

Service Oriented Analysis and Design Process for the Enterprise

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Abstract: - Development of applications at enterprise level based on Service Oriented Architecture (SOA) requires a comprehensive software process. While Object Oriented Analysis and Design (OOAD) is a powerful technique for modeling real world objects, it does not address several aspects of the services model. This paper discusses the difficulties in applying OOAD to services based applications and presents a Service Oriented Analysis and Design (SOAD) process that can be used at enterprise level. Services at enterprise level are identified and four sub-processes to develop the different services have been presented. It also recommends a roadmap for implementation of SOA based applications at enterprise level based on the SOAD process.

Key-Words: - SOA, OOAD, Service Oriented Analysis and Design, SOAD

1 Introduction

Service Oriented Architecture (SOA) is increasingly being adopted by CXOs in organizations for business transformation. SOA is a suitable architecture style when reusability, integration and agility are key concerns of an enterprise.

The four tenets of Service orientation are as follows [3]:

- Boundaries are explicit
- Services are autonomous
- Services share schema and contract, not class
- Compatibility is based upon policy

In the services model, services are exposed by service provider applications and invoked by service consumers. Service provider and service consumer applications are loosely coupled by the use of service contract and data contract. A service contract is an interface that defines the message types used by service providers and consumers to exchange messages [7]. Service contracts specify one or more operations that represent individual message exchange or a request/reply message exchange. A data contract is a formal agreement between a service and a client that abstractly describes the data to be exchanged [6]. The definition of contracts enables loose coupling because the service provider and consumer can base all the interactions on the contract definitions than make any assumptions of each other.

On account of the differences between the services model and object oriented model, the traditional Object Oriented Analysis and Design (OOAD) process does not address all aspects of development of services based applications. While several insightful papers have been written on this subject [1], they have been found to be either generic or meant to address specific types of services or applications. A comprehensive process is needed for analysis and design of different kinds of services at an enterprise level. This paper discusses such a service oriented analysis and design (SOAD) process for design and development of applications for the enterprise.

2 OOAD Process

In software engineering, Process is “sequence of steps required to develop or maintain software” [4]. A Process model deals with *what* of developing software [8]. Methodology is a set of principles, practices and procedures that may be repeatedly applied to develop a specific category of applications. Methodology deals with the *how* of developing software.

This section covers the essentials of the OOAD process to serve as the foundation for the SOAD process to be discussed in subsequent sections.

With the advent of object oriented paradigm, OOAD process has been applied to develop object oriented applications. Object oriented applications are developed on the following principles:

- Encapsulation
- Abstraction
- Inheritance
- Interface
- Polymorphism

Object oriented analysis and design process involves modeling real world objects based on the requirements described as a set of use cases, realizing the use cases through a process of identifying the analysis classes (boundary, control and entity) and mapping the analysis to technology elements that constitute the design classes. Classes are fine grained elements that are tightly coupled. Design classes can be implemented through programming and tested to develop the required application.

The key steps in OOAD process are shown in Fig. 1 below.

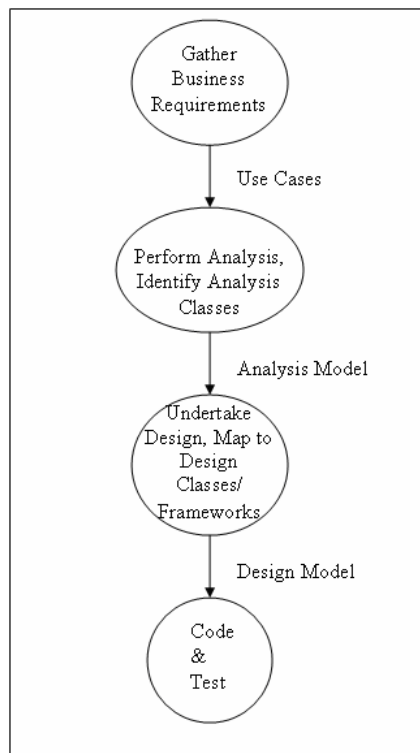


Fig. 1

While OOAD is a powerful technique that leverages the modeling of objects based on their class hierarchies, it presents some difficulties when applying to service oriented applications [9].

The granularity in OO applications is at class level. Service oriented applications deal with services at a course level of granularity. While interfaces defined

for objects do provide for abstraction and information hiding and in principle can provide loose coupling, the fine grained nature of the classes and interfaces do not yield the benefits that one could derive from a services model. Further, class hierarchies are based on inheritance which brings strong associations and tight coupling. Service definition on the other hand promotes loose coupling between service providers and consumers. Also, the run-time environment for O-O applications assumes object housekeeping services (such as Garbage collection in J2EE applications).

3 Services Model for the Enterprise

Though there are some difficulties in applying OOAD to address all aspects of service orientation, it still is a powerful approach for addressing some aspects of process required for services model. In order to extend the OOAD process to support services model, certain key considerations of the model need to be addressed in the process:

- 1) Reusability – The reusable and coarse-grained nature of a service is fundamental to the services model
- 2) Agility – Applications based on services model have their business processes externalized in an “orchestrable” manner
- 3) Integration – Service providers and Service consumers are loosely coupled and communication between them is based on published contract

Analyzing above considerations in an organization context, results in four types of services [5].

- Client services
- Business Process Management Services (or Process Services)
- Business Application Services (or Activity Services)
- Data Services (or Entity Services)

The four types of services are integrated by the Enterprise Service Bus (ESB) pattern as shown in the Fig. 2.

Client services deliver content to the business users that require an aggregated enterprise view. They provide presentation content to the “front-end” applications of the enterprise such as Portal, dashboard or CRM applications that provide the necessary presentation capabilities and typically are service consumers for the other services in the enterprise. Business Process Management services allow for externalization of business processes in an

orchestrable fashion resulting in agility for the enterprise. Business Application services are reusable business level services that can be orchestrated as part of a configured business process. Data Services encapsulate access to data in various sources such as ERP, legacy, a data warehouse or a system external to the organizational context.

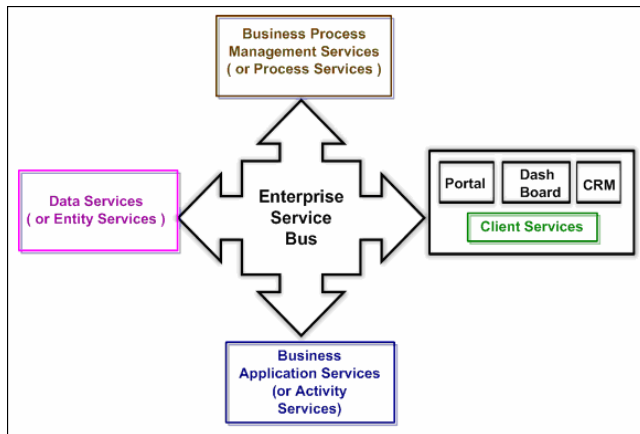


Fig. 2

4 SOAD Process for the Enterprise

Taking into account considerations for the services model and the different types of services discussed above, a service oriented analysis and design (SOAD) process has been defined as shown in Fig. 3 for developing SOA based applications in an enterprise context.

As in the case of the OOAD process, the first step is to gather objectives and business requirements for which the application needs to be developed. This is followed by business process modeling that involves identification of business processes and workflows that applications in the enterprise would need to support to meet the business objectives. The business process model thus generated is a key artifact in SOAD process for the enterprise and serves as input to four sub-processes identified by the first letter of the names of the Sub-processes.

Sub-Process A - Activity Services Development

The business applications expose activity services that are developed through this sub-process. Business process model is analyzed to scope out the applications (that would implement the business processes) and their requirements as a set of use cases. It may be noted that any enterprise would have a set of applications supporting the current-

state business. Minor or major changes may be needed to the applications that support future-state business to not only support the services model but also to meet the objectives of the future state business. The use cases identified determine the scope of each of the applications for the future state from a functional perspective. Activity Services exposed by the applications are identified and defined by specifying their service and data contracts. In order to realize activity services so defined, the analysis, design, coding and testing steps of OOAD process are followed.

Sub-Process (B) - Business Process Services Development

The agility in business processes for an enterprise is due to the business process management services developed by means of this sub-process. The business process model provides the workflows that may be expressed as BPEL, configured and orchestrated to generate the Business process services. In most projects, these services are rarely built ground up. A product that provides process orchestration capabilities is typically used as basis for development of these services.

Sub-Process (C) – Client Services Development

In an enterprise context, business users need to have an enterprise view of business through dashboard, portal or CRM infrastructure. The content for the enterprise view is provided by client services that are developed through this sub-process. The purpose of defining services for the content required by business users is to facilitate delivery of content provided by these services through multiple channels such as web, mobile etc.

With the advancement in Mashup technologies, sophisticated and innovative approaches can be adopted in delivering content to users by leveraging the client services.

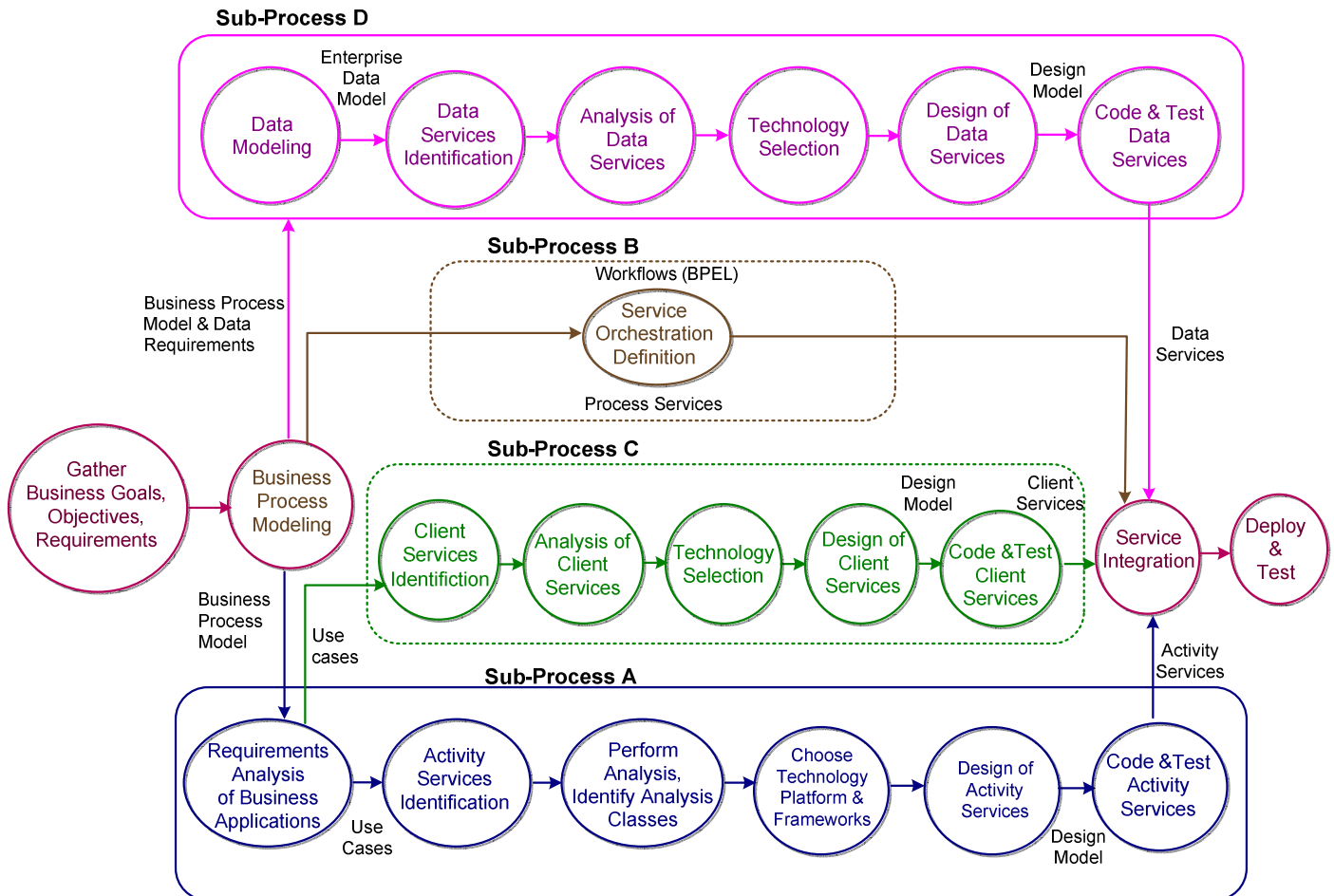


Fig. 3

Sub-Process (D) – Data Services Development

As organizations mature and bring alignment to business and IT and migrate to a services model, it becomes imperative to model enterprise-wide data. This sub-process deals with development of data services or entity services that support the business process model of the enterprise. The first step in development of the data services is creation of an Enterprise Data Model after analysis of the Business Process Model. Data services are then defined to store and access of core data in the enterprise (e.g. those required to provide a single view of customer). The rest of the steps in this sub-process involve identification of tools, analysis, design, coding and testing of data services.

5 Roadmap for Implementation

The sub-processes of the SOAD process discussed above can be implemented using a chosen methodology (such as Iterative, Spiral or Waterfall)

depending on the business and IT considerations of the enterprise.

A roadmap for implementation of SOA at enterprise level (based on the SOAD process) needs to be defined taking into account the context of the enterprise including the business and IT considerations and views of the key stakeholders. The following is the recommended roadmap for implementation of the SOAD process for the enterprise:

- 1) Constitute a SOA Governance team for the enterprise with representation of the key stakeholders of the enterprise
- 2) Gather the business objectives, drivers and key business requirements
- 3) Formulate a SOA Strategy for the Enterprise
- 4) Develop SOA Architecture for the Enterprise
- 5) Undertake Business Process modeling

- 6) Identify Activity, Business Process, Client and Data services
- 7) Establish a technology stack for implementation of services
- 8) Develop a PoC with representative Activity, Business Process, Client and Data services to validate the technologies
- 9) Develop Data, Activity, Business Process and Client services based on the chosen methodology for the enterprise
- 10) Integrate and deploy the services

The above roadmap allows for multi-location development teams to work in parallel without significant dependencies. Steps 1-8 are strategic in nature and help in formulating a blueprint for the enterprise based on the services model. Most of the effort in migrating an organization to the services model is in step 9 and the SOAD process discussed above can be employed by multi-location teams to accomplish it. Development of services for different services requires resources (with varying skill sets) who may belong to different business units according to the organizational model of the enterprise. The blueprint developed in steps 1-8 helps bring about alignment of effort to a common enterprise context with little or no dependencies.

For example, consider a large global organization operating in number of geographies (e.g. US, Europe, Australia and Asia) with varied IT systems on account of mergers and acquisitions. As is the common practice with several large organizations, consider that the large global organization has decided to outsource portion of the IT systems development and maintenance to a System Integration partner.

The recommended roadmap may be applied as follows:

- 1) A SOA Governance team is formed with representation from different units consisting of key stakeholders, system integration partner, business analysts, a central architecture team (if one exists) and architects from different business units.
- 2) This team takes an inventory of the existing systems and captures the AS-IS business architecture, application architecture, information architecture and infrastructure architecture.
- 3) An enterprise wide SOA strategy is adopted keeping in mind business drivers and other considerations such as protecting

- of investments in existing IT assets and distributed management of IT systems and infrastructure.
- 4) A SOA architecture is defined for the enterprise that would establish reuse, agility and integration at the enterprise level.
- 5) The key step of business process modeling of the future state business process is then undertaken.
- 6) Activity, Process, Client and Data services are identified and their service and data contracts defined.
- 7) To benefit from economies of scale as well as standardization in terms of technologies used in the enterprise, a reference "technology stack" is defined. The SOA Governance team manages technology adoption in the enterprise using the SOA architecture, reference technology stack and other considerations.
- 8) In order to mitigate risks due to inadequate strategy and choices of technologies, PoC is developed as a reference implementation. The lessons learned from the PoC effort are used to fine tune the SOA implementation strategy.
- 9) The next step is where the benefits of the SOAD process are realized. With the service contract and data contract definitions in place, development of services can be parallelized by an organization-wide effort and that of the outsourced system integration partner. Each unit of the organization can base its development effort based on the SOA strategy, reference technology stack and implementation as per the SOA architecture defined in step 4.
- 10) Integration of the services in an iterative manner will result in a relatively smooth transition to the services model.

6 Conclusion

A comprehensive Service Oriented Analysis and Design process is needed to implement SOA at enterprise level. This paper discussed such a process in detail and provided a roadmap for implementation. Large organizations and system integration benefit from such a process when migrating to a services model.

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