the organization services, which can be stored in a repository that shows the contract of the services in UML notation and BPMN business logic. This way, the analyst could consult the services in the early stages of development and activate SOA Services Policies, such as Create SOA Services, Versioning SOA Services or Using SOA Service.

The main objective of this study is to present the set of required activities for NDT lifecycle that could be integrated with the SOA paradigm throughout the development process. This will give the process a more global vision of the approach to business as well as the component reuse, which is one of the SOA paradigm foundations. The aforementioned activities will be added to NDT development process in relation to the Service Lifecycle. Thus, in the process making conditions it may not only reuse existing services in the organization, but also elicit new services that may be used in future roadmap developments. As a direct consequence, it is necessary that the life cycle could contain activities to:

- Model the organization's business processes.
- Relate processes to the functionality of the system that supports this process.

- Guarantee traceability to allow direction management, that is, impact analysis and business processes change.
- All these activities fall under Requirements Phase. These activities will be added to the current life cycle and are not taken into consideration for those events that are not made under the SOA paradigm.
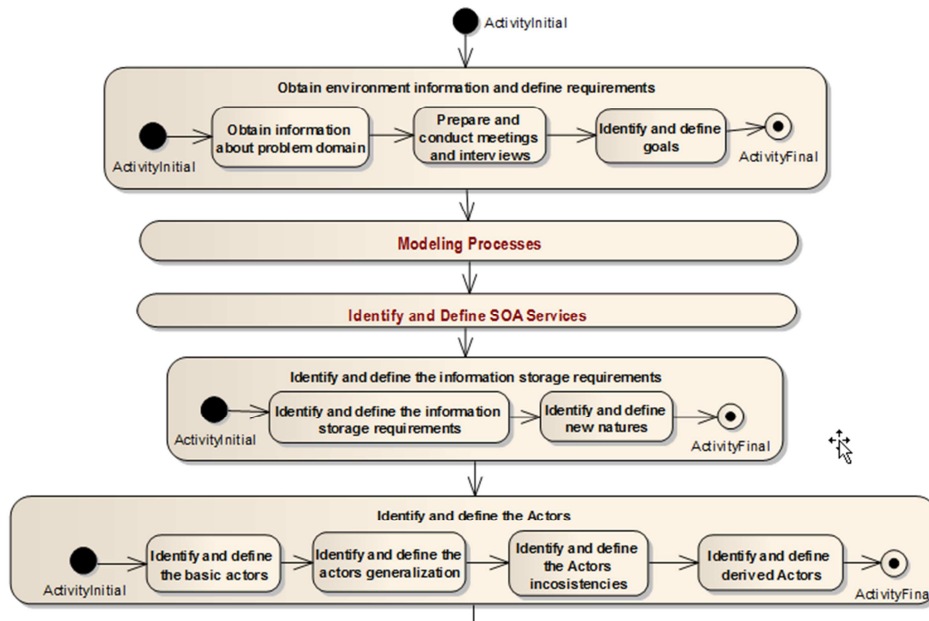

Fig. 2. Detail of the Requirements Phase (Activities Diagram in UML)

3.1 Requirements Phase

Figure 2 outlines how these activities are integrated into NDT lifecycle (in red).The relevant SOA Governance policies will trigger depending on the Service existence.

A set of actions to incorporate SOA Governance processes are performed in the proposed activity called "Identifying and Defining SOA Services", which links services to activities. This fact can be observed in Figure 3 below. Now, we propose several solutions to "Identifying and Defining SOA Services" into Serviced Governance in terms of the exposed problems:

- As first solutions, we recommend that a Meta-Model should be used to describe the Services; the information will be grouped so that it can be part of representative entities, focused on different views. The entities of this Meta-Model are Service, Domain, Context, Operations or Service Taxonomy, among others. Each service has associated Policies Governance.
- The second solution proposed involves the necessity of having a set of high-level requirements [15], covering the full functionality of the new application, to find

which services are appropriate to be used in that application. We will use formalization, by means of another meta-model, of the user stories. A user story can be defined as a short piece of functionality that provides a customer or a user of a system with a value. A user story represents certain user needs, but not an exhaustive documentation of them. Most of the Agile estimation techniques use the method called "user stories" that was firstly introduced by extreme Programming and then popularized by Mike Cohn [16].

- Once both high-level requirements meta-models and the services are defined, it will be necessary to have adequate systems to match them. This system shall consist of an IR (Information Retrieval) based on text indexing engine which is fed from Services Meta-model. A service to a "document metadata" will be assimilated and high-level requirements will be used as queries.
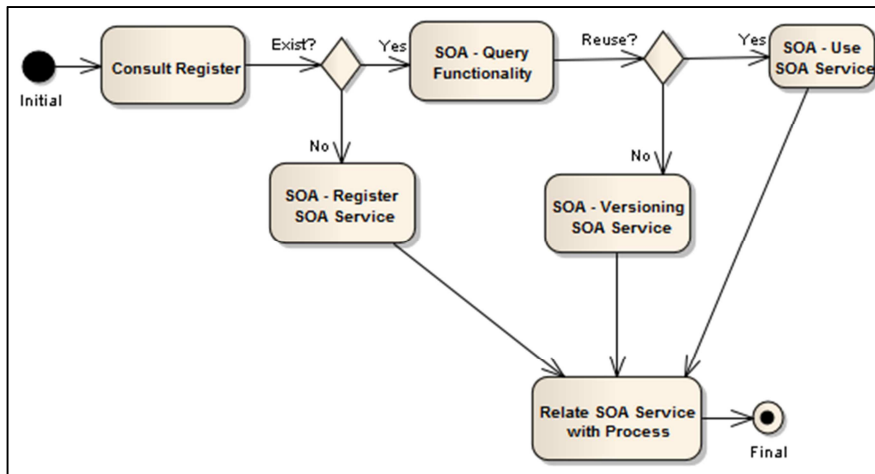

Fig. 3. Identifying and Defining SOA Services (Activities Diagram in UML)

4   Preliminary Work

The most relevant up-to-date work and results achieved are presented below:

- The preceding work about an approach to transform Public Administration into SOA-based organizations that was presented as a Master Science Degree thesis [5], that includes a practical experience dealing with applying this process to a Spanish regional public administration.
- An article published in an international conference [6] regarding transferring this knowledge to Public Administration, in order to be transformed in terms of its legal nature into organizations capable of operating under the SOA paradigm.
- An article published in a national conference [7] about the Methodological components. The root of the metamodel 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. The Ministry of Education, Culture and Sport [6,7,9], for instance, works with a methodology focused on the Model-driven Web Engineering paradigm, called NDT. It covers all aspects regarding the lifecycle development.

5 Expected Contributions

Our principal contribution can be tackled from different sides. We expected a theoretical approach to integrate NDT with SOA Governance in a coherent methodology that could develop Web applications in SOA-based environments according to SOA Governance. From a practical point of view, an NDT extension is a mature MDWE methodology that can incorporate services naturally in the early stages of development in which the services work. This extension will include NDT-Suite evolution [9]. Finally, Enterprise Architect (an UML tool) backs up the design of a services repository, so as to consult SOA Services in analysis time.

6 Plan for evaluation and validation and current status

It is deemed necessary to work in liaison with Public Administration to show that the work solves the targeted problem and overcomes the existing state-of-the-art. The validation cycle focuses on four principles: plan, do, check and act (known as PDCA).

First, we will define the new activities of this methodology. Second, we will modify NDT-Suite to incorporate all aspects to this work. For this aim we will work within SOA Services in the proposed organizations. Third, we will test this framework in the IWT2 Group context through the existing relation with the Ministry of Education, Culture and Sport and other administrations that also work together with this research group.

Finally, we could compare the results obtained from these organizations using the new development framework with the previous results achieved after incorporating that new suggested in this study. Section 4 refers to previous studies that obtained the results and metrics. Those metrics will be used for subsequent comparisons.

This work is currently in its initial phase. It is expected to conclude in the next two years. A PhD dissertation on this topic will be presented in 2016.

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