Gestão de Processos de IT Service Management com Plataformas EAI

Using EAI platforms to manage IT Service Management processes

Paulo Rúben Pereira Sebastião

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Júri

Presidente:	Prof. Doutor Pedro Manuel Moreira Vaz Antunes de Sousa
Orientador:	Prof. Doutor Miguel Leitão Bignolas Mira da Silva
Vogais:	Prof. Doutor Diogo Manuel Ribeiro Ferreira

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Abstract

Business Process Management (BPM) is one of the emerging trends in Information Technology, motivated by subjects such as Service Oriented Architectures, Business Activity Monitoring and Business Process Reengineering. In this thesis we discuss various subjects, such as Business Process Management, lifecycle of a business process, Enterprise Integration and describe how Enterprise Application Integration (EAI) tools are including BPM concepts in their suites and how these two disciplines have historically converged. In this thesis, we propose to study EAI tools and assess how well they support BPM. To achieve this, we used two EAI applications to support and manage an ITIL Change Management process through its lifecycle. This case study allowed us to point out some key research areas where these tools have to focus on to improve their BPM support and such findings are presented on this thesis.

Keywords

Business Process Management, Enterprise Application Integration, Process Lifecycle, ITIL

Resumo

A Gestão de Processos de Negócio (BPM) é uma das tendências emergentes no mundo da Tecnologia da Informação, tendência motivada por assuntos como Arquitecturas SOA, *Business Activity Monitoring* e Reengenharia de Processos de Negócio. Nesta tese discutimos vários assuntos, como Gestão de Processos de Negócio, ciclo de vida de um processo de negócio, Integração Empresarial e descrevemos como as ferramentas de Integração Empresariais (vulgo EAI) começam a incluir certos conceitos da disciplina do BPM nas suas suites de *software*, dado que ambas as disciplinas convergiram historicamente. Nesta tese, propomos a utilização de ferramentas EAI para gerir o ciclo de vida de um processo de negócio, i.e. suportar a disciplina do BPM, ao utilizá-las para suportar e gerir um processo de ITIL dedicado à Gestão de Alterações. Este caso de estudo permitiu-nos identificar algumas áreas nas quais estas ferramentas devem focar a sua atenção para melhorarem o seu suporte à disciplina de BPM.

Palavras-chave

Gestão de Processos de Negócio, Integração de Aplicações Empresariais, Ciclo de vida de um Processo, ITIL

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List of Abbreviations

BAM	Business Activity Monitoring
BP	Business Process
BPI	Business Process Integration
BPM	Business Process Management
BPMS	Business Process Management System
EAI	Enterprise Application Integration
ERP	Enterprise Resource Planning
ESB	Enterprise Service Buses
ITIL	Information Technology Infrastructure Library
KPI	Key Performance Indicator
WFM	Workflow Management
WFMS	Workflow Management System

1. Introduction

"Build to adapt, not just to last"

Howard Smith and Peter Fingar, BPM: The third wave

William Shakespeare said "All the world's a stage, and all the men and women are merely players" and we say that the entire world is a collection of business processes and all of the men and women are merely actors in them. Business processes are a fundamental part of organizations since they are responsible for their competitive advantage and added value. If every organization had the same business processes, how would they differentiate from each other? Management theory will answer "they can differentiate using a low-cost strategy", but to use a low-cost strategy you need a business process that will help you achieve costs-reduction (e.g. Wal-Mart and their supply chain management process). However, business processes are not static; they're always changing in a somewhat chaotic way. Nordström and Ridderstråle wrote in *Funky Business*: "The new society works in real-time" meaning that now, more than ever, business processes need to be able to change in real-time. Competition among organizations is fierce and with the aid of technology business processes can be easily "cloned". To maintain a competitive edge, market leaders need to be able to respond to competition moves by changing their processes. Organizations nowadays have a clear vision that their business processes are their most important assets, but it wasn't always like this.

In 1990, Michael Hammer's "*Reengineering Work: Don't automate, obliterate*" was one of the most important contributions to the business process management discipline. It paved the way for the rise of business processes as first-class citizens in enterprises. Hammer's article stated that it was time to take the (outdated) business processes from the hardware and software and obliterate them, revamping the way that companies did business in the 80's. In the 80's, organizations worked in a functional manner organized by departments and functions. This led to a proliferation of business applications in organizations, since each department managed their own IT investments. Hammer's reengineering work has highlighted the need to change the functional perspective to a process focused perspective in order to improve customer satisfaction, improve cycle times and increase productivity.

When organizations tried to change to a process focused perspective, soon they realized that they had immense business applications in their IT infrastructure that needed to be integrated. The first

answer to process management and application integration was the Enterprise Resource Planning (ERP) business application. In its core fundamentals ERP had automation of processes and integration of information through the organization and they are considered the pioneers of business process management. However, they lacked change agility. According to Thomas Davenport, ERP were like cement – highly flexible in the beginning, rigid afterwards. Still, ERP's had another major flaw. They were the first promise of integration between systems; however it was also difficult to integrate them with other systems.

The first real solution to business applications integration came in the form of the so-called "middleware". Enterprise Application Integration (EAI) powered the organizations with integration capabilities. The first generation of EAI was only concerned with the integration of data and message routing. Later on, they focused their attention on business processes and captured the agility and flexibility to change needed by organizations. We believe that EAI is one of the most important technologies in the new wave of Business Process Management (BPM).

Business Process Management emerged as one of the biggest trends in the Information Systems industry and the interest in this area is growing, as shown by a study done by Forrester Research [26]. BPM software proposes to help organizations manage their business processes, i.e. manage their processes lifecycle. And how do they do this? By combining a series of technologies and ideas from disciplines such as: EAI, Workflow Management, ERP, WebServices, etc.

We start this thesis by studying the technologies which influence the third wave of BPM, as Howard Smith and Peter Fingar call it. We try to clarify what BPM is, what WFM is and what ERP and EAI are, since there's a lot of confusion about these terms in the scientific community as well as in the software industry. Some call EAI the second-generation of WFM [11], others say that BPM and EAI are the same technology and other view BPM as the second-generation of WFM [48]. To successfully understand what BPM is, one must also understand what a business process lifecycle is. As so, we present several perspectives of the business process lifecycle from different authors and propose a new perspective with six-phases: discovery, modeling, implementing, execution, analysis and optimization.

We also study the subject of integration and how integrations tools have evolved to become one of the best candidates for the support of BPM in organizations. We provide an historical perspective

of how these two disciplines have converged together. In this thesis, our goal is to assess the BPM capabilities of EAI software tools and answer the question:

Is it possible to fully support BPM solutions using EAI platforms?

We believe that EAI software has a strong advantage over BPM pure-play software and workflow based software, because business processes can be seen as nothing more than the integration and orchestration of several actors (humans and applications) that collectively realize a business goal and deliver value to an organization's customers. To answer the question above, we'll use two EAI software tools to manage an ITIL Change Management business process, WebMethods Fabric and TIBCO BusinessWorks. We'll assess how well these tools do support business process management and identify research points that these software tools need to focus on to improve BPM support. Our research findings are presented in this document.

2. Business Process Management

Over the past few years, Business Process Management (BPM) has emerged as one of the trends in Information Systems [12, 24, 44]. Competitive pressures are forcing organizations to increasingly integrate and automate their business processes such as procurement, order processing, claims processing and the like. BPM promises to help them in doing that. Although they are two distinct layers, Enterprise Application Integration (EAI) and BPM are usually seen as the same concept. We do not agree with this symbiosis of the two disciplines. We believe, however, that BPM needs EAI to be successful.

Before we go on, it's important to define what a business process is. Several definitions for business process can be found on scientific research papers (e.g. [17, 33]), white papers, books, etc. In this report we'll use Workflow Management Coalition definition of a business process [4]:

Definition 1. A business process consists of a set of one or more linked procedures or activities which collectively realize a business objective or policy goal, normally within the context of an organizational structure defining functional roles and relationships.

We'll now discuss how and why business process management (BPM) discipline was created. We start with the historical perspective that led to BPM and end with the definition of the business process lifecycle and its several phases.

2.1. Historical Perspective

Until very recently business processes were hard-coded in applications, the business logic was hard-coded in the applications. This makes applications aware and dependent of each other, which is undesirable since changes in an application may require changes in several applications. Several software vendors recognized this problem and started offering workflow management systems. To further complement this history perspective on BPMS, let's look at the evolution on Information Systems in the last forty decades [47].

Figure 2.1 shows the evolution of information systems which led to Workflow Management Systems. In the sixties, information systems were a collection of applications that would sit on top of the operating system with their own routines for user interface and data storage and retrieval. In the seventies, the data was pushed out of applications into DBMS leveraging the burden of data

management out of applications, examples are IBM Information Management System (IMS for short) and Oracle Database. In the eighties, similar events happened with user interfaces. The user interface was detached from the business logic, an example of this are n-Tier architectures and Model-View-Controller software pattern.

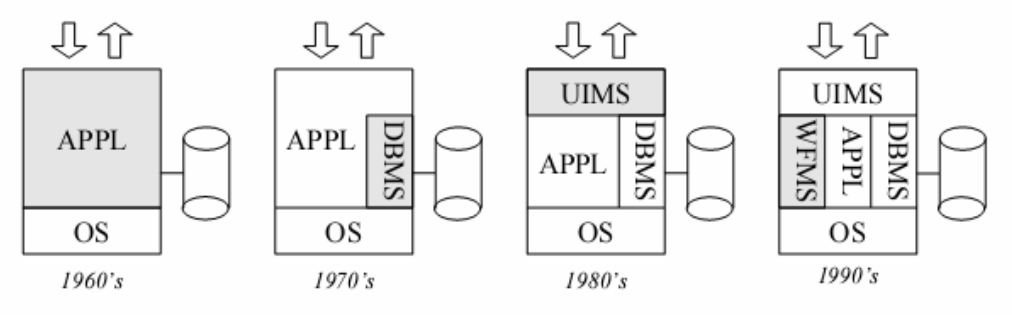

Figure 2.1. Business process management systems in a historical perspective [48]

In the nineties, WFMS pushed the business logic out of applications. As Figure 2.1 illustrates, the several sequential decoupling of functionality from applications sets the stage for WFMS, and answered Michael Hammer's claim that business processes had to exposed and removed from software [22]. Information systems are now seen as a composition/orchestration of diverse functionalities provided by different applications/systems. "The challenge no longer is the coding of individual modules but orchestrating and gluing together pieces of software" [32], a proof of this statement is the focus on software practices such as Service Oriented Architectures.

In the seventies and eighties software development followed a data-centric approach focusing on data storage and manipulation [48]. This led to a situation where businesses processes were the ones to adapt themselves to information technology, rather than the opposite. Eventually, these events triggered a shift of focus from data to processes. Focus on management disciplines such as Business Process Reengineering [15, 22] and on business-IT alignment [32] illustrates the change of focus from data to processes and the need for workflow management systems [5].

Another recent organizations' claim that illustrates the need for systems such as BPMS and WFMS is the need of business agility. Business agility is becoming a competitive requirement. Business is changing and the rate of change is accelerating [8] and as a consequence, information systems need to change on-the-fly [48]. We need what vendors usually refer to as "the real-time enterprise" [8, 18]. Enterprises must be able to view, manage and monitor business processes in business time,

rather than reacting only to the end-of-month reports after the facts. This is the idea behind subjects such as SOA, BPM and EAI, as we'll discuss further later.

With Figure 2.1 we were able to illustrate the evolution in information systems that led to the necessity for workflow management systems. But what about business process management systems? It is becoming more and more difficult to distinguish these two terms. Some authors view BPM as an extension of WFM and/or EAI [28, 48], other authors treat BPM and WFM as the same [11] and some authors even view EAI as the second generation of WFM [11]. We believe that BPM is the natural evolution of WFM and we'll present this argument in the next section.

2.2. WFM and BPM

BPM and BPMS are a natural evolution of WFM and WFMS. As so, to define a business process management system we'll start by defining what a workflow is and what a workflow management system is. The Workflow Management Coalition (WfMC) defines workflow and workflow management system as:

Definition 2. The automation of a business process, in whole or part, during which documents, information or tasks are passed from one participant to another for action, according to a set of procedural rules. [4]

Definition 3. A workflow management system is a system that defines, creates and manages the execution of workflows through the use of software, running on one or more workflow engines, which is able to interpret the process definition, interact with workflow participants and, where required, invoke the use of IT tools and applications. [4]

As we can see by Definition 2, workflows follow a document-centric approach. This is not strange since workflows roots are closely related to document imaging and automation of office paper reviews/approvals processes [48], i.e. human-centric processes [13]. According to these definitions, we may conclude that workflows and WFMS are focused on the routing of work items or documents between human workers inside an organization [17]. This notion of workflows and WFMS is the starting point for the differences between BPM and WFM. There are several definitions of BPM that can be found in literature [8, 44, 48], each author presents it's own view of BPM. Although, there is one definition that best defines BPM:

Definition 4. Business Process Management is the discipline that supports business processes using methods, techniques and software to design, enact, control and analyze operational processes involving humans, organizations, applications, documents and other sources of information [48].

The authors of the definition make notice the emphasis on "operational processes", i.e., processes that cannot be made explicit (e.g. strategic level processes) are excluded from this definition.

From Definition 4, we may see that business processes usually involve more than one organization and users outside the organization (e.g. B2B and B2C processes) [30], instead of workflows which are mainly organizational processes that usually don't cross the boundaries of the organization.

In Figure 2.2 we can see a simplified version of an ordering process. In this model, we have two distinct entities: the customer and the organization that manufactures the product. This is an example of a process that spans different organizations (for this example, we consider a customer to be an organization). Another example of a process that crosses the boundaries of an organization is the supply change management process.

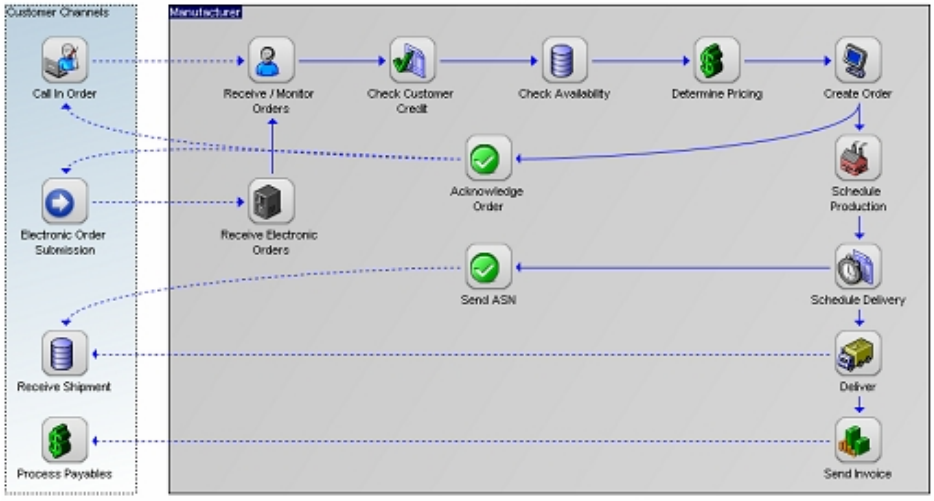

Figure 2.2. Simplified model of an ordering process

If we look at Definition 2 and Definition 3 they express a profound focus on enactment/execution of the processes. This is another difference between typical WFMS and BPMS. By Definition 4, business process management systems must support the management of the whole business process lifecycle (from design to analysis). Traditional WFMS overlook this aspect of Business Process Analysis, focusing on execution and modeling rather than the whole lifecycle of a business

process (Figure 2.3). Gartner identified Business Process Analysis as one important aspect of BPM [43], motivated by the interest in Business Activity Monitoring (BAM). BAM is the merger between real-time and business intelligence [8] as we'll discuss later..

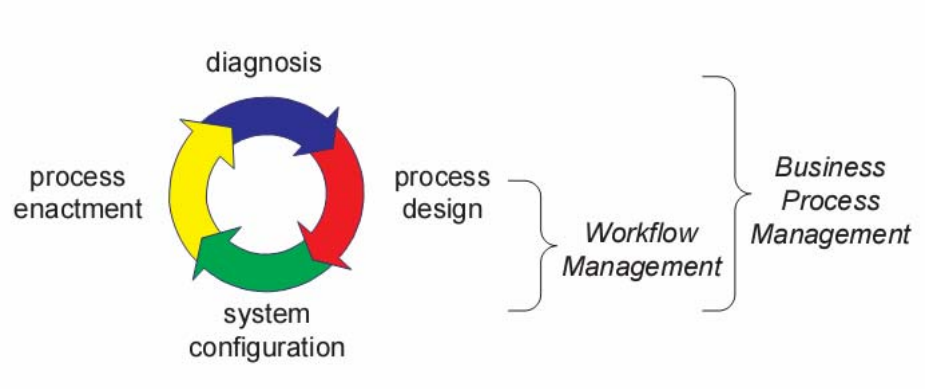

Figure 2.3. Comparison between the workflow management and BPM lifecycle [48]

With these two findings, we can see that BPM is not WFM but has some elements of it. We believe that BPM is not just an extension of WFM. Howard Smith and Peter Fingar support this view by writing that BPM is a) not an enhanced WFMS, b) not a new layer on top of EAI, c) not the next generation ERP, nor d) a set of collaborating web services [45] but a "synthesis and extension of all these technologies into a unified whole" [44].

2.3. Lifecycle of a Business Process

One of the proposals for the definition of business process lifecycle and also for the BPM lifecycle, which is also a process, is the 8 Omega framework from Business Process Management Group [3].

According to Figure 2.4 , there are three stages of the BPM lifecycle:

- Phase one: Deployment
- Phase two: Iterative Refinement
- Phase three. Step Change

Phase one starts when the organization starts a BPM initiative. Phase two consists of iterative refinement which starts when phase one is completed and the process is stable. In this phase, we continue to manage the process (not the BPM process, but the process itself) but the management cycle is much shorter. There isn't any limit of iterations on this step. This confirms that BPM is indeed an iterative process. The last phase, Step change, is triggered by an event on the

organization or its surrounding environment that affects the business process and the way it operates.

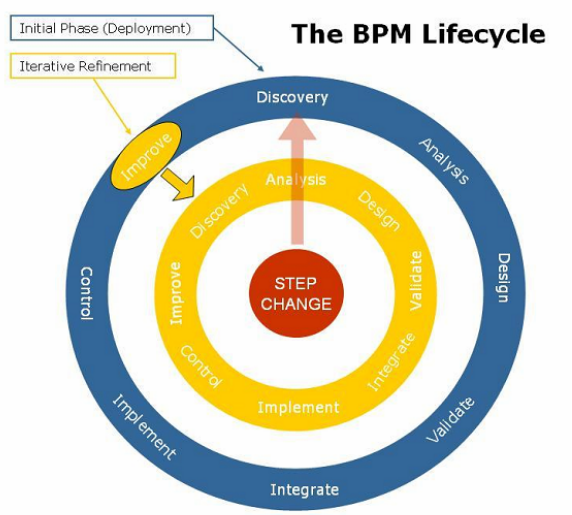

Figure 2.4. The BPM lifecycle according to the 8 Omega framework [3]

The 8 Omega framework follows what they like to call the DADVIICI approach: **D**iscovery, **A**nalysis, **D**esign, **V**alidate, **I**ntegrate, **I**mplement, **C**ontrol and **I**mprove. According to BPMG, each of these phases is part of the business process lifecycle.

2.3.1. Georgakopoulos et al.

Dimitrios Georgakopoulos and Aphrodite Tsalgatidou in [20] give another view of the process lifecycle with fewer phases. According to them, the business process lifecycle only has four phases (Figure 2.5).

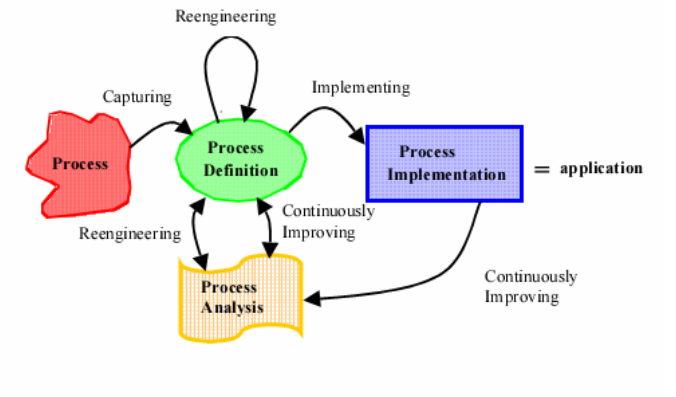

Figure 2.5. Lifecycle of a business process according to Georgakopoulos et. Al [19]

Phase one is the capturing of the process definition (maps to the first four phases of the DADVIICI approach). As the authors say, in this phase it's essential to understand the process. Interview techniques such as requirements elicitation interviews in software design should be used to gather information about the process. This process definition should give birth to the first process model. This process should describe its activities, users or organizations involved in the process and their roles and how the activities are coordinated / orchestrated. Finally, this model should allow its validation through behavioral simulation and / or static analysis [20].

Phase two is the reengineering of process definition. Unless the BPM software has simulation tools, in our opinion, this phase can only be executed after the process analysis phase. Nevertheless, some BPM software vendors, such as ARIS Simulation [2], offer simulation capabilities on their software. In this phase, we should define reengineering objectives such as: reducing costs, remove bottlenecks or reducing the cycle time of a process. We'll not discuss methodologies and frameworks for business process reengineering, since it's outside the scope of this thesis.

Phase three of the business process lifecycle is implementation. It's the phase where we take the definition of the process and enable identification and coordination of resources to realize the process. As we already stated, some of the activities in the process may not be automated and can be performed by people. In this phase we start by associating activities to people, applications, web services, etc. and execute the process. During the execution of the process, most BPMS create an audit log of the process execution that can/should be used to perform process analysis such as BAM.

The last phase, continuous process improvement, occurs in parallel with the process execution. As we noted before, this is the phase that most WFMS don't support. In this phase, data from audit-trail of process executions are fed into tools that manipulate these data to produce reports. These reports can show how many errors occurred, what were the paths that led to those errors, elapsed cycle times, what costs were incurred, and similar results. As Figure 2.5 illustrates, these results are then used to perform reengineering of the process definitions.

One term that's popular in the scientific community for Business Process Analysis (BPA) [5] is also Business Process Intelligence (BPI) [21]. This is a natural choice for a name, since trends like Business Activity Monitoring (BAM) are nothing more than real-time business intelligence. There are also other trends such as using ETL tools to feed data warehouses known as Process Data

Warehouses [10]. This is outside of the scope of this report. Further information about these subjects can be found in [10, 21].

Once again, we reinforce the idea that BPM is an iterative process and that the stages of BPM are themselves iterative (e.g. one may create several process definitions before implementing the process).

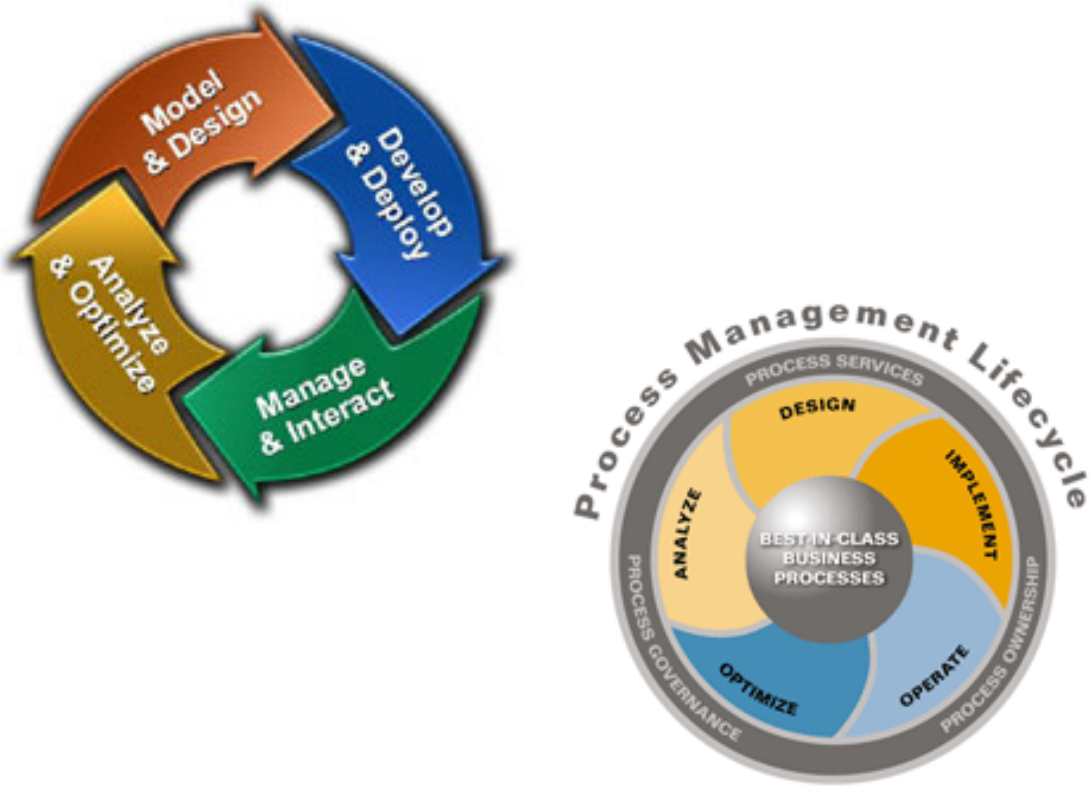

Figure 2.6. Stages of the business process lifecycle proposed by Microsoft (left) [34] and SAP (right) [41]

We provide two more process lifecycle figures from software vendors [34, 41], SAP and Microsoft, both of which offer BPM solutions. As presented in Figure 2.6, the several stages of a business process lifecycle proposed by these vendors are very similar to the stages mentioned in this report.

2.4. Proposal for Business Process Lifecycle

Merging all the proposals we presented for the definition of the business process lifecycle and others such as [36] and [25], it's possible to conclude that the lifecycle of a business process has six main phases: **Discovery, Modeling, Implementation, Execution, Analysis,** and **Optimization.**

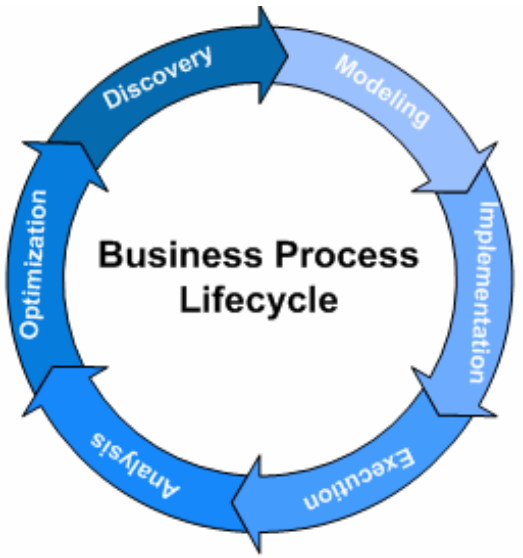

Figure 2.7. Business Process Lifecycle

We now present the description of each phase of the lifecycle and in the end a table that shows how each of the phases proposed in Figure 2.7, relates to the other lifecycle definitions already presented.

2.4.1. Discovery Phase

The first phase of the business process lifecycle addresses the discovery and definition of the business process. Management should be involved in this activity to provide the strategic vision and reengineering of processes to meet business objectives. Usually this role is filled by a business analyst, i.e. an user with IT and business knowledge [34] who fills the gap between the IT department and business.

Business analysts and their team should map the process end-to-end with complete description of the entities involved and their roles [41], not only the roles of departments inside the organization but also of their business partners.

The document produced in this phase should also detail all activities that are part of the business process and how they are orchestrated/coordinated [20] to meet business process objectives. The best way to represent this coordination of activities is with a graphical tool where a first model of the business process is produced. Be careful not to confuse this model with the model we'll address in the modeling phase. This model is a model of the **as-is** process and is used to aid the company in understanding their business practices and how they can improve the process to meet

their new business objectives (e.g. cost reduction, better customer satisfaction, etc.). After the company decided which improvements will be made to be business process and how they will be made, it's time to produce a new model of the process. Discovery is usually an activity that occurs only in the first iteration of the process lifecycle. Once the process is under BPM, there's no need to re-discover the process since it's already modeled and documented inside the BPMS.

2.4.2. Modeling Phase

In this phase a new model of the process is created bearing in mind the objectives of the process improvements defined in the previous phase. The business analyst should supervise this process and work with the process owners and IT developers to produce a model which improves the current process in execution. Also, the business rules are made completely explicit so IT developers can understand the process execution flow. During this modeling stage, stakeholders are encouraged to share suggestions on how changes to the process can better support business goals.

Once all the steps and flow of the business process have been documented, the business analyst works closely with IT to see how the various activities will be supported by technology. For each activity of the process that can be automated, the technology which will support it is identified. As an example, if in the order fulfillment process (Figure 2.2) the 'Check Customer Credit' is a call to the CRM software or a database stored procedure call, IT and the analyst must decide which they'll choose to better meet the business objectives. Once this is completed, IT developers start to implement the services that will support the process activities.

2.4.3. Implementation Phase

Aided by the detailed model of the business process and description of the business rules done in the previous phase, the IT developers start to map each activity of the business process to the underlying technology that will support it. Since legacy systems are normally involved in business processes, all the integration code is done in this phase as system and business interfaces are created and/or reengineered.

Much of the IT developer's job during this stage is to ensure that the solution incorporates the functionality, performance metrics, and user interface to meet business user needs. Once the solution is tested, the process is ready for deployment and execution.

2.4.4. Execution Phase

With the process in execution, users start interacting with the process as it runs through the various process stages. At the same time, system administrators monitor/control the business process for potential exceptions along the various steps and take actions as required. They may suspend and resume processes as well as verifying the current status of each executing processes.

2.4.5. Analysis Phase

Analysis of a process usually occurs in parallel with the process execution. In this phase, business analysts define process metrics to be collected during process execution. These metrics are used to verify process compliance with business objectives, measure improvements and also compliance with Service Level Agreements (SLA). This is usually called Business Activity Monitoring (BAM) which is one of the most important trends in BPM, giving companies the opportunity to gather real-time data of their processes.

One of the emerging trends in BAM is predictive monitoring, i.e. process engines are able to predict when a process will lead to an error by examining previous instances of finished processes and making a comparison of the process flow, enabling companies to take appropriate measures to prevent process exceptions before they occur.

2.4.6. Optimization Phase

Information derived from performance metrics is critical in driving the iterative process of optimizing the business practices and policies that support organizational goals. Armed with the data gathered in the analysis phase, business analysts make adjustments in the business process for better compliance with business objectives. These adjustments can be small changes in the business rules as well as partial or complete redefinition of the process.

One can see by examining Figure 2.7 that the lifecycle is an iterative process and depending on the adjustments made in the optimization phase a new discovery phase may be triggered, starting a new iteration of the BPM lifecycle.

In Table 2.1, we show how each phase of our proposed definition for the process lifecycle maps to the phases of proposals presented before.

Table 2.1. Relationship between proposals for the business process lifecycle phases

W.M.P van der Aaslt (Figure 2.1)	8 Omega Framework (Figure 2.4)	Georgakoupolos et Al. (Figure 2.5)	Microsoft (Figure 2.6)	SAP (Figure 2.6)	Our proposal (Figure 2.7)
N/A	Discovery and Analysis	Capturing process definition	Model and Design	Analyze	Discovery
Process Design	Design and Validate	Capturing process definition	Model and Design	Design	Modeling
System Configuration	Integrate and Implement	Implementation	Develop and Interact	Implement	Implementation
Process Enactment	Control	Implementation	Manage and Interact	Operate	Execution
Diagnosis	Control	Continuously improving	Analyze and Optimize	Optimize	Analysis
Diagnosis	Improve	Reengineering	Analyze and Optimize	Optimize	Optimization

3. Application Integration

Traditionally, organizations have been functionally divided, i.e. companies have been separated into departments like marketing, human resources, production and the like. However, the functional organization has been shown to have a number of weaknesses [30]. Most information systems were built around different functions, and business units. In particular, it required a huge administration effort to handle issues crossing functional borders. Managers had a hard time assembling the data they needed for a comprehensive overall picture of the organization's operations [30].

When organizations started to be interested in initiatives such as BPM, they realized that they had to somehow integrate business applications and data. BPM tries to enable real-time enterprises. Enterprises need to respond to the surrounding changing environment and wills of the customer, by making adjustments in their business processes. Enterprises need business agility [8]. As you may imagine, this is not an easy task when our organization is functionally organized. Applications in functional organizations needed to be integrated.

These functional applications were unable to "talk" with other applications in the enterprise. This leads to the creation of "information silos", i.e. systems that are not able to share data with other related systems in the organization [6, 30]. To avoid this we could try a point-to-point integration technique and connect all applications to each other. This isn't a good solution, since for n applications we would have a number of $\frac{n(n-1)}{2}$ connections (Figure 3.1). This solution may work in an enterprise with few applications but this number may easy escalate on larger enterprises with several applications. There was need for a structured approach to integration.

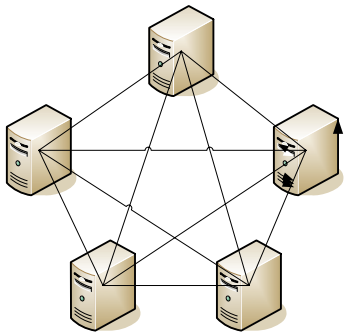

Figure 3.1. Example of ten point-to-point connections

3.1. Enterprise Resource Planning

In the beginning of the 90's many software vendors started offering what is called an Enterprise Resource Planning (ERP) system. ERP systems were the first promise of enterprise integration [31] and of the first information systems that focused not only on data but also on business processes. An ERP is a system that attempts to integrate departments and functions across a company into one single software system [30] (Figure 3.2). ERP systems do this with a huge database that stores the information previously scattered trough a company. Information can then be accessed by software modules provided by ERP software vendor. This way, the various departments could share information between them much more easily.

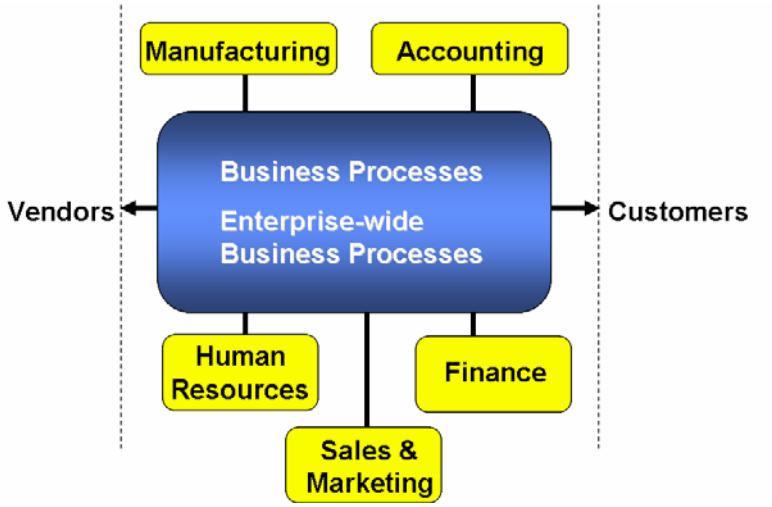

Figure 3.2. Several modules for each function communicate with a central software piece, the ERP (in blue) [30]

To start the implementation of an ERP system in a company, these would start by doing a full business process reengineering to adapt their business processes to the processes of the ERP solutions. Such reengineering proved benefits to companies looking to review their business processes (e.g. for standards and legal compliances), but companies that tried to adapt the ERP processes to their own processes would generally fail, as these systems provided little customization.

The reengineering of companies processes to adapt to ERP solutions had great disadvantages. It's said that the business processes are a company's competitive advantage over a competitor. Reengineering of business processes to fit the "industry standard" prescribed by the ERP system may lead to a loss of competitive advantage. Another disadvantage of ERP systems is that they

cannot integrate with other applications easily. Companies wishing to integrate legacy or new applications had many costs in trying to do so. It may seem ironic, but ERP systems who were the solution for integration problems failed to integrate seamlessly with other systems. To tackle this, ERP vendors would create more and more modules that would integrate easily with their systems [29], so companies wouldn't need to buy third-party products that wouldn't integrate with their software.

ERP systems hadn't only disadvantages and most of them helped a lot of companies to streamline and reduce the cycle time of their processes and to reengineering their processes to achieve compliance with regulations such as Sarbanes-Oxley. However, it was clear that ERP systems weren't the real solution to enterprise integration and a serious candidate for enterprise integration started to gain attention.

3.2. Enterprise Application Integration (EAI)

Traditional EAI has its origins on the concept of middleware, which is software that connects two distinct applications and allows the exchange of data between them. First generation EAI focused on converting and exchanging data between applications in a point-to-point fashion. Although, as we already stated in the beginning of chapter 3, point-to-point integration becomes very complex in large enterprises as it requires a lot of programming. A solution to these problems came with generic middleware topologies such as 'hub and spoke', 'enterprise buses', 'message queues' and 'message brokers' [23, 31] (Figure 3.3).

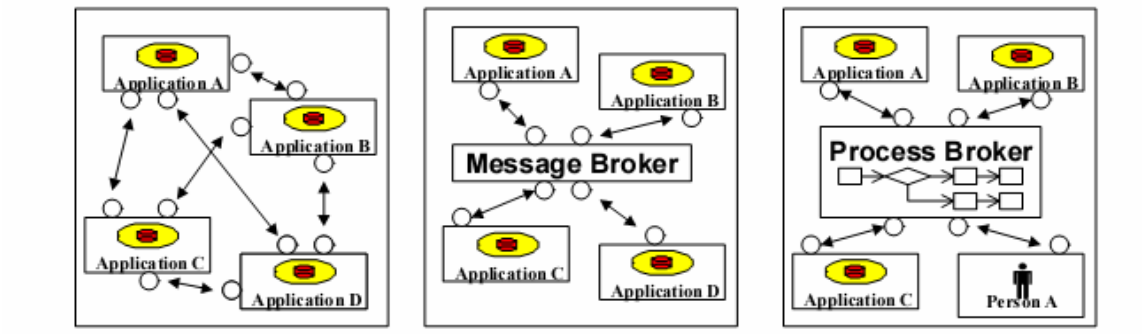

Figure 3.3. Different middleware topologies [23]

The first generation of EAI was focused on the conversion and exchange of data. The second generation of EAI focused on integrating applications. The new generation of EAI is focused on

integrating applications at the business processes level [38], also known as Business Process Integration (BPI).

3.2.1. Data-level Integration

The objective of data-level integration was the exchange of data between multiple data stores. As one may see, this is a natural type of integration and very useful when in need of synchronizing various data sources. This level of integration was useful in functionally organized companies, i.e. companies who had information systems for each department/function within the enterprise. For example, information about a customer could be scattered through the sales department, the financial department and the logistics department. As so, there was a need to synchronize and maintain this information updated in all systems.

Data-level integration became easier to perform when middleware technologies like JDBC and OBDC were introduced, also, middleware to access databases was available without cost for the companies. Both these factors contributed to the popularity of data-level integration solutions. This solution also reduced costs for companies by reducing the number of errors in data induced by human input, the first form of synchronization between various systems [8].

Although popular, this approach to integration had disadvantages. One of them was the need for applications to know the database schemas of other applications. These schemas could be very complex in some systems and difficult to understand. This approach also made applications aware of each other, and as we previously said, this reduces enterprises business agility [8].

3.2.2. Message-level integration

Experiences with data-level integration alerted companies and software vendors that applications should manage their own data stores. This conclusion led to the development of a new approach to integration, message-level integration.

Message-level integration promotes the exchange of messages between applications. In this approach, APIs to applications are leveraged so they can receive and send data to other applications. To avoid the pitfalls of having to define for each application n APIs, where n is the number of other applications this application communicates with, we need to use middleware. A popular solution for this problem is Message Oriented Middleware (MOM) [8] such as Message Brokers (Figure 3.3) and Enterprise Services Buses (ESB).

By using solutions such as Message Broker architectures, we reduce the complexity of integration by having a single point of integration in the system, i.e. applications only need to know how to exchange data with the message broker who is responsible for routing the message and transforming so it can be understood by the destination application.

Integration at this level was focused on the exchange of message data between applications and the transformation of these data between applications. However, the business logic was still encapsulated in the applications. Consider an order processing system: if it receives an order above to 100 units has to redirect the order for approval by a manager; if the order is inferior to 100 units the order is automatically approved and redirected to the logistics department so they can ship the order. In a message-level integration scenario, the message broker would receive the order request from another system and redirect it to the order processing system. The order processing system would then decide what to do with the order request i.e. redirect it to approval or approve it automatically. If a business manager decides to change the unit threshold to 200 units, the order processing systems would have to change the order processing system, usually by changing the application code.

3.2.3. Process-level Integration

As we already said in chapter 2, there was a great interest in business processes in the 90's. Authors such as Hammer and Davenport [15, 22] claimed the need to change the functional perspective to a process focused perspective in order to improve customer satisfaction, improve cycle times and increase productivity. This view began to gain popularity in the manufacturing industry but soon caught the attention of the information systems industry [30].

Message-level orientation didn't provide the flexibility real-time enterprises needed to respond to changes. So, EAI vendors started to transform their message brokers in process brokers (Figure 3.3). The motto for the process brokers was to remove the business logic from the applications. This trend is very similar to the one that promoted the appearance of WFMS, as we saw in chapter 2. Process brokers contain the business rules and business logic of processes (Figure 3.4).

In this stage of integration we evolved to a new type of middleware, one that allow us to do Business Process Integration (BPI) [38]. If we take the example we previously gave about the order processing system; with process-level integration if the business analyst wants to change the process, he can change it in the process broker without having to write or change code because

process brokers usually give graphical tools to model the processes [23, 38]. We were approaching a solution similar to the first WFMS, giving companies the flexibility to rapidly respond to change and becoming a real-time enterprise [8, 30].

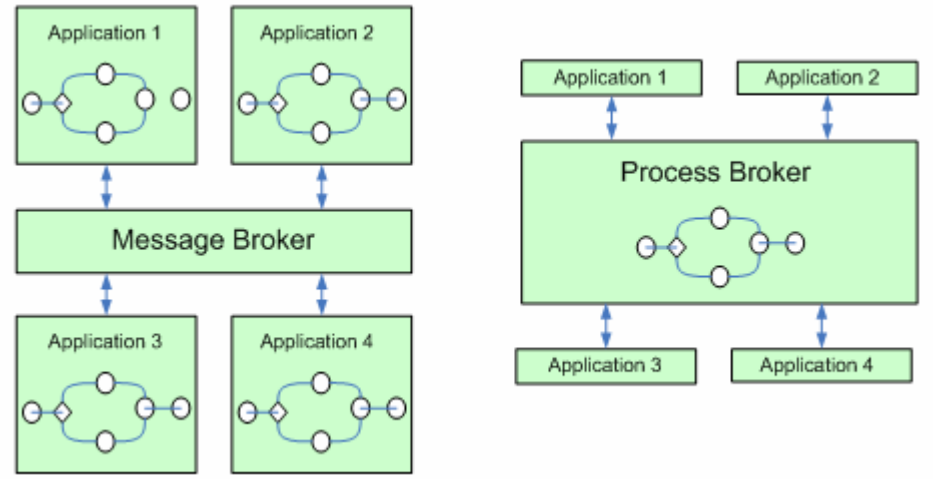

Figure 3.4. Message level and process level solutions.

3.3. EAI support for BPM

Now that we have presented an overview of EAI and BPM, it's clear that these two different disciplines have converged historically. Both the motivations for the introduction of BPM and for the introduction of process integration in EAI are similar – the decoupling of business logic and applications and the growing interest in business processes.

4. Hypothesis

Throughout the last two chapters we gave the reader an overview of two different disciplines, EAI and BPM, which converged together due to similar motivations. In this chapter we'll present the problem that will by the basis for this thesis and the development of the case study.

We've seen that the first information systems in organizations were dedicated to a single task, such as accounting, finance or human resource management. Because of this dedication, many organizations found themselves acquiring a variety of systems and applications to handle their different functional areas. However, organizations found out that many of their systems were incompatible with each other and would not seamlessly interact. Rather than replacing systems, organizations continued to work with their existing systems and applications, leading to obsolete systems, redundancy of hardware and data, inconsistencies of one system to another, etc.. This created the concept of "information silos" as we've seen previously [30].

To solve the problem stated in the last paragraph, software vendors focused on creating ways to integrate different applications throughout organizations. Two major systems emerged of this trend: ERP and "middleware"/EAI systems. Together with the emergence of this trend, organizations and the scientific community started to focus on a business process-centric approach rather than the typical data-centric approach, and EAI evolved from a traditional data-centric approach to a process-centric approach, as we've showed in chapter 3.

When WFM and EAI practitioners were faced with the idea of BPM, they concluded that their systems had great potential of becoming BPMS. As we've already seen, workflows were focused on routing documents and work items between people in an organization. When WFM faced processes that involved the cooperation between people and machines of different organizations, it had to adapt its philosophy to this new vision of processes. The easy solution for this was to adapt concepts of the EAI discipline. That's why some authors call EAI the "second-generation WFM" [11].

As WFMS vendors saw the opportunity to add more functionality to their suites to provide the management of the whole lifecycle of a business process, so did EAI vendors. They achieved this by developing custom BPM on top of their solutions and/or by buying smaller companies

specialized in WFM and BPM solutions (e.g. TIBCO bought Staffware, a workflow company) and integrating their software in their suites to provide BPM support.

4.1. EAI as a business advantage

Many companies have collections of processes to manage and some think they don't have the required tools to manage them, but many of them already have EAI platforms used as "middleware". What they don't know is that they can use these platforms to manage their business processes. One of the clients of the company where we developed our work overlooked EAI only as the "glue" between systems, exposing interfaces (e.g. Web Services, API, HTML, etc.) to be called by other applications which contained the business logic inside it. Only now, in 2007, after years using the WebMethods Fabric EAI platform they've realized that they could use its BPM potentials.

The awareness about BPM solutions is growing in the industry, with Forrester Research predicting that "Business process management suites' (BPMS) license, services, and maintenance revenue from software vendors will grow from $1.2 billion in 2005 to more than $2.7 billion by 2009, which is more than a 21% compounded annual growth rate (CAGR), as enterprises seek to improve the efficiency, effectiveness, and strategic value of key business processes." [26]. Factors such as the possibility of real-time and historical analysis of Key Performance Indicators (KPI) are increasing the interest of companies in these technologies [7].

Other important factor contributing to the awareness of EAI and BPM tools is a type of architecture in Information Systems, named Service Oriented Architecture and Web Services. Service Oriented Architecture was a term coined by Gartner in 1996 [42] and it describes a software architecture where the whole information systems is regarded as a collection of services interoperated and communicated through a common interface, the service bus. Notice the similarities between Figure 4.1, which depicts service oriented architecture, and the figures we've presented before for different middleware topologies (Figure 3.3). The ability to easily integrate with Web Services and other types of services gives the motto for EAI to be used as an enabler of Services Oriented Architectures.

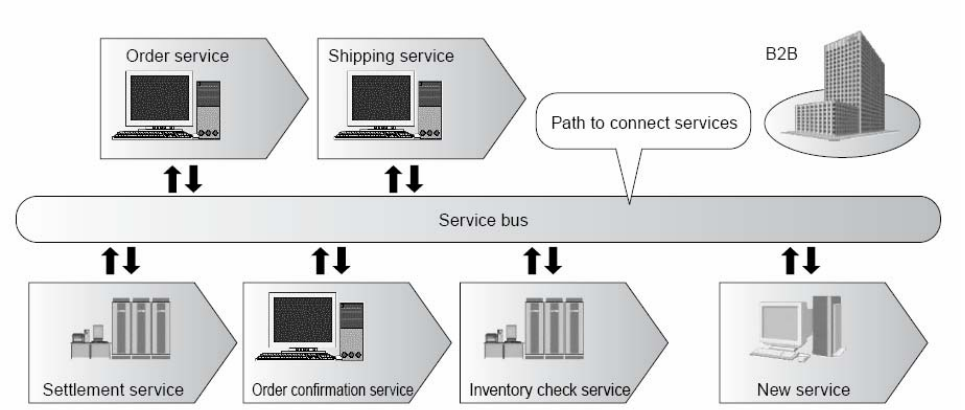

Figure 4.1. Service Oriented Architecture

It's our opinion that integration plays a fundamental role in BPM, as business processes cross boundaries of organizations and different types of systems and applications and it's logical to say that EAI vendors have more experience in systems/people integration than WFM or BPM vendors. We've seen that EAI platforms have graphical tools to model processes [23, 38]. As so, it's our belief that EAI tools are better positioned to offer better BPM solutions, than WFMS vendors or pure play BPM vendors. If we look at the definitions we gave earlier in chapter 2, for BPM and business process, it's clear that more than ever business processes cross organizational departments and even organizations. Business processes cross the "functional stovepipes" of an organization (e.g. B2B processes), thus leveraging the need for integration of different applications and information systems. With their knowledge in integration matters, EAI vendors have a real competitive advantage over other BPM vendors in this subject.

4.2. Goal of the thesis

As we've said in the beginning of this section, many companies have EAI tools but they don't use them with their full potential. It's our aim to understand if **it's possible to support a BPM solution using EAI platforms**. It's also our goal to highlight some of the research areas that need to be focused on EAI/BPM research. So, the question that will rule the rest of this thesis is:

Is it possible to fully support BPM solutions using EAI platforms?

To answer this question, we propose to manage a single business process using two different EAI platforms. If we can manage the whole lifecycle of a business process using these EAI platforms,

it’s safe to assume that it’s also possible to manage other processes with similar characteristics, i.e. of the same type. After that, we’ll evaluate the support of these tools for each phase of the lifecycle of a business process identified in Figure 2.7.

5. Case study

To help us answering the question proposed in the previous chapter, we propose to use different EAI platforms to manage a business process throughout its whole lifecycle. This way, if we are able to do this we can assume that is also possible to deploy and execute full BPM solutions with another process of the same type.

Since we're looking for any kind of process, we focused our attention on ITIL which is a library of "best-practice" processes used to manage IT services [9]. In this chapter we'll discuss the different types of business processes that exist, and later we'll give a brief introduction to ITIL and we'll describe the process that we've chose for our case study – the Change Management process.

5.1. Business process types

There are lots of business processes in organizations and each one has their own type, i.e. each process has different characteristics that need to be addressed with specific tools. Since we assume that if we can do BPM on a single business process using an EAI tool it's also possible to do it successfully on another process of the same type, it's of extreme importance to talk about the existing types of business processes. That's what we'll do in this section.

The scientific community and software vendors usually agree that there are two major categories of business processes: **human-centric** processes and **system-intensive** processes[1] [13, 17]. As the names suggest, human-centric processes are driven by human actors collaborating with other humans or business applications and system-intensive processes involve interaction/integration between several types of information systems with little or no human interaction (e.g. billing process). We'll now dedicate two sections to explain these two genres of processes in detail.

5.1.1. Human-centric processes

A human-centric, or human-driven processes, are types of processes that involve interaction between humans and business applications, databases, collaboration tools, documents and other human actors. A typical human-centric process is the loan approval process depicted in Figure 5.1.

[1] Note that various nomenclatures exist for this type of processes: application-intenstive, integration-intensive, people-centric, etc; In this thesis we'll use the nomenclatures used by Forrester Research in [13].

If we look at this process we can see that when the flow reaches 'InvokeLoanApprovalService' it expects a human decision to continue the flow and execution of the process. That's a simple model of a human-centric process.

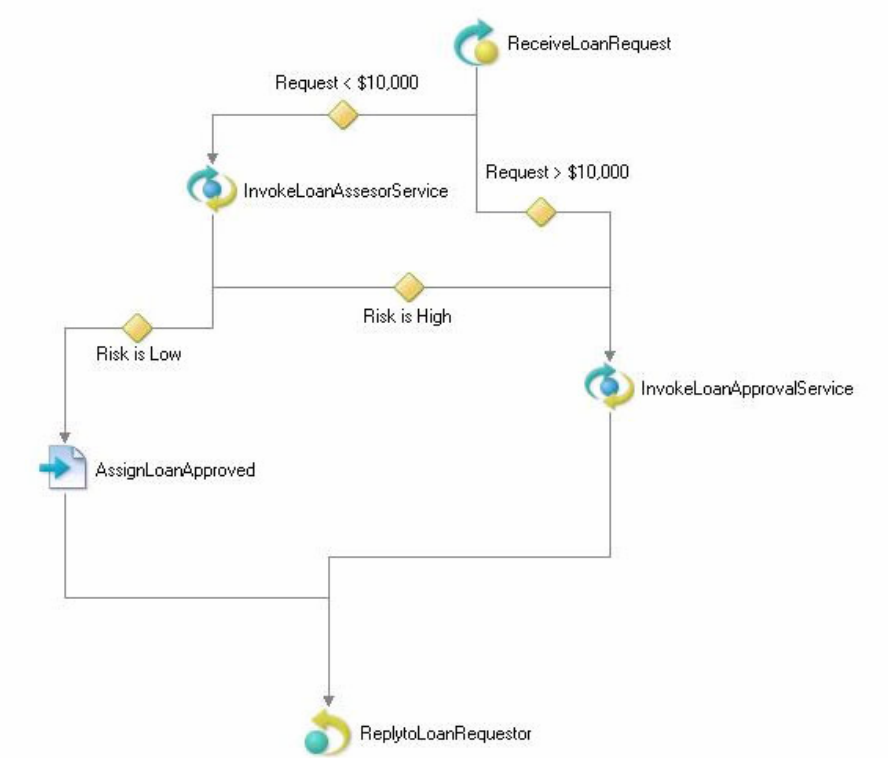

Figure 5.1. Loan approval process [1]

Inside this type of processes we have different characteristics and this leads to a division of human-centric processes in: **people-intensive**, **document-intensive** and **decision-intensive** [13]. People-intensive processes are all about interaction between human actors for routing, approving and fulfilling requests (e.g. on-boarding new employees). Document-intensive are processes that require users to review documents, take decisions, etc. based on scanned images or e-documents, i.e. the typical workflow (e.g. loan approval). Decision-intensive processes require users to make decisions based on business rules or on business intelligence (BI) tools used to analyze information. The types of vendors that usually offer suites to support these processes have a strong interest in workflow management. TIBCO, leader in EAI, became a leader in this area after purchase of Staffware Inc., a workflow management software company [13].

5.1.2. System-intensive processes

System-intensive processes, application-centric [17] or integration-centric [27] processes are those kind of processes that describe interactions between a lot of business applications, typically involving millions of transactions per day with little or no human interaction involved (except when exceptions in the process occur). These processes orchestrate the interaction between packaged applications (e.g. SAP, Siebel), custom applications and external applications (i.e. from other organizations). Examples of system-intensive processes are supply chain management processes and ordering processes (Figure 2.2). One can see that EAI software has a strong advantage over other type of process management suites in this area, due to the necessity of the number of applications involved in a process of this type. That's why WebMethods and TIBCO, typically EAI vendors, are leaders when it comes to manage system-intensive processes [27].

5.2. ITIL

In recent decades, the fast development of IT has created new business opportunities in organizations. The PC, networks and Internet have enabled companies to succeed in ways that other tools haven't until date. You just need to remember how the Y2K affected organization's concerns to notice how important the role of IT is in our organizations today. This growing focus on IT infrastructure has highlighted the need for IT Service Management and has laid the background for ITIL.

The Information Technology Infrastructure Library (ITIL) is a framework developed by the UK's Office of Government Commerce (OGC), outlining best practices in Information Technology and Communication (ICT) service management [9]. ITIL has been used as inspiration to create several other service management frameworks such as Microsoft Operations Framework [35] (MOF) and HP Information Technology Service Management [40] (HP-ITSM). It has been created by observing best practices in the IT Service industry and it focus on the quality of the delivered services and on the assurance that these services support a company's business objectives.

It is said that in the overall cycle of IT products, the operations phase weight on the total cost is about 70% to 80% [9], so it's important to efficiently manage these services so they are reliable, of high quality, and of acceptable cost. Since these problems occur in any type of organizations, be it small, medium or large-sized companies, the OGC presented ITIL as a collection of "best-practice" processes that organizations can adapt to their own environment and structure, and each process describes a typical task executed in IT departments in all types of companies.

ITIL reached the public as a collection of books published by the OGC, each one describing a specific area of maintenance and operation of IT infrastructure. The core of the ITIL publications is considered to be Service Support and Service Delivery. The other books were concerned with other complementary subjects such as managing customer relationships [9]. However, since originally ITIL focused on ITSM from the IT perspective a set of books named "The Business Perspective" was published to fill the gap between IT and the business. In Figure 5.2, you can see the current set of ITIL best practice publications.

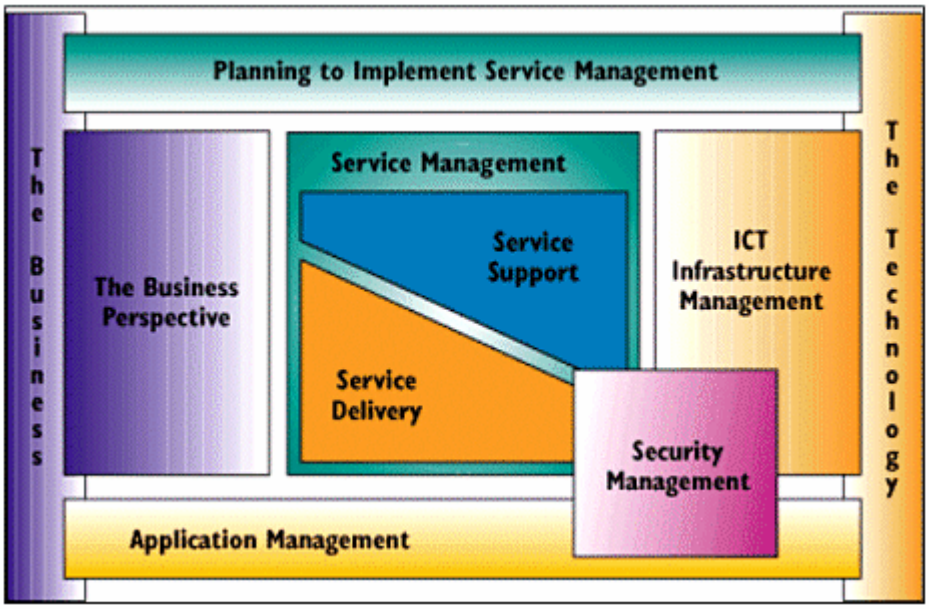

Figure 5.2. ITIL publication framework (Source: OGC)

We'll now focus on describing the two core components of the ITIL framework: Service Delivery and Service Support.

5.2.1. Service Delivery

As we previously said, Service Support and Service Delivery are considered to be the core of IT Service Management in the ITIL framework. The first concerns the support processes necessary to ensure service quality to the users. These processes manage problems and changes in the IT infrastructure and more technical than the Service Delivery processes which concern the business done between the Service Provider, who can be an internal IT department or an external IT organization, and the Customer organization. Service delivery processes consist of a number of

management practices to ensure that the services are provided as agreed between the Service Provider and the Customer [9]. The subjects/processes addressed by the Service Delivery book are:

- **Service Level Management:** One of the most important processes of the ITIL service management is Service Level Management (SLM), which ensures that the customer and the provider make clear agreements about the type of services to be delivered and their quality and also ensures that these are monitored and reviewed. Usually these agreements are expressed in the form of a Service Level Agreement (SLA). SLAs define metrics (e.g. availability rate of a service, maximum answering time) that measure the levels of the services and that are monitored by SLM to ensure their qualities;
- **Capacity Management:** Capacity Management supports a cost effective delivery of IT services by aiding organizations in matching their IT resources, to support the agreements made with the customer. It involves continuous planning of the IT infrastructure to make sure that the agreed Service Levels are met;
- **Financial Management for IT Services:** Financial Management is used to provide information about the costs incurred while providing IT services to assure that funds are well spent. It is used identify, allocate, monitor and forecast costs to support cost awareness, i.e. what's the cost of a specific IT Service;
- **IT Service Continuity Management:** In the event of a disaster, IT Service Continuity Management ensures the existence of recovery measures to safeguard the continuity of the customer's business. It concerns the planning and coordination of resources needed to ensure continuity of the previously agreed services levels after a disaster;
- **Availability Management:** Due to the dependence of organizations in IT, a few hours of computer downtime can have a major impact on the company's operations. As the name suggests, Availability Management ensures the availability of IT Services agreed previously on SLAs.

As one may notice, these processes are mostly strategic/tactical processes which manage the business conducted between the customer organization and the service provider. On the other hand, the Service Support processes have an operational and more technical perspective (Figure 5.3).

5.2.2. Service Support

Service Support encompasses the support processes necessary to ensure service quality and efficient service provision. These processes manage problems and changes in the IT Infrastructure and are more control-oriented than technical in nature.

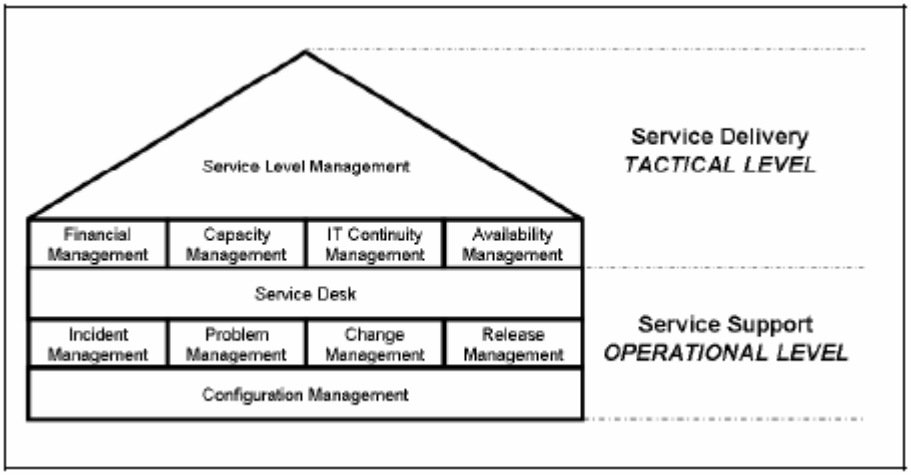

Figure 5.3. ITIL Service Management Core Functions

As you can see from the figure above, the processes that compose the service support function are:

- **Service Desk:** The service desk is the main point of contact between the IT organization and users, when they need to request services and report problems. The main functions of the service desk are to record, monitor and resolve problems.
- **Configuration Management:** This process is responsible for identifying and recording all the components of the IT infrastructure and their status in a central database called Configuration Management Database (CMDB). This database also stores the relationships between the different Configuration Items (CI's) to further assess the impact of changes in the IT Infrastructure.
- **Incident Management:** This process aims to resolve incidents and restore the provision of services as quickly as possible. It's primarily a reactive process: incidents are reported by the users, recorded, classified and allocated to appropriate specialists to be solved quickly.
- **Problem Management:** Depending on the impact of an incident or if incidents share a common root cause, incidents can escalate to a problem. Problem Management encompasses the identification of the problem and the underlying cause of the incidents. Once the problem is identified it's classified as a known-error and a business decision is taken to decide whether or not to make a permanent fix to prevent new incidents. If they decide for a fix in the infrastructure, this originates a Request For Change (RFC) on the IT Infrastructure. On the other hand, if they decide on a temporary work-around the problem remains classified as known-error.

- **Change Management:** This process is responsible for approving and controlling all changes in the IT Infrastructure, making sure that these contribute to the business objectives of the organization and have a minimum adverse impact on the provision of the IT services. Changes are tracked throughout their whole lifecycle: definition, planning, building and testing, acceptance, implementation and evaluation [9]. These are usually request by RFC's issued from Problem Management; by monitoring activities in Configuration Management and several other processes.
- **Release Management:** Release Management ensures the successful rollout of releases, including integration, testing and storage. A release is a set of configuration items that are introduced into the live environment of the IT infrastructure. Release Management is closely related to Change Management since most changes are carried out through release management activities.

As you can see, all these processes are very closely related since an incident reported to the service desk can originate a problem that will need fix, creating an RFC that will be executed by change management under the supervision of configuration management and implemented through release management activities. One can have a hard trouble in distinguishing between incidents and problems, and one of the main contributions of ITIL is the distinction between these two. An incident can be viewed as an issue that requires a reactive response by the service desk, that's why Incident Management is regarded as a reactive process. On the other hand, Problem Management tries to be a proactive process to prevent the appearance of new types of incidents and problems.

5.3. Change Management

Due to the fast-pace of events surrounding organizations and the rapid development of IT businesses need to constantly adapt their strategies to the changing environment, i.e. they need to change the way they do their business. However, these changes need to be properly executed and monitored since experience shows that changes often create conditions for the appearance of new IT incidents. Inadequate testing, poor impact analysis and insufficient preparations are often causes for such incidents [9]. Since business requires constant changes and fixing incidents often involves changes, if these incidents related to changes are not controlled the business can get out of control. "*Change Management manages the process of change and consequently limits the introduction of errors and so incidents related to changes*"[9]. The motto for Change Management is:

Not every change is an improvement, but every improvement is a change.

Change Management inputs have a strong relation with other ITIL processes since these propose changes to the organization: new developments and improvements (Service Delivery and Problem Management), changes (RFC's made to change management) and solutions to problems (Problem Management) [9].

5.3.1. Process roles

Before we describe the process and its activities, we start by discussing the various human actors/agents involved in the process and what are their roles. There are basically four types of agents involved in the change management process from start to finish: **Change Issuer**, **Change Manager, Change Owner** and the **Change Advisory Board (CAB)**.

- **Change Issuer:** As the name implies, the change issuer is the person who issues/requests the change. This can be a request originating from a problem management fix, an improvement to the IT infrastructure request from Service Delivery, etc. Basically, it's the entity who issues the Request For Change (RFC).
- **Change Manager**: The change manager is the responsible for executing most activities of the change management process, from filtering, accepting and classifying all RFC to planning and coordination of the implementation [9]. Depending on the size of the organization, the change manager can be supported by change coordinators who represent him in different areas of the organization, e.g. coordinators divided by functional areas or process owners.
- **Change Owner:** The change owner is basically the person who's responsible for implementing, coordinating and reviewing the change implementation.
- **Change Advisory Board (CAB):** When changes have a higher priority and/or bigger impact on the organization it's necessary to create a committee to assess the impact of change, prioritize, to decide whether or not to implement it and to plan it. This committee includes representatives from all major IT sections of the organization (a detailed list of members can be found in [9])

5.3.2. Process Activities

In this section, we'll describe what the activities that compose the change management process are and give a brief description of each one of them. We start by depicting in Figure 5.4, the change management process adapted from van Bon et al. [9]

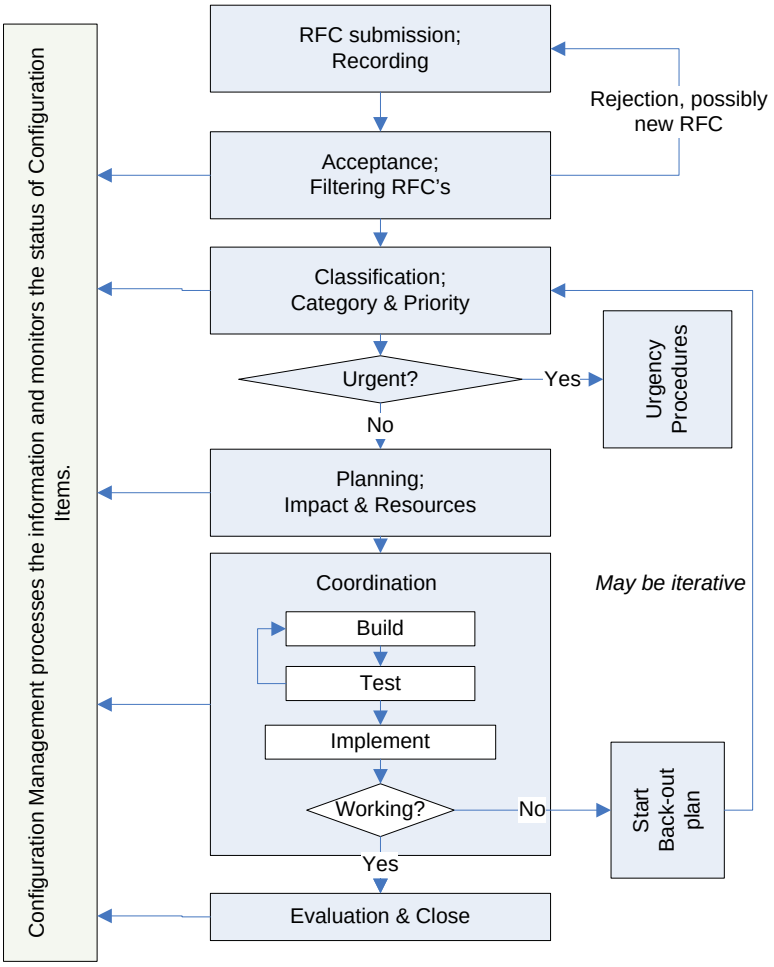

Figure 5.4. Change Management Process (adapted from [9])

The first activity of the process concerns recording all incoming RFC's. This activity involves registering in a database or other medium of storage information such as: identification number of the RFC, description and identification of the CI's to be changed, reason for the change, identification of the person submitting the RFC, submission date, etc. so the change manager can review the request and decide whether to approve it or not, which is the next activity of the process. After the change is accepted by the change manager, he needs to classify it by category and priority. The level of priority ranges from "low" to "urgent" and the category level from "minor impact" to "major impact". If the change is prioritized as urgent it follows special emergency procedures and an emergency reunion of the CAB may be required. Changes of minor impact need not to be submitted to the CAB and the change manager can approve them without consulting the board. As you may suppose, all the other changes must be submitted, reviewed and approved by the CAB. Once approved, it's the change manager responsibility to plan the change by elaborating a change calendar usually named Forward Schedule of Change (FSC), which contains all approved

changes and their planned implementation dates. This calendar allows the change manager and the CAB to make provisions for resources, costs, affected services aspects and personnel. Approved changes are communicated to the relevant product specialist (or a team of specialists) who can build and integrate the change, a change responsible. Release management can play an important role in this step of the process.

After the change implementation takes place they should be evaluated to know if they satisfied the original objectives, if the users are satisfied with the result, if there were any impacts on other services, etc. If the change was successful, the RFC can be closed and the evaluation results are included in the Post-Implementation Review (PIR). On the other hand if the change wasn't successful, the back-out plan is set in motion and then the process is restarted. However, it's usually better to roll-out the change and create a new RFC based on the original one, as suggested by Van Bon et Al. [9]

From the description of the change management process and participating actors, one may conclude that this is a human-centric process, specifically a people-intensive since there's a lot of routing, approval and review of requests between human actors.

5.3.3. Process Objectives

The objective of change management is to execute and control all the changes on the organization and therefore, reduce the number of errors and incidents resulting from these. To achieve this objective, change management ensures that every change in the organization follows standard methods and procedures to minimize the impact on service quality, and to make all the process traceable. Some of change management benefits are (from van Bon et Al. [9]):

- Reduced adverse impact of changes on the quality of IT services;
- Better estimates of the costs of proposed changes (use of historic data);
- Increased ability to accommodate frequent changes without creating an unstable IT environment;
- Traceability of all changes and each one's status.

5.3.4. Process Control

To ensure that service quality keeps up with the agreed in the SLA's, ITIL processes also need to be monitored and controlled and change management is no exception. Also, data related to change management can be useful to the organization, such as: reports about changes implemented in a

period, which ones were successful and which were not, etc. This way the organization can learn about change management deficiencies and improve it. There also other indicators that can be used as Key Performance Indicators, here are some (from van Bon et Al. [9]):

- Number of changes completed per time unit, by category;
- Number of rejected changes;
- Number of back outs related to changes;
- Time consumed by change implementation;

6. Implementation

In this chapter, we start by giving a brief summary of the EAI tools used in this case study: webMethods Fabric and TIBCO BusinessWorks. According to a study made by Forrester Research [27] these two software platforms are leaders in integration-centric BPM software (Figure 6.1).

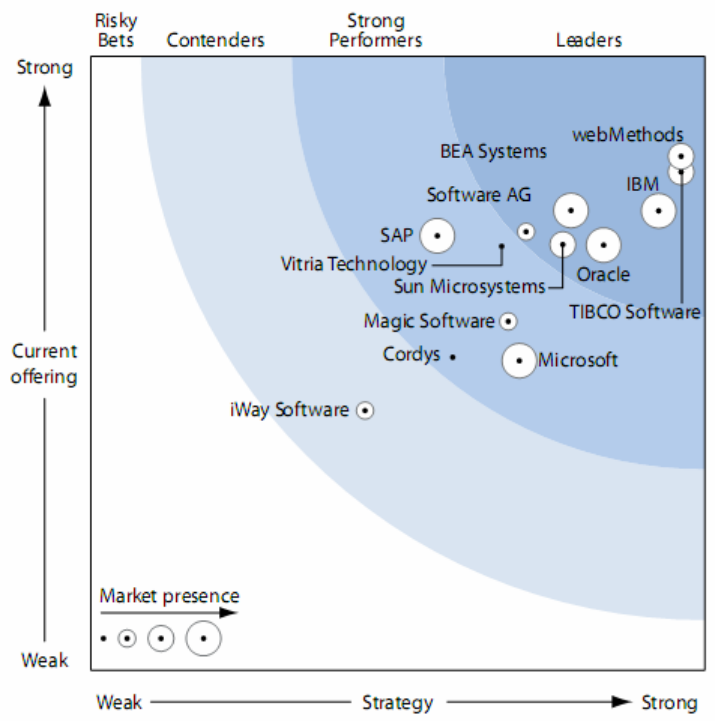

Figure 6.1. BPM software vendors market positions [27]

It may seem strange to use integration-centric BPM software to manage a human-centric process like change management, but if we are able to support BPM on such type of process using this type of tools, it's reasonable to assume that these tools can do a better job with system-intensive processes. Nevertheless, human-centric processes may also involve interaction and integration with business applications as we previously said in chapter 5. We'll now present a brief overview of the tools used in this case study.

6.1. WebMethods Fabric

WebMethods has been recognized through the years as one of the integration market leaders. In October 2004 they've introduced webMethods Fabric, their suite for business integration claiming support of composite application development (SOA) as well as EAI, BPM and BAM capabilities.

The first stage of a business process inside webMethods Fabric is its modeling inside webMethods Modeler. Modeler is a tool that graphically supports the model of processes, either from scratch or by importing a BPEL process that may be modeled in other tools such as Microsoft Visio, using standard notation such as BPMN. Modeler has a strong SOA component, where business analysts may associate process activities with services already developed for other processes by using ServiceNet which is a repository of services inside webMethods, similar to UDDI.

When the model is validated and built, developers may start to develop the business services (named flow services in webMethods) that support the activities in the model. This is done by using webMethods Developer. Developer allows a codeless approach to build flow services by using predefined flow logic (i.e. primitives such as *if*, *branch*, etc.), by combining other existent flow services and development of flow services in Java and C++. Due to its integration roots, Developer also provides graphical mapping and transformation of messages inside flow services.

After all the flow services that support the activities in the business process are developed, we can start to execute the process. Business processes are executed with webMethods Process Runtime Engine (PRT). PRT is hosted within Integration Server (IS), the core of webMethods Fabric solution. Integration Server executes services, acts as the runtime environment for adapters, and hosts the webMethods PRT for process execution.

Integration Server is a robust and standards-compliant platform that supports data transfer and web services standards, such as J2EE, JSP, XML, XSLT, SOAP, and WSDL. Other core component is the Broker, which is the messaging backbone of the Fabric suite, who works mainly in a publish-subscribe fashion.

When the process is executing, business analysts can use webMethods Monitor and Optimize to monitor and analyze their processes. The Monitor tool allows real-time monitoring of your processes and other components of Fabric (e.g. Broker, documents, adapters, etc.). The system administrator can suspend or resume currently running business processes, discovering their current state and analyze already finished processes.

WebMethods Optimize is the BAM tool of Fabric; it permits the definition of KPI, monitoring rules and alerts so business can respond to process exceptions and other events in a fast manner. Optimize as also available a technology developed by webMethods called “Fingerprint” which can

alert business users when a process is deviating from their normal behavior. For example, if an order fulfillment process such as the one in Figure 2.2 usually takes 1 hour to complete, when Optimize detects an order fulfillment process that's stalled for more than 1 hour it alerts the process owner or the system administrator so he can analyze the situation.

Table 6.1. Mapping between process lifecycle phases and webMethods Fabric

Our proposal (figure 7)	webMethods Fabric support
Discovery	Not available
Modeling	Modeler
Implementation	Developer
Execution	Integration Server/Monitor
Analysis	Optimize
Optimization	Optimize

6.2. TIBCO BusinessWorks

Although TIBCO's software for BPM support is iProcess Suite, we only had access to the TIBCO BusinessWorks integration software in this case study. TIBCO BusinessWorks is an integration-backbone that includes an enterprise service-bus (ESB) and a Web Services platforms used to connect disparate applications and data with little programming. The processes are modeled in TIBCO Designer which aids the implementation effort of the process activities by including a set of services/adapters used to communicate with several business applications, which TIBCO names "Activities". Since Designer is standards-based, the standard for messages inside processes is XML and each message can manipulated throughout the process flow using XPath. Unlike WebMethods Fabric, all the modeling and implementation is done inside TIBCO Designer. This means that the processes and their activities are all represent using a process modeling fashion, as one may see in Figure 6.2 which represents a process activity called "CreditCheck".

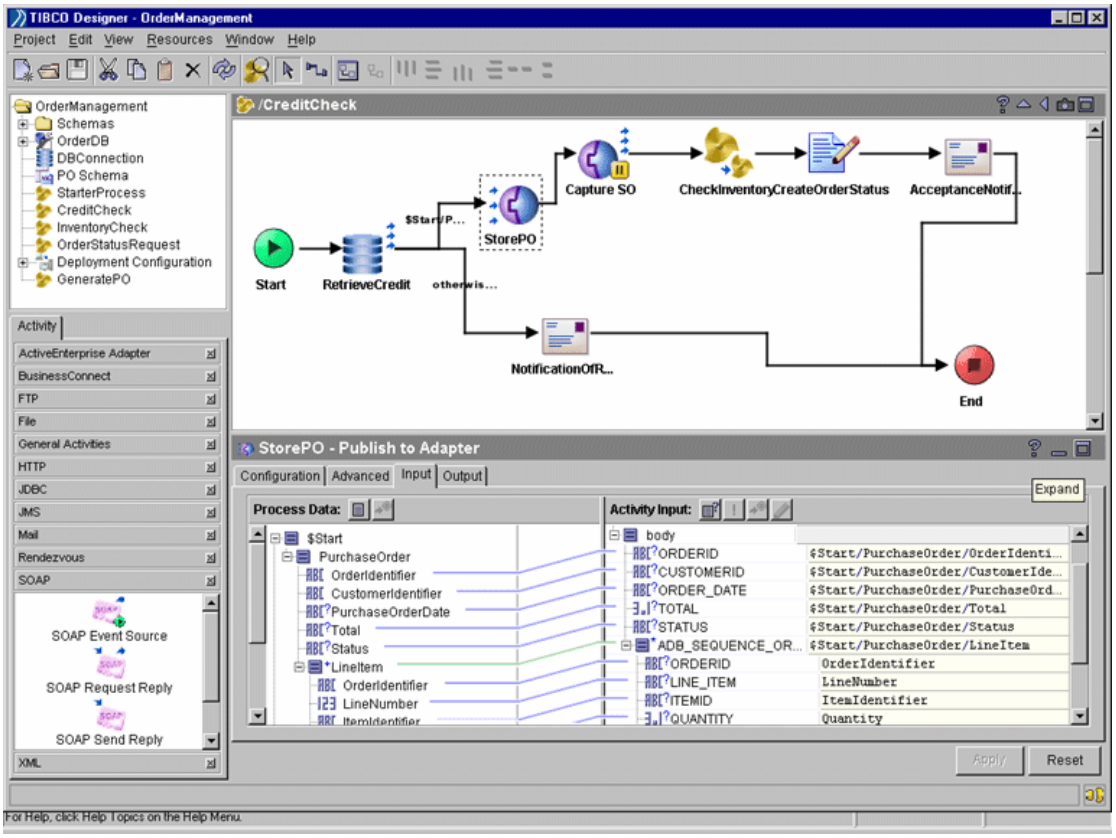

Figure 6.2. TIBCO Designer screenshot

Once a process is validated and tested inside TIBCO Designer, one may create an "Enterprise Archive" (EAR), then create a "Process Archive" and finally add the process to this archive. Unlike webMethods Modeler, processes in TIBCO Designer cannot be deployed directly to their runtime engine. After creating the EAR, it's now possible to enter TIBCO Administrator, a web-based console for process managing, and select within Administrator which EAR package you want to deploy. After deployment it's possible monitor the process, stop it, restart it and obtain some metrics, like in webMethods Monitor.

Since TIBCO BusinessWorks is an integration-solution and not BPM solution, there's no tool for process analysis and optimization. This is left to another TIBCO tool called "TIBCO OpsFactor", which imports data from the BusinessWorks process environment and allows the definition of "activity sensors" and threshold alarms inside TIBCO Designer modeling environment.

Table 6.2. Mapping between process lifecycle phases and TIBCO BusinessWorks

Our proposal (figure 7)	TIBCO BusinessWorks support
Discovery	Not available
Modeling	TIBCO Designer
Implementation	TIBCO Designer
Execution	TIBCO Administrator
Analysis	TIBCO OpsFactor*
Optimization	TIBCO OpsFactor*

*not used in this case study

6.3. Solution architecture

In our solution we'll use a variation of the typical 3-tier architecture used in information systems, i.e. presentation layer, logic layer and data layer. Between the first layer and the last, we had two layers instead of one, the process logic layer and the business logic layer (Figure 6.3).

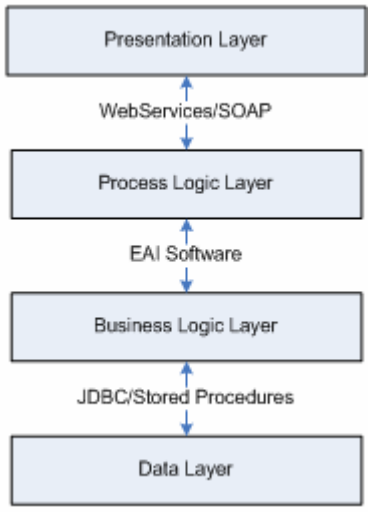

Figure 6.3. 4-tier solution architecture

The process logic layer is basically the process model and message flow between process actors. The business logic layer is a "technological" layer, meaning that it interacts directly with systems or in our case with a database. Process actors will interact with the process through a "Process

Portal" [44] in the presentation layer using webservices to interact with the process logic layer, so the presentation layer can be independent of the others. Communication between the process logic layer and the business logic layer is done by the EAI software, through a message broker (webMethods) or an ESB (TIBCO). Finally, the business logic layer communicates with the data layer using JDBC. We opted for Stored Procedures so the business logic layer doesn't need to know anything about how data is structured in the data layer. In our case study, we won't implement the Presentation Layer but we'll expose webservices from the EAI software that can be used to enable a future process portal.

However, once we started to study and work with the EAI software we concluded that it wasn't possible to use the architecture depicted in Figure 6.3. This is due to the fact that there's no possible way to communicate with the Process Logic layer directly. This has to be done through the Business Logic Layer as depicted in Figure 6.4.

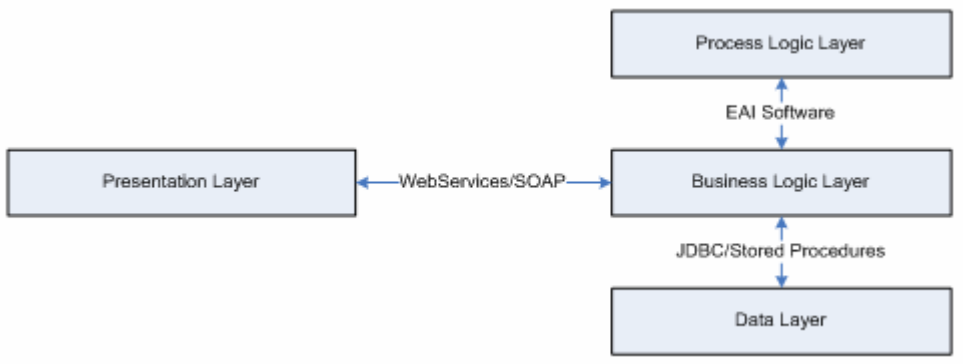

Figure 6.4. Solution architecture

The reason for this is that inside these tools, processes work in publish-subscribe fashion and the only way to communicate with the process is to publish documents in the message broker or ESB, which can only be done using services from the business logic layer. Therefore our presentation layer will work asynchronously as the webservices used will only be responsible for publishing documents to the message bus of the EAI software. Once in the bus, the EAI software can find out the recipient of the message by looking at the message type and/or by using correlation [8].

6.4. Process Model

As we've stated chapter 2, we can only do business process management in operational processes. As so, the first task was to transform the change management process in an operational process. To

make our task easier, we've based our process on other the Microsoft Operations Framework (MOF) [35] and HP-ITSM [40] which are both IT Service Management process collections based on ITIL, who provide a more operational view of its processes. We've also decided to simplify the original change management process by assuming that in our organization there's no need for urgent procedures and every change, no matter what its impact or priority is, is approved by the change manager and there's no need for a CAB. We've also switched the classification and acceptance activities, since we believe that all changes should be classified before being approved or rejected. Figure 6.5 summarizes the changes we've made in the original process.

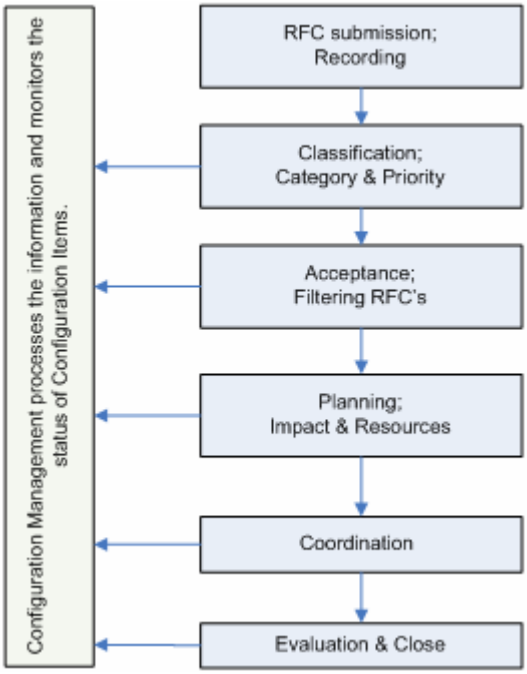

Figure 6.5. Simplified model of ITIL change management process

Now that we have a simplified version of our original ITIL change management, we need to turn it into an operational process. In Figure 6.6, we represent our operational process using the business process modeling standard notation – BPMN [51]. We've also represented the various actors involved in the process and what their responsibilities in the process are.

Change management starts when an RFC is issued by a customer and recorded by the change manager. After setting the priority and category of the RFC, it's the change manager's duty to inspect all the pending approval RFC's and decide whether or not to approve each one of them. Once a change is approved it's the change manager job to create a schedule for all the changes and

assigning an owner responsible for their implementation. After being implemented the change needs to be reviewed by all the intervenient to assess if it was successfully implemented or if there's the need to roll-out the change and start a new RFC. Although the change manager is the one who creates the Post-Implementation Review (PIR) document, the change requester and owner must also collaborate in the creation of this document.

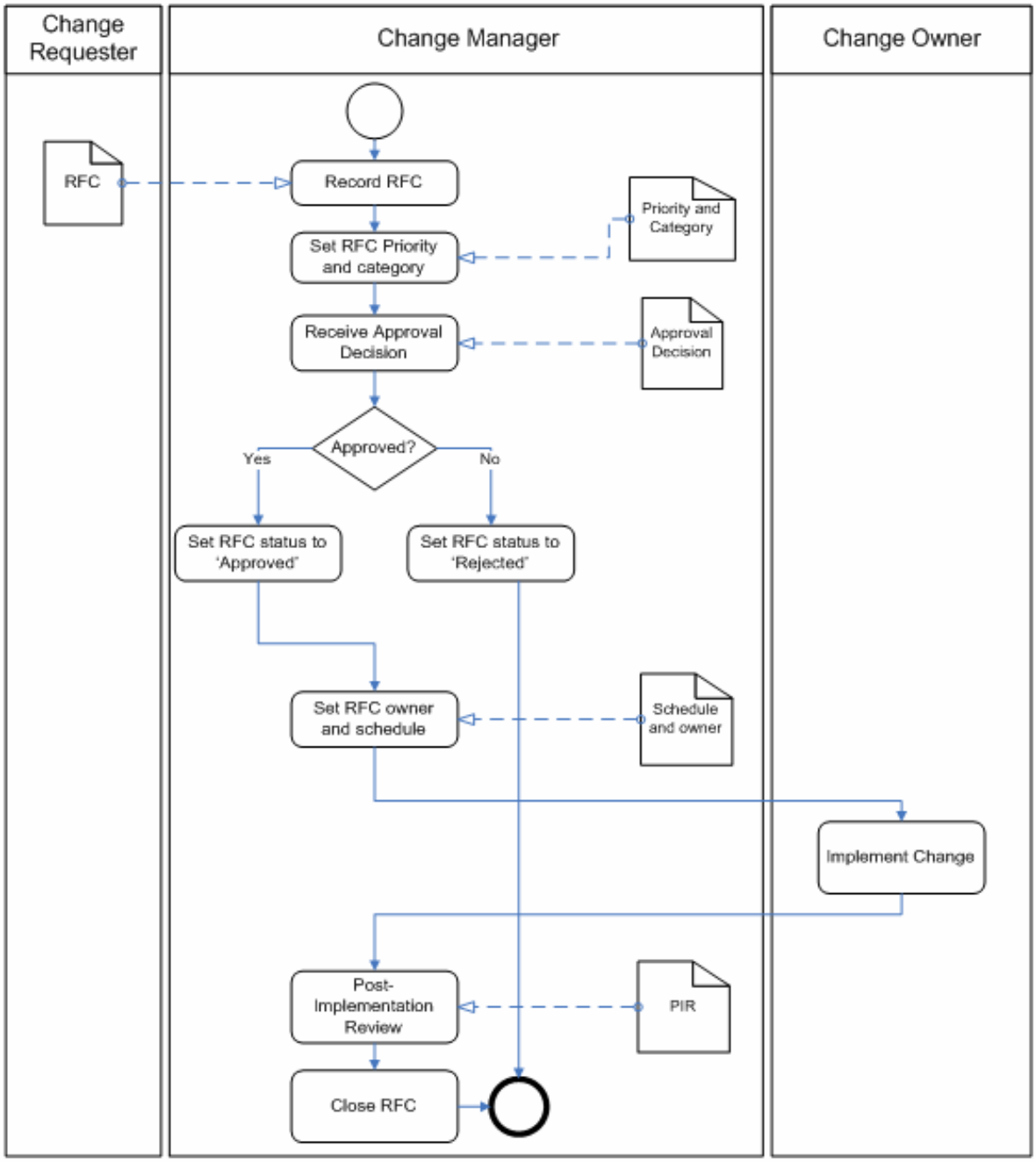

Figure 6.6. Change management process in BPMN

6.5. Document Schemas

With the process modeled, our next step was to describe the structure of each process document. We've include as example the structure of the document used to set the RFC priority and category, the rest of the document schemas can be found in Appendix B.

Table 6.3. "RFC Priority and Category" document schema

RFC Priority and Category	
RFCID	**Type:** Integer
	ID of the RFC which we're setting the priority and category
Priority	**Type:** Integer
	Priority of the change; ranges from 1-4 (low-high)
Category	**Type:** Integer
	Category of the change; ranges from 1-4 (low impact - major impact)
ReviewedBy	**Type:** String
	Manager who reviewed the RFC

6.6. Process implementation

In this section, we'll address the steps took to make our change management process executable and manageable. Table 6.4 summarizes the tools we'll be using to address each phase of the process lifecycle. As you may notice, we won't be using the analysis and optimization tools of both EAI platforms. Due to technical problems and lack of experience of the team supporting us in the webMethods installation/configuration, we weren't able to install the Optimize module. So, we'll focus our analysis on the first four stages of the process lifecycle: discovery, modeling, implementation and execution.

Table 6.4. Mapping between lifecycle phases and EAI tools

Our proposal (figure 7)	webMethods Fabric support	TIBCO BusinessWorks support
Discovery	Not available	Not available
Modeling	webMethods Modeler	TIBCO Designer
Implementation	webMethods Developer	TIBCO Designer
Execution	Integration Server/Monitor	TIBCO Administrator
Analysis	webMethods Optimize*	TIBCO OpsFactor*
Optimization	webMethods Optimize*	TIBCO OpsFactor*

*not available in this case study

6.6.1. Modeling

Figure 6.7 shows screenshots of our process modeled in webMethods Modeler and TIBCO Designer (full scale models available in Appendix A). The two tools are very similar, both providing modeling in a drag-and-drop fashion. It's also possible to import BPEL processes in webMethods Modeler, but it's not possible to export a process modeled in Modeler as BPEL. On the other hand, TIBCO Designer doesn't allow the import of BPEL processes. One matter that came to our attention is that neither of these tools uses the standard notation for businesses processes – BPMN [39, 51]. In webMethods Modeler every process step is initially an empty flow, only then the user can select which service that process step invokes and/or which document subscription to wait for. In TIBCO Designer, a process step that invokes a service is treated as a call to a sub-process and one that waits for a document is a "wait for message" activity.

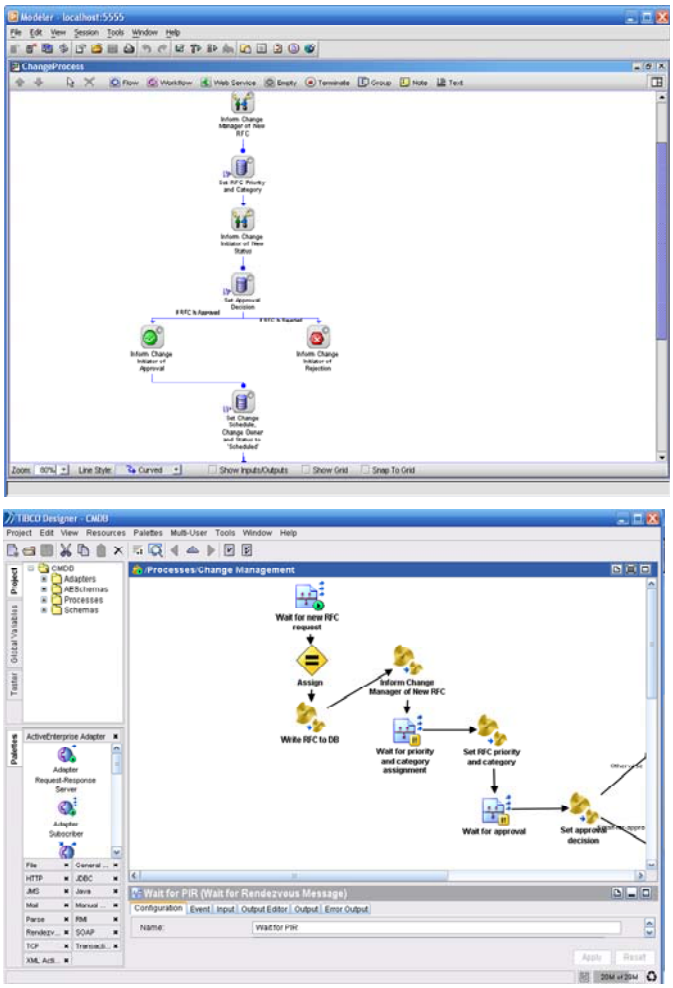

Figure 6.7. webMethods Modeler and TIBCO Designer screenshot

In both tools, before the user can associate document subscriptions with process steps he must define the document schema. In webMethods, this is done in the Developer tool and in TIBCO it's done inside Designer and both use XML-Schema standards to describe the document. With the process modeled and validated in each tool, it was time to address the implementation phase.

6.6.2. Implementation

Although we've used the word implementation to describe this phase, there's a better word for it – "Enactment". It's the phase where we make our process executable. In this phase, we created the document schemas and the services invoked by the process. Figure 6.8 shows two screenshots of the tools where this is made, webMethods Developer and TIBCO Designer.

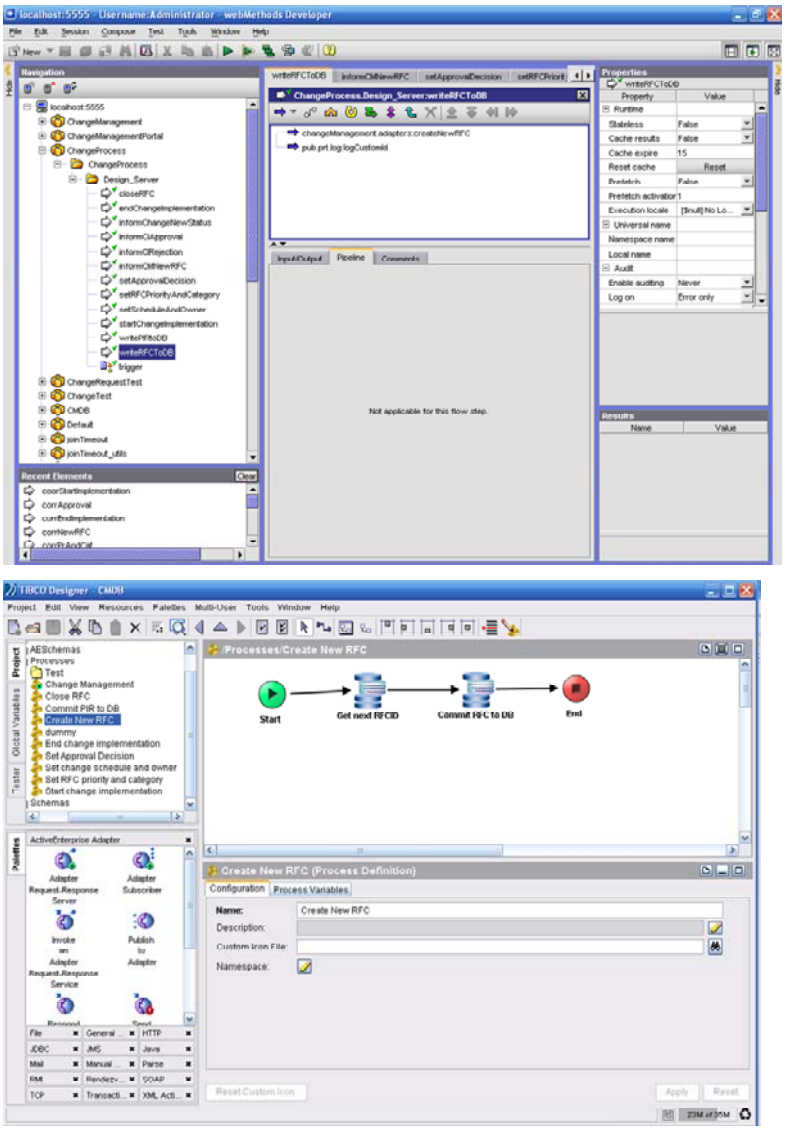

Figure 6.8. webMethods Developer and TIBCO Designer

As you may notice, creation of services inside TIBCO's software is done in Designer. That's because TIBCO BusinessWorks doesn't have the concept of a "service" in its pure meaning. Every service is treated as a call to a sub-process and all service logic is modeled as a process. On the other hand, webMethods distinguishes these two components: process model and the services. All the service logic (or application logic) is done inside webMethods Developer, which provides a set of primitives and adapters that allow a codeless approach of technologic services. webMethods calls these services "flow services" and a flow service can be a composition of several flow services. In Figure 6.8, it's possible to see the same service (Record RFC) created in both tools.

As we previously said, webMethods provides a service repository called ServiceNet and with few clicks a service can be published in that same repository. This is of great value for SOA-enabled companies, since it plays the same role as a central UDDI repository. Likewise, exposing a flow service as web service requires only two-clicks and you instantly have a WSDL that allows you to call that service via SOAP. In TIBCO Designer the task is a bit more painful because you have to use the included SOAP activities to create a webservice enabled sub-process.

Since the only system our process interacts with is a DBMS we've used the included JDBC adapter in both tools. Its configuration in both tools is very easy since both provide a configuration step-by-step wizard. Interaction with the human actors is done via webservices and in both tools we've created services that do no more than validate document data and publish the document into the message bus. This implies that our process portal must be asynchronous.

After we defined all the document schemas and created all the services, it was time to go back to webMethods Modeler and TIBCO's Designer to associate each change management process step with services and/or document subscriptions. After concluding these two phases, we believe they can be done in parallel reducing the process development time. However, to achieve this it's important to describe accurately the services and documents involved in the process execution, which may not be so clear when the modeling starts.

Once services and document schemas are created and associated with the process model, it's possible to deploy the process for execution. In webMethods this is done in Modeler easily, and again, needing few mouse clicks. In TIBCO the task is more difficult since the user must create an Enterprise Archive (EAR), and inside that archive a Process Archive and add the process to that archive. The task is eased because Designer detects the process dependencies and adds them to the

archive as well, so it's only necessary to select the main change management process. Once deployed, the process is ready for execution.

6.6.3. Execution

One of the components of the process execution phase is controlling the process. Both webMethods and TIBCO offer this control through a web-based console. In any of the tools, it's possible to suspend, resume, stop the process, see its current status (Figure 6.9), view data contained in the documents, etc. It's also possible to obtain some metrics, namely time metrics such as: total execution time, when a process step started and ended, etc.

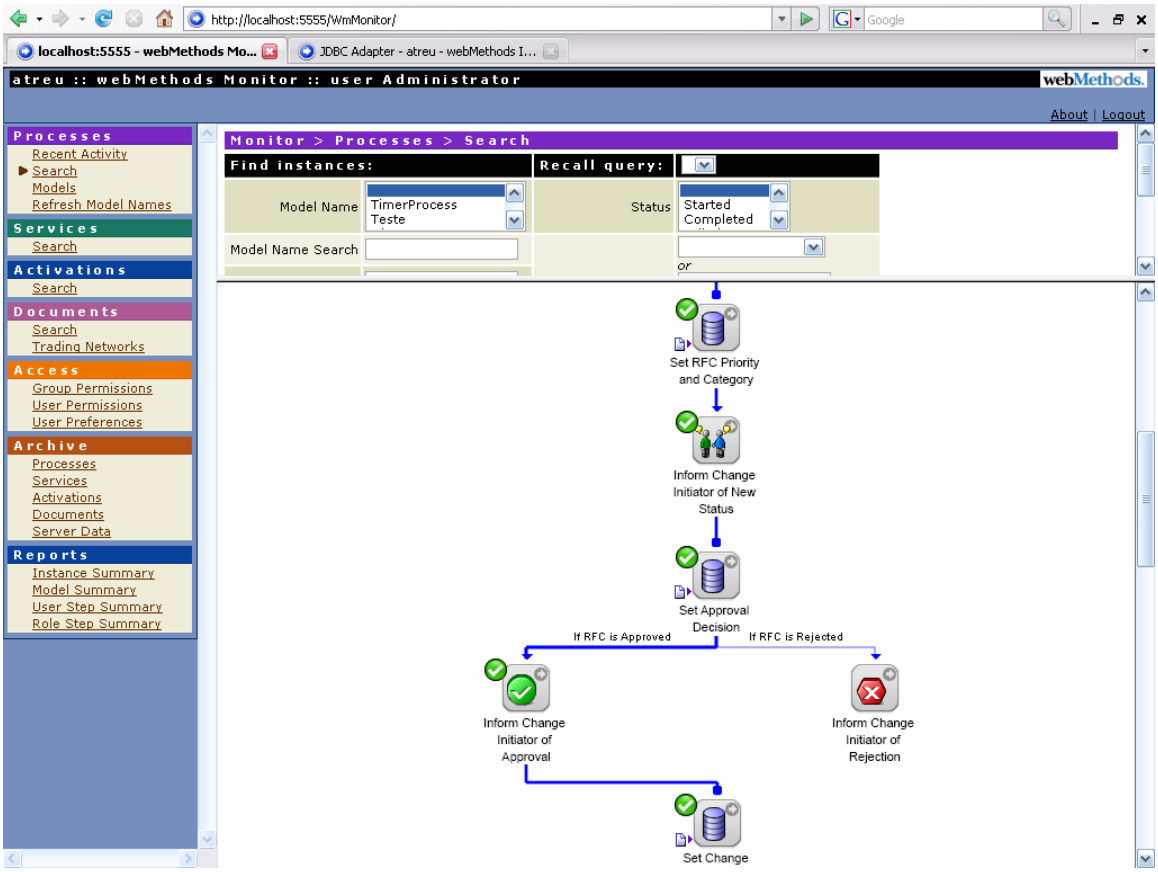

Figure 6.9. Process execution inside webMethods Monitor

In both tools it's also possible to see ended processes and processes which ended with exceptions (error) and it's possible to resume the process once these errors are corrected. Since process data generated by execution is permanently stored, people or applications can also query the state or structure of processes.

6.6.4. Discovery

Since this phase is not supported by any of the tools, we've opted to discuss it in the end. Discovery phase is usually a manual-driven process with the business analyst answering the question "how do we do this?" so we believe there's no possible way to be supported by BPMS. However, there are some subjects such as Process Mining [49] and Workflow Mining [46] that can be useful in the future to aid the discovery phase. They promise to discover process and workflow models from event logs generated by traditional business applications (ERP, CRM, etc.).

6.7. Implementation follow-up

After the first implementation we've decided to make some changes in our initial process by adding activities to inform the change initiator (requester) and the change manager about the current status of the RFC. This way we could the agility and flexibility of these tools. In webMethods we've also created a Timer Process (Figure 6.10), that's triggered by alarms defined on the change schedule so the change owner can be more reactive. Adding another set of activities to the process had no disruption in the process, we've only needed to create new process steps and services to be called by that step. At the moment, what the service does is logging messages to a text file but one could easily use a mail server adapter to send e-mails regarding the RFC status.

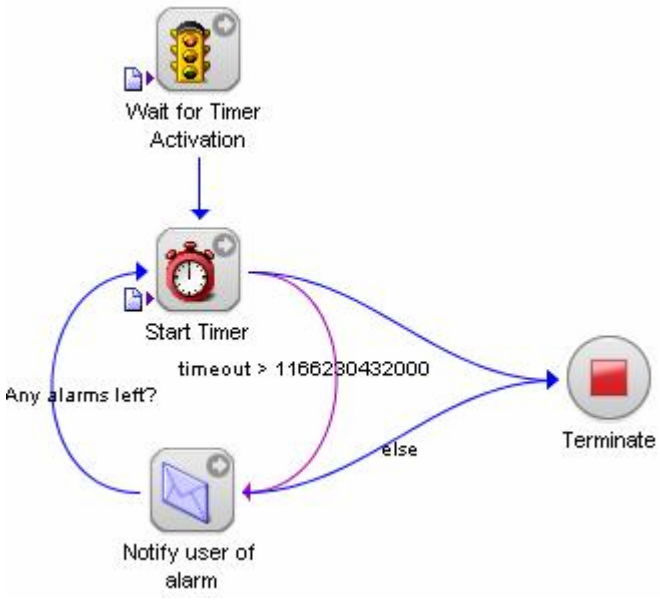

Figure 6.10. Timer process modeled in webMethods Modeler

To build the timer process, we needed to change the document schema for the "Change Owner and Schedule" document by adding a subset of AlarmTimes that trigger the process. We've made this

optional, since there's no obligation to define alarm triggers. After changing the document schema, the only thing left to do was to change the service invoked by the "Set RFC owner and schedule" activity, by adding a flow to publish a new type of document that triggers our timer process. We've add some problems with the process executions rules, especially defining timeout condition due to a bug of the application. Once again, the "Notify user of alarm" activity invokes a service that logs the alarm to a log file.

7. Evaluation

In this chapter we'll address problems we've faced during our case study and also, suggest key research areas EAI software vendors should focus on to improve their BPM support. Right from the start, one could say that our case study was undermined because we weren't able to test the Analysis and Optimize tools of both platforms, leaving us testing just the discovery, modeling, implementation and execution phase. This was also our thought when we decided not to test those phases. However, we reached a new conclusion in the end.

We started this thesis with a positive view regarding the BPM capabilities of EAI tools. Having previously worked with this type of tools (Microsoft BizTalk), it was our belief that they fully supported the BPM discipline. As so, when we accepted this challenge and placed the question "Is it possible to fully support BPM solutions using EAI platforms?" we were confident that the answer would be "Yes, it is." However, from the moment we started to study BPM we understood that we were wrong.

We assumed that BPM was merely a technological discipline, although it's also an holistic management theory [44]. From the IT perspective, BPM is all about process automation and the support of the different phases of a process lifecycle but technology plays only a partial role in Business Process Management. Despite this, technology could influence or even undermine the quality of the management theory behind BPM.

Even if we had tested the Analysts and Optimize tools of both platforms, and even if they excelled in their job, we would answer the question that ruled this thesis this way: "No, it's only possible to partially support BPM using EAI platforms." However, we found some deficiencies in both tools and there's still work to be done to improve BPM support in these platforms. In the following paragraphs, we'll try to highlight some of the key research areas and hot-topics that EAI software vendors should keep an eye on.

7.1. Obliterate the Business-IT gap

One of the objectives behind BPM is the elimination of what's called the "business-IT gap". Throughout the years, IT has been regarded as the cost-center of organizations. Partially, because of the way we do software engineering today and also because of the stiffness of business applications when we want to change them. As Michael Hammer wrote, it's necessary to remove

the business processes from the business applications because of the cost of changing a business application [22]. To clarify this we'll use an indicator usually used to characterize the cost of IT expenditures called "Total Cost of Ownership" (TCO). Before BPM, each improvement effort was usually accompanied by its own change program and its own IT systems implementation project. This approach as increased IT's total cost of ownership in the past years [16], leaving many potential improvements on the shelf, lacking sponsorship [44]. BPM strives to diminish the IT total cost of ownership by reducing the costs related to change. On the other hand, changes were also left in the shelf because "IT would take too long to implement it" [44]. This is mostly because of the way we do software engineering today.

7.1.1. A new era in software engineering

We follow a code-centric approach in the way we do software engineering today, because we have to translate business logic into requirements and CASE diagrams. It's known that requirements elicitation is one of the most time consuming phases in software engineering, and it's also very error-prone. BPM wants to change the way we do software engineering by eliminating the translation between business logic and requirements. Figure 7.1, adapted from Smith and Fingar [44], summarizes the differences between the software development and process development lifecycle.

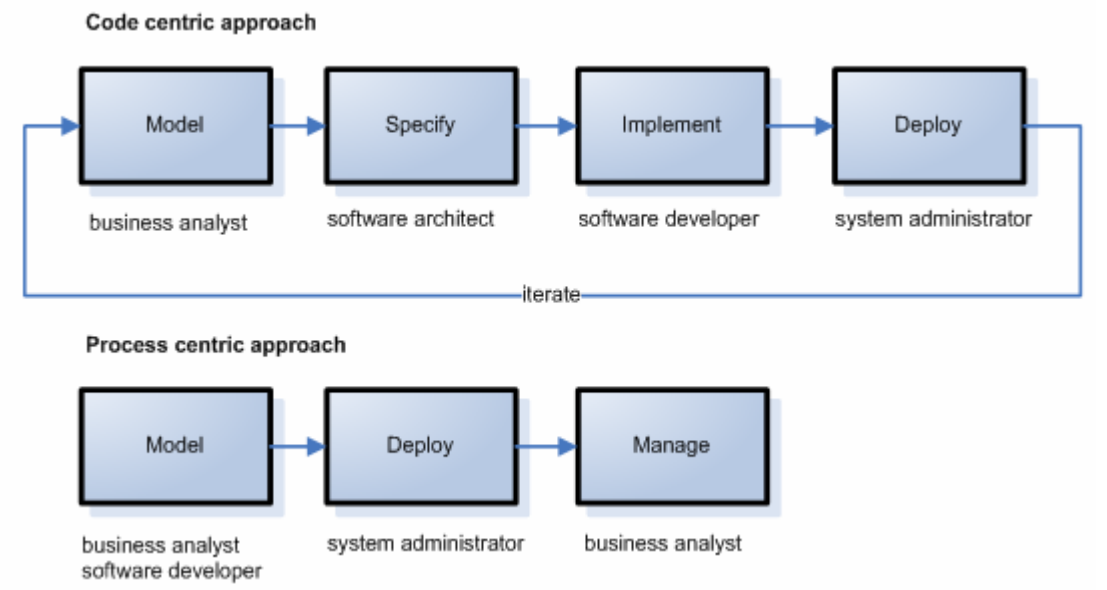

Figure 7.1. Software versus Process Development Lifecycle (adapted from [44])

If we look at the process development lifecycle, we see that there's no specify activity (i.e. requirements elicitation) because there's no need for translation of the process language. By focusing on processes, software developers and business analysts can understand each other. And we do this by creating a unified process modeling language that allows developers and analysts to communicate using the same language. This language already exists, and is called Business Process Modeling Notation (BPMN) [51]. Now that we gave a brief explanation of this software engineering paradigm shift we'll address the problems we found in both tools, and we'll start with process modeling.

7.2. Process modeling issues

It isn't coincidence that the modeling issues come after a section appealing for the adoption of a standard process modeling language. One of the biggest problems, if not the bigger, with the EAI platforms we analyzed is the lack of adoption of modeling standards. Neither webMethods nor TIBCO use BPMN as modeling notation.

BPMN is a standard for a process modeling notation developed by the Business Process Management Initiative (BPMI) group and the first specification was released to public in May 1, 2004 [52]. The aim of BPMI was to create a notation that could be easily understood by business analysts, technical developers, by business users and by the business people who manage those processes. This way, it's possible to bridge the gap between process design and process implementation. In both of the used tools, we first modeled the process in BPMN and then we had to "translate" it to the proprietary modeling notation each tool uses. This is not the way to do it. If EAI tools want to increase their support to the process lifecycle's modeling phase, they must use standard notation, i.e. BPMN. While they don't do this, they can never consider their tools to be BPM enabled. The lack of standard adoption doesn't end here. Neither tools use BPEL as their execution language or XPDL as their process description language, although webMethods allows the import of BPEL processes. BPMN and XPDL are mainly process modeling "languages", the first is the processes' graphical representation and the second describes the way that representation is stored digitally using XML. BPEL is a process execution language and differs from XPDL, because BPEL stores the specifically underlying sequence of interactions. We'll address BPEL when we discuss the process execution phase. We're discussing modeling, so we'll address BPMN and XPDL.

XPDL stands for XML Process Description Language and is a language supported by the WfMC [50] used to store BPMN graphical representations digitally. The adoption of these two standards is important because of two factors:

- **Communication among stakeholders:** One aspect of BPM is the participation and collaboration of all process stakeholders in the process design [23, 44] and as we said, we need a standard modeling language to do this effectively. BPMN allows us to use a standard graphical notation that all stakeholders understand and XPDL allows the sharing of processes digitally.
- **Platform-independency:** Using modeling standards, the business analyst and business users can use other modeling tools which they're more familiar with (e.g. Microsoft Visio) instead of having to use the BPM software design tool (e.g. webMethods Modeler and TIBCO Designer). If both these tools use standards such as BPMN and XPDL eases process models exchange between them.

On the subject of communication between stakeholders, we leverage the need for a central process repository which can be accessed by all stakeholders to further facilitate this communication and participation in the process design [44]. Neither tools offered this, although TIBCO has an application, not included in BusinessWorks, called XML Canon which allows the storage of XML data in a central web-based repository. Since XPDL is XML, it could be possible to store processes using this software tool. However, this isn't enough. Processes aren't static, they change and we advocate that these repositories should store previous model designs to allow companies to change to previous design models when they need to. Also, processes don't exist in an organization by themselves; they're part of an organizational context. As so, we believe that there should the possibility to append to the processes models in this repository, several types of documents related to the process such as: document schemas, SLA's, actor's roles, etc. so any user can understand the context of that business process in his organization. Smith and Fingar also support the need for a process repository [44] in BPMS.

Finally, the way exception handling is done in these tools can sometimes obscure the main business logic. Deviations from the normal flow of the process due to human or system error result in exception and need to be addressed. However, the process model can get very complex once you start to include exception handling [23]. What we would like to suggest as improvement is the creation of different views for the process models within EAI and BPM tools, a process view and

an exception handling view. The first is targeted at the business analyst, leaving the second for a software developer, so the business analyst can get a clean view of the process login and don't worry about the exception handling. Figure 7.2 represents our idea.

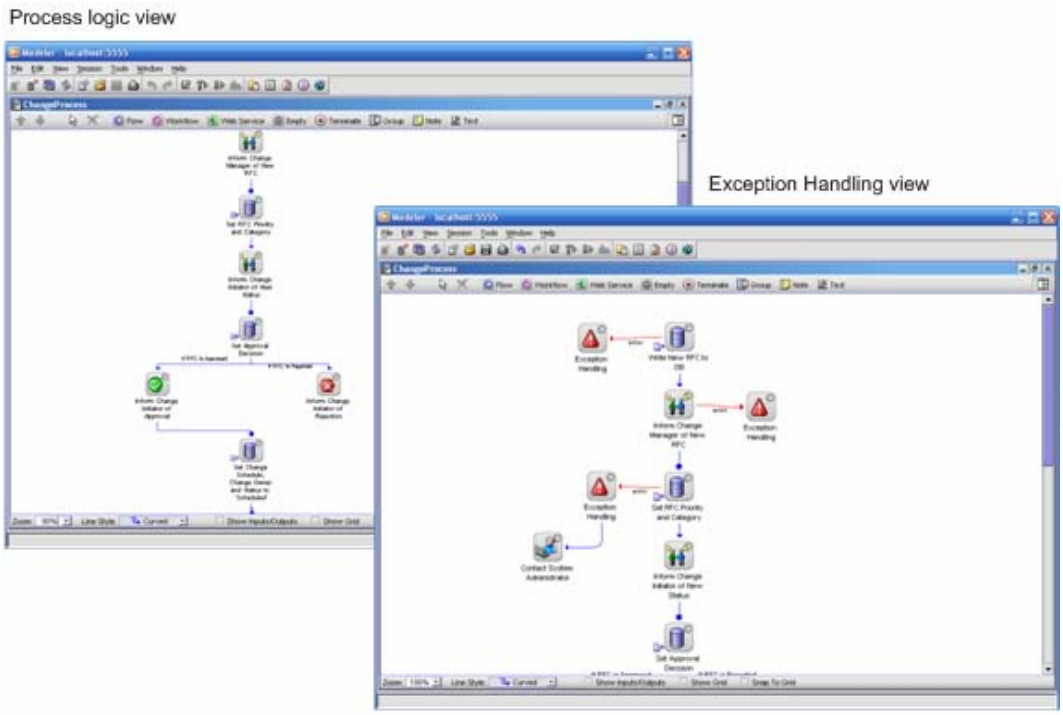

Figure 7.2. A process logic view and an exception handling view

The two last identified issues, need for a process repository and different exception handling scenario, can be interpreted as suggestions for improvement and not as serious problems that need immediate attention. However, the adoption of standards as BPMN and XPDL is a matter of urgent attention and requires utmost priority.

7.3. Execution: BPEL or no BPEL?

BPEL is short for Business Process Execution Language, and is the de-facto standard for business processes programming language. BPEL has origin on a language for the orchestration of WebServices and from our point of view it can only be used successfully in a SOA-enabled organization where every IT service is exposed as a WebService. One of the objectives behind the adoption of BPEL is to create process platform-independency, so companies can easily change from a BPMS provider to another. We believe this is important but few vendors adopt this standard. Some of the causes can be:

- BPEL doesn't have all the primitives necessary to successfully model a business process;
- Direct translation between BPMN and BPEL is a difficult process [39];

Since BPEL is largely based on the orchestration of webservices it provides little support for other types of service invokes. We believe this is one of the main reasons why we couldn't find BPEL adoption in any of the tested tools, because EAI tools use message brokers and ESB as the favorite communication protocol and not webservices. This can be changed by adding extensions to the BPEL language, as IBM did with their WebSphere platform becoming one of the few vendors offering a BPEL compatible process engine. On the other hand the problem may also be the mismatch in direct translation between BPMN and BPEL [37, 39]. Since BPEL wasn't created as a translation of BPMN to a programming language, trying to make this translation can be very difficult at the moment. We believe that BPEL has to become a more mature standard in other to be largely adopted by BPM software vendors.

7.4. The future of process discovery

As we've previously said, the way process discovery is conducted today is largely manual. Processes are implicit in work patterns and/or ingrained in systems and discovery tries to make them explicit as digital assets, by inspecting system code, by interviewing participants, etc. [44]. As you may be thinking, this requires an immense human-labor effort. So, what we would like to do in the future is to aid this process by making it less manual and more automatic, and that future is near.

In a 1995 paper titled "Automating process discovery through event-data analysis" [14] we can see what was the beginning of the automation of process discovery, named today as Workflow Mining [46] and Process Mining [49]. The motto for these sciences is that most of our business applications today create event-logs that can be "mined" to gather a process model, detecting and mapping patterns of work practice and behavior. It's not our intention to lecture about process and workflow mining since we've had little contact with the subjects, however one can easily see the potential of such type of tools and their application to the BPM field. We truly believe that it won't take too long until we start to see process mining tools in BPM suites and it's a hot-topic BPMS vendors should focus on as well.

7.5. Implementation

There’s not much to say about implementation. We believe that both EAI platforms provided the necessary tools to develop the services supporting the process, both in a codeless approach. Also, both include lots of adapters to interact with systems and business applications and it’s also possible to interact with human actors exposing webservices and invoking them using a web portal. So it’s easy and possible to support both human-centric as well as system-intensive processes.

8. Conclusion

Enterprise Application Integration and Business Process Management are two very different disciplines, but as we've seen they have converged historically and we believe that they need each other. Integration plays a very important role in business processes, since these can be characterized as the integration and orchestration of several actors to produce business value for an organization. As so, we accepted the challenge to study how well EAI technology supported BPM. The question that ruled this thesis was: "Is it possible to fully support BPM solutions using EAI platforms?" And the best way to find our answer was to work with EAI software and try to use it to support BPM.

To choose what process we should manage, we studied what types of processes exist in organizations today. Smith and Fingar [44] agree that organizations are usually composed of three types of processes: strategic processes, operational processes and best-practice processes. This said, we decided to narrow our search for a process in collections of best-practice processes. In the end, the best practice processes we chose were ITIL, and the Change Management process was our main choice for our prototype. Change Management is a process that's concerned about the management and control of changes that occur in an organization's IT infrastructure. It's well known that changes can lead to incidents and problems in the quality of IT services, so change management tries to minimize the impact of changes by carefully controlling it. We adopted this process and proposed to answer our thesis question by creating an application to support this process and its management by using software from two EAI market leaders, webMethods and TIBCO.

The first thing we did was to transform the change management into an operational process because the way ITIL describes change management in a strategic way [9], which is good because organizations can adapt this processes to their organization specifically instead of using a rigid process with offers little customization flexibility. To aid our effort we studied other IT Service Management suites who took inspiration from ITIL: Microsoft Operations Framework (MOF) and HP-ITSM. Both use a more operational approach to the change management process, which helped our task. Like BPM suggest, we took the position of a business analyst: we developed a model of the process using BPMN as our notation, and described the structure of all documents involved in the process flow. This was our discovery phase of the process lifecycle we described in chapter 2.

On our case study we used webMethods Fabric and TIBCO BusinessWorks. webMethods Fabric has its origins on application integration but webMethods saw the opportunity to move into the BPMS market and started to adopt some BPM concepts into its platform. TIBCO BusinessWorks has some BPM concepts but TIBCO opted to launch its BPM suite in another product called iProcess Suite. However, we believe that pure EAI only software can also support BPM. The next step after "discovering" the process was to model it in both tools which provided a drag-and-drop process modeling interface, very accessible to business analyst as well as to business users. After we accomplished the process modeling, we took the role of software developers and "coded" the services that supported, i.e. were invoked, by the process flow. Both tools support a codeless approach to this lifecycle step. In the end, we had to go back to the modeling tool to associate process steps with services invocation and document subscriptions. We believe that these two phases, modeling and implementation can be done in parallel if both services requisites and document schemas are carefully defined in the discovery phase. After model validation we deployed the process to the process engine so we could execute it, and in both tools the process was simple. Once in execution, TIBCO and webMethods provided a web-console in which the system administrator can control the process, suspend it, stop it, resume it, inspect process status, etc. With the process in execution we were left with the two missing lifecycle phases: Analysis and Optimization. Unfortunately, we weren't able to test them in any of the solutions. In webMethods, we couldn't install the Optimize module partially because of technical problems and lack of experience (in this module) of the team working with us. TIBCO offers their analysis and optimization in a product called TIBCO OpsWare which he hadn't access to. This ruined some of our expectations since we believe that they're two fundamental parts of BPM and really create added value in organizations.

After studying BPM, EAI, WFM and working with integration platforms we reached a conclusion. We started this thesis with the view that BPM was mainly a technologic innovation, but it's also a management theory. So, instead of asking "Is it possible to fully support BPM using EAI platforms?" we should have asked "Is it possible to partially support BPM using EAI platforms?" because technology plays a partial role in making organizations BPM enabled. Despite this, we believe that there's still work to do to improve the BPM support of the tools we've worked it, namely in modeling. Having worked with these tools and studied the subject we identified what we think will be the key research areas and future hot-topics in the BPM support arena.

One of our biggest concerns the adoption of process modeling standards in both tools. Neither of the tools use BPMN as standard notation for process modeling. BPMN stands for Business Process Modeling Notation and is the de-facto standard in the industry for process modeling. One of the objectives of BPM is to bridge the gap between IT and the business and proposes to do by using a standard notation for process modeling so they can eliminate the burden and costs of requirements elicitation. It's known that one of the major time consuming and error-prone activity in software development is requirements elicitation, and that's because we try to translate what the business users want into something that the IT personnel can understand [44]. BPM eliminates the need for this "translation" by leveraging the process modeling notation as first-class language between business and IT. To create a language that's understood by all it's necessary to adopt a standard language, and that language is BPMN.

Also, since BPM tries to involve all the organization to participate and collaborate in the process modeling and managing we need a common language. However, since we live in a digital world is by using digital formats that can be opened in every process modeling as easily as we do this in the tools we've tested. XPDL is the standard digital format for storing BPMN notations, and neither of tools allows us to save our processes in XPDL. It's important to be able to digitally share processes and to make that process even easier, we believe that BPMS vendors should consider the inclusion of processes repositories which store process models available to all to the organization. These repositories should allow to rollback to previous models of the same process and also, letting users append documents to the process model because processes exist in an organizational context and have lots of information associated with them (e.g. SLA's, document schemas, process revision documents, etc.). Exception handling is another issue in modeling since the main process can become obscured by exception handling steps. To solve this we propose the creation of two different views in a process model: process logic view and exception handling view. Here's a summary of the issues we've identified in the modeling phase:

- Lack of modeling standards adoption, namely BPMN and XPDL;
- Lack of a central process model repository;
- Exception handling in process model can obscure main process;

We haven't identified any issues concerning the implementation phase, since we believe both tools adequately support software developers in creating the services in a codeless approach, and the

inclusion of several integration adapters makes the integration with existing legacy systems very easy.

In process execution one of the main trends is to adopt process engines which run BPEL processes. This makes organizations processes platform independent since processes can be stored in BPEL and used in any process engine available (as long as it natively supports BPEL). Despite being a very important step, we believe that BPEL has to become a more mature standard before it can be adapted for the majority of EAI and BPM software vendors.

We believe that process discovery in a near future will be partially supported in an automatic way by BPM tools, instead of the largely manual way it's done today. Subjects like Process Mining and Workflow Mining will play an important role in the process discovery phase and will be a topic that BPM and EAI vendors should keep an eye on.

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Appendix A. Process Models

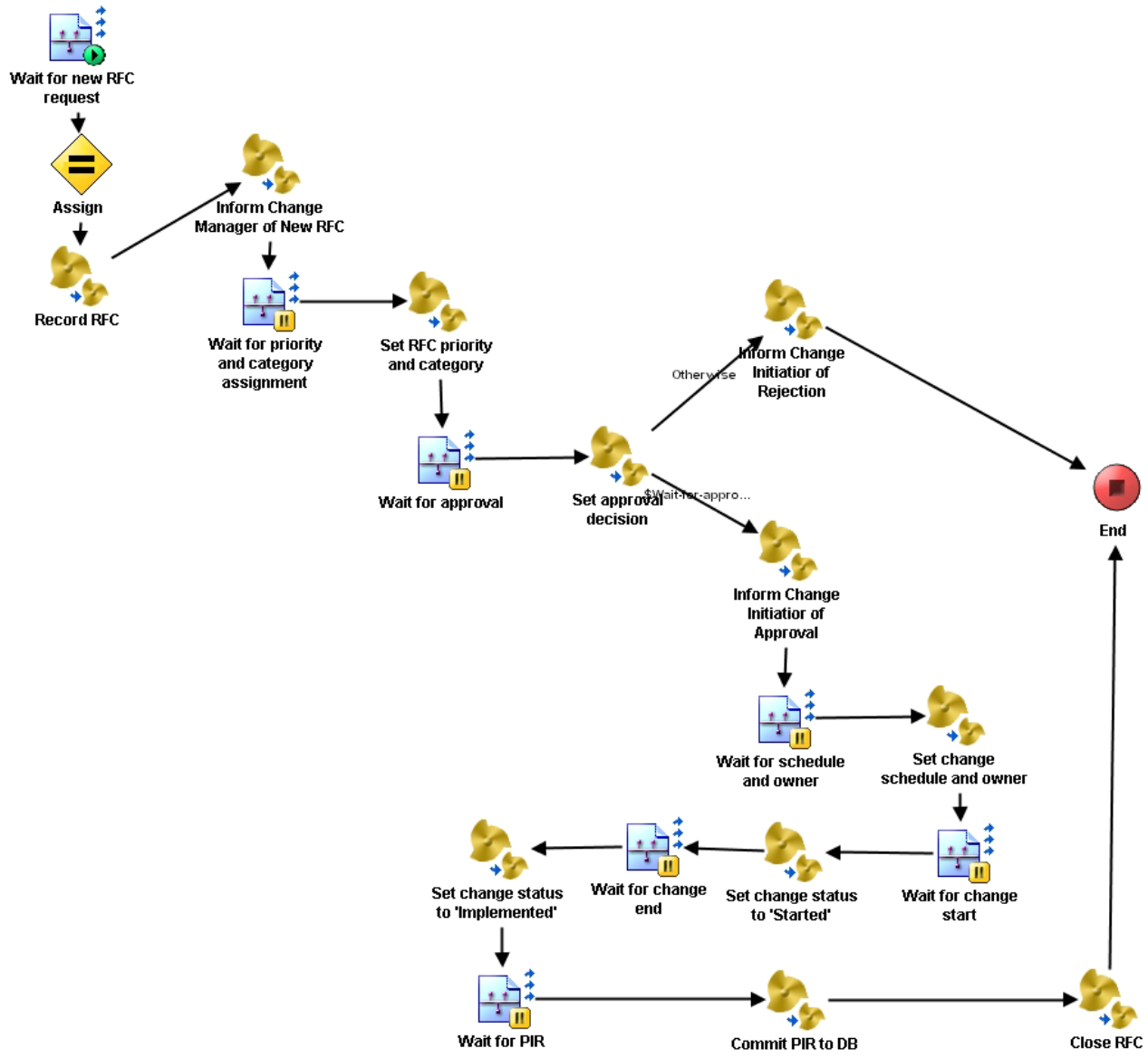

Figure A1. Change management process modeled in TIBCO

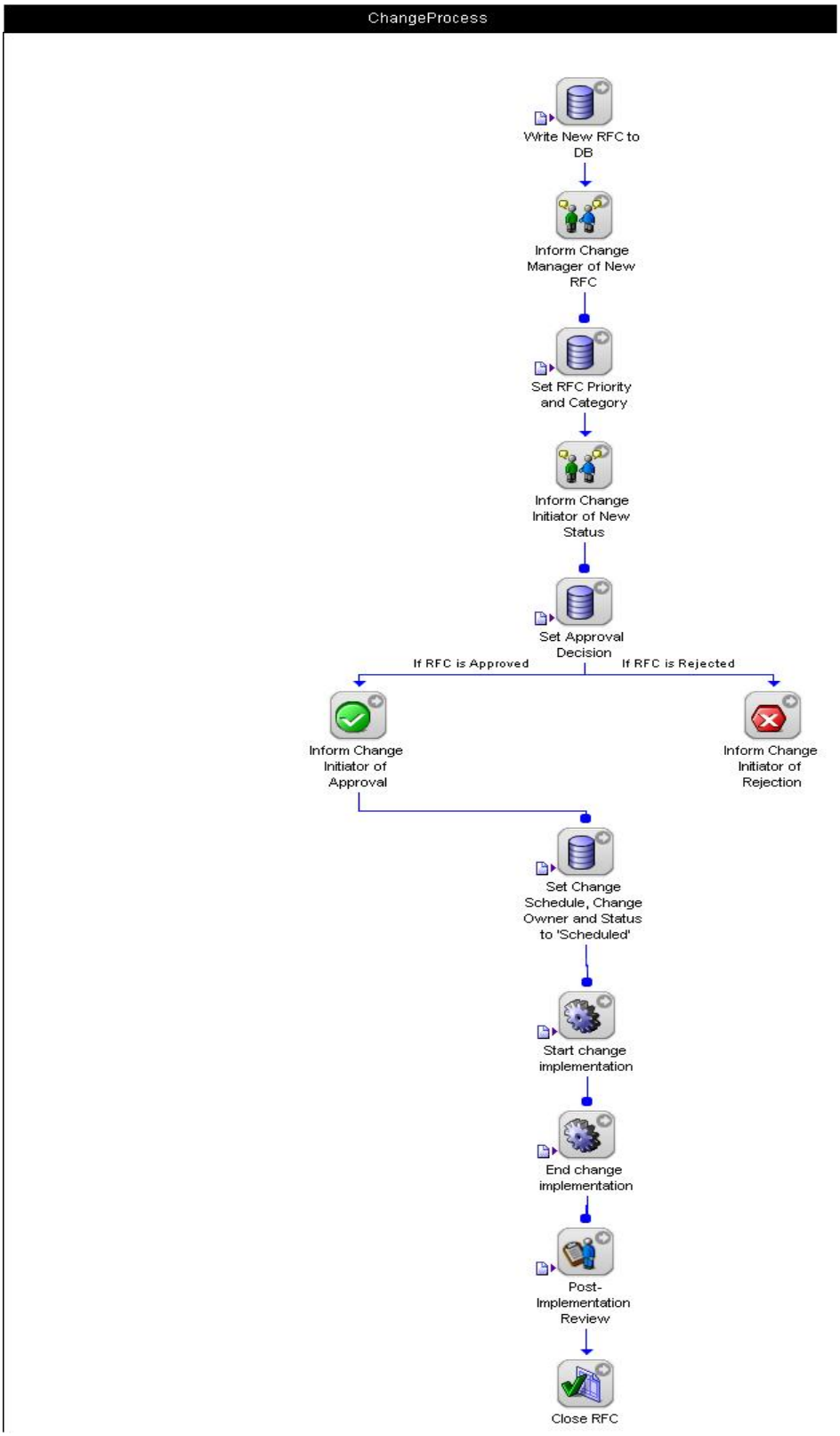

Figure A2. Change management modeled in webMethods

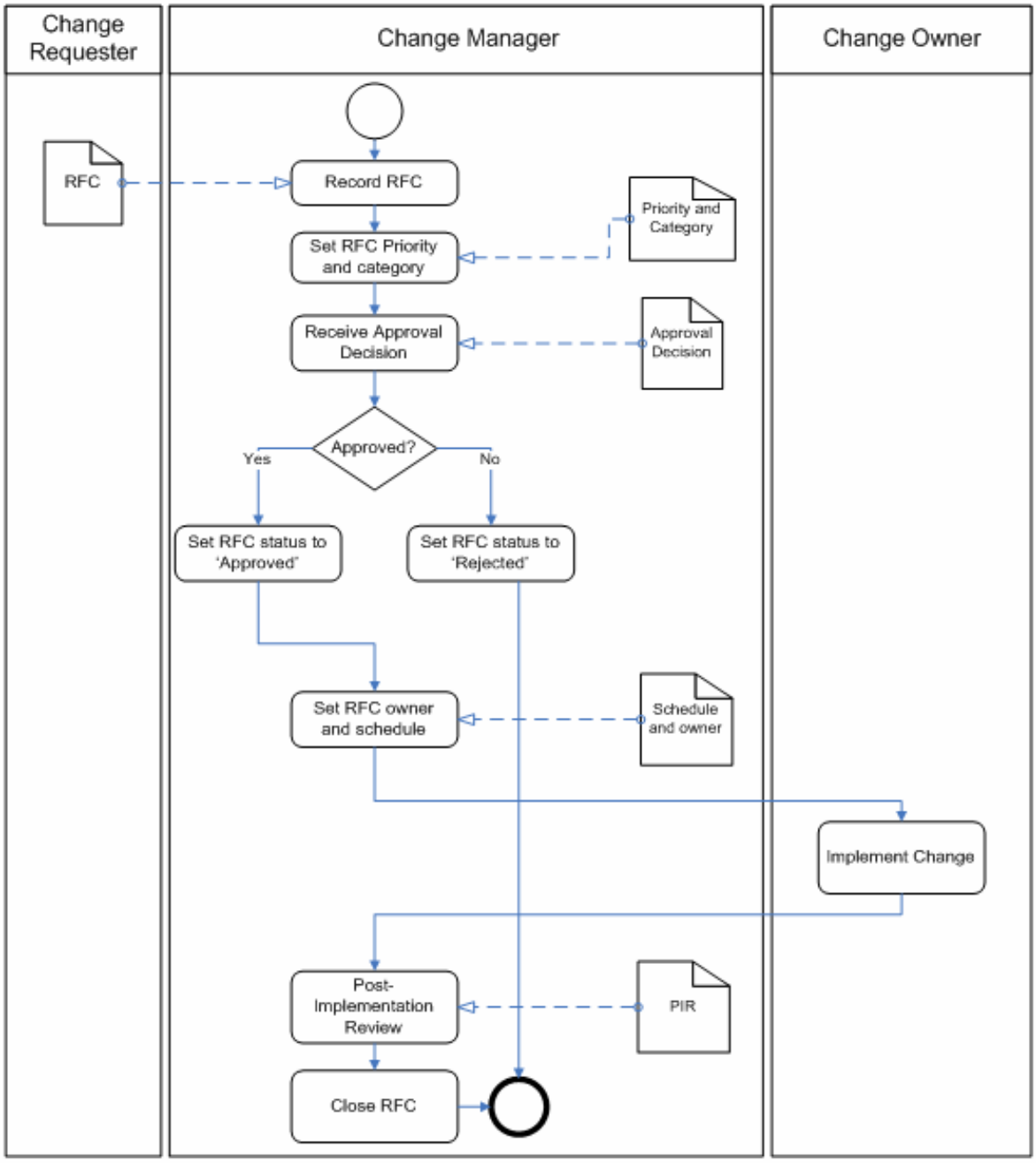

Figure A3. Change management process modeled in BPMN

Appendix B. Document Schemas

This appendix contains tables describing the schemas of the documents involved in the change management process (Figure A3).

Table 9.1. RFC document schema

RFC	
RFCID	**Type:** Integer
	ID of the RFC
ShortDescription	**Type:** String
	Short description of the change
FullDescription	**Type:** String
	Full description of the change
ReasonForChange	**Type:** String
	A text describing why the change is needed and how it contributes to the organization
RequestedBy	**Type:** String
	UserID of the user issuing the RFC
ItemToBeChanged	**Type:** Integer
	ID of the Configuration Item to be changed

Table 9.2. RFC Priority and Category

RFC Priority and Category	
RFCID	**Type:** Integer
	ID of the RFC which we're setting the priority and category
Priority	**Type:** Integer
	Priority of the change; ranges from 1-4 (low-high)
Category	**Type:** Integer
	Category of the change; ranges from 1-4 (low impact - major impact)
ReviewedBy	**Type:** String
	Manager's UserID who reviewed the RFC

Table 9.3. RFC Approval Decision

RFC Approval Decision	
RFCID	**Type:** Integer
	ID of the RFC concerning the approval decision
Decision	**Type:** Boolean
	False for 'rejected' change and True for 'approved' change

Table 9.4. RFC Change Owner and Schedule

RFC Change Owner and Schedule	
RFCID	**Type:** Integer
	ID of the RFC
ChangeOwner	**Type:** String
	UserID of the person responsible for implementing the change
Schedule	**Type:** Elements(startDate,endDate)
	Schedule for the implementation
startDate	**Type:** Date
	Date and time when the change implementation should start
endDate	**Type:** Date
	Date and time when the change implementation should end

Although we've originally not represented the documents in Table B.5 and B.6, they're used to let the system know when the change has really started so it can calculate deviations from the original schedule.

Table 9.5. Start implementation

Start Implementation	
RFCID	**Type:** Integer
	ID of the RFC

Table 9.6. End Implementation

End Implementation	
RFCID	**Type:** Integer
	ID of the RFC

Table 9.7. Post-Implementation Review

Record Post-Implementation Review	
RFCID	**Type:** Integer
	ID of the RFC being reviewed
PIR	**Type:** String
	Review of the change

Also, not originally represented in the process model in Figure A3, the "Close RFC" document is used to let the system know when to close the RFC. Since it's possible to leave the RFC open after the PIR is done.

Table 9.8. Close RFC

Close RFC	
RFCID	**Type:** Integer
	ID of the RFC to be Closed