INSTITUTO SUPERIOR TÉCNICO
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EAI Support to Business Process Management in the Telecom Industry

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Dissertação para Obtenção de Grau de Mestre em

Engenharia Informática e Computadores

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Novembro 2007

Abstract

In a world where business environment is constantly changing, Business Process Management is a philosophy that most organizations claim to be adopting. In the last decades technology has also undergone a constant evolution which allowed it to support all the changes that occurred in the business environment. Enterprise Application Integration tools were, from among those cases of technology evolution, one where the progress was most accentuated. The vendors claim that their tools have stopped being only a solution to middleware integration, having moved on to offer full Business Process Management Support. But how well do EAI tools really support BPM?

Keywords

Business Process, Business Process Management, Enterprise Application Integration, Information Technology.

Acknowledgements

Antes de mais, gostaria de agradecer a todas as pessoas que de uma forma ou outra me apoiaram durante este último ano no desenvolvimento deste trabalho.

Em primeiro lugar quero agradecer ao professor Miguel Mira da Silva não só pela oportunidade que me concedeu (pois sem ele a realização deste projecto nunca teria sido possível) mas também por toda a orientação ao longo deste último ano.

Em segundo lugar quero deixar aqui um abraço a todos os meus colegas por todo o apoio ao longo deste difícil ano lectivo. Um abraço especial para o meu colega Paulo Sebastião pelo acompanhamento e troca de ideias que ao longo de todo o projecto fizeram com que a qualidade do mesmo aumentasse exponencialmente.

Em terceiro lugar, quero expressar a minha gratidão à minha família, especialmente pais e irmã, por toda o apoio e paciência.

Para terminar um grande obrigado a todos os meus amigos e amigas pois o trabalho não é tudo e sem os bons momentos não teria conseguido terminar este projecto

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API	Application Programming Interface
BAM	Business Activity Monitoring
BP	Business Process
BPM	Business Process Management
DBMS	Database Management System
DSS	Decision Support System
EAI	Enterprise Application Integration
ERP	Enterprise Resource Planning
eTOM	Enhanced Telecom Operations Map
IT	Information Technology
MOM	Message-oriented Middleware
WFMS	Work-flow Management System

1 Introduction

1.1 Context

In the past decade we must highlight three factors that contributed the most to business environment changes: Globalization, Digitization and Deregulation. Globalization removed regional obstacles and enabled enterprises to expand their businesses across borders. Deregulation has helped the market become more customer oriented. Digitization has made production costs become marginal because of its amazing improvements in bandwidth and computation power. In a world where business environment is constantly changing Business Process Management (BPM) stopped being a buzzword used by academics and has become a common practice in organizations. Meanwhile Information Technology (IT) has also evolved, trying to adapt to business changes and that's where EAI tools get in. Their evolution was amazing but can they really support BPM as well as people say they can?

1.2 Problem

With the quick evolution that occurred in the business scenario, every organization tried to adapt their systems the best they could so that those systems could maintain the business running with all those changes. But because of the quickness of that evolution (and of the lack of planning) the IT infrastructure of those organizations became a chaotic network of redundant data and systems.

Most of those problems could be eliminated but the big one is still present in most organizations. The business logic is spread among many different systems and layers, data silos or even in all the people that execute the business. For a manager this is really a headache. The business becomes very difficult to adapt to the frequent changes and thus not allowing the organizations to adopt a true BPM

philosophy among their businesses. The telecom industry deals with this problem on a daily basis. The business is always changing and processes have to be adjusted often, either in spite of the strong regulation pressure or by the innumerous products that every service provider releases every year.

1.3 The Solution

All the problems in the telecom industry presented above have motivated the appearance of the eTOM framework. This framework is an agglomerate of best practices that helps organizations in the telecom industry manage their processes. But how can IT support that framework?

EAI tools have evolved, that's a fact. The vendors claim that they are no longer a tool that just integrates applications, but they can now integrate businesses and fully support BPM. We will implement our processes according to the eTOM framework on EAI platforms and see if those claims are true.

1.4 Thesis Organization

In section 2 we will try to contextualize this work, by giving a quick overview of how Information Technology evolved during the last decades, a brief introduction on EAI (origins, objectives, evolution) and a quick analysis on BPM. In section 3 we will try to describe the problem that this thesis tries to solve. Section 4 will explain the proposal to the problem. In section 5 we explain the process that we chose as the case study. Section 6 contains all the details about the implementation of that process. To finalize, section 7 describes and analyzes all the results derived from the implementation.

2 Context

2.1 The Evolution of Information Technology

Information Technology (IT) was born with one main goal and from the very beginning until now that goal still remains the same: business support. At first only some very specific functional areas were supported by IT but as time passed by, managers became aware that IT had potential to greatly improve their business.

So in the 1960's we witnessed the appearance of the Transaction Processing Systems (TPS) which allowed the collection, storage, modification, and retrieval of the organization's transactions. These systems bore the fundamental concepts of Database Management Systems (DBMS), which is why those systems appeared in the 1970's as a natural evolution of TPS.

But managing the transactions was still not enough and so in the 1980's the Decision Support Systems (DSS) made their appearance. With all the information that could be gathered across the organization with the help of TPS and DBMS the DSS could be very useful. It provided the organization's managers with a great way to gather business intelligence generate alternatives and make decisions.

The word 'integration' was only brought up in the 1990's when the first Enterprise Resource Planning Systems (ERP) and Data warehouses were built. Each had a different integration purpose. While Data warehouses provided the integration of information for decision-making, ERPs gave organizations means to implement some level of operational integration, which allowed it to support daily operations.

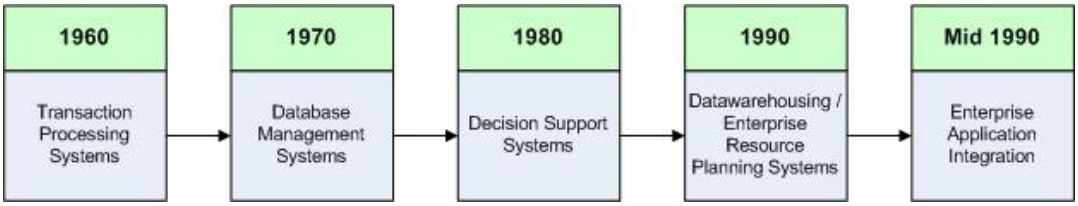

Figure 1 – Evolution of Information Technology (Adapted from "Enterprise Integration with ERP and EAI" [15])

But this integration only occurred within the organization, because it didn't go past their internal functions. At the time it was very difficult to integrate functions from different organizations because there was no simple and direct way to do it. Some organizations worked past this problem by connecting their ERP to the ones of various business partners. But that was just a workaround, not a good solid solution.

But business environment never stops evolving so organizations demanded more. We were in the mid 1990's when EAI made their debut. Cross-organization integration was now a reality as these solutions really promoted it. And as stated before, integration until then was mostly internal and even so it was slow and costly but with the appearance of EAI those downsides were minimized. Integrating all the organization's legacy systems and databases was now much more easy and efficient.

EAI also attempted to enable new and innovative ways of leveraging organizational knowledge to create further competitive advantages for the enterprise.

2.2 Enterprise Application Integration

As we previously saw, EAI was born of the necessity to avoid the costly, slow and limited integration provided by change-resistant systems such as ERPs [15]. Besides those integration problems, there is one special reason why organizations just walk away from ultra-expensive ERP projects: they don't really support their important business processes. At this point they reach a dilemma and there are only two things they can do:

- **Change the business process**: the business process can be adjusted to accommodate the software, which will then impose deep changes in their standard way of conducting business (and as a consequence they may lose competitive advantage) and shake up important people's roles and responsibilities (most organizations do not have the courage to do that);

- **Modify the software**: the software can undergo some changes to fit the business process. This solution will slow down the project, introduce bugs on the system and will make a future upgrade to the next software's vendor release extremely difficult to execute because it will have to be re-written to fit with the new version. Sometimes it is not even possible to alter the software itself in due to the legal protections around it.

2.2.1 First Purpose of EAI

In the mid 1990's the concept of EAI made its appearance. The main purpose of EAI was to eliminate the bottleneck of having only internal integration and to start moving to external integration, because business demanded the business processes to overcome cross-organization barriers (one simple case was/is the classic example of integrating different organizations processes in a supply chain). EAI also provided simpler, cheaper, less programming-dependent and more efficient means to achieve a good level of internal integration [15].

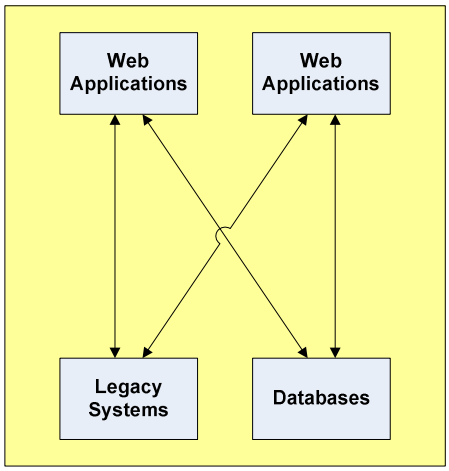

Figure 2 – System integration before EAI

The first advantage that could easily be observed with the use of EAI in integration was that the level of connectivity achieved was a lot less complex than the one offered by existing integration solutions until date. Without EAI, islands of information or information silos could often be found in organizations and that was a problem that undermined internal communication.

That problem could be avoided before EAI but a point-to-point connection implementation was needed between every single source of information (see Fig. 2). This, however, would originate another problem because in this case we would have $\frac{n(n-1)}{2}$ connections. Just to give a glimpse of how fast the number of connections needed scales with that method, if in a given organization we have 15 points of information we would need 105 connections to implement the full point-to-point network. That's just not feasible.

So how does EAI solve the internal integration problem? The answer is very simple. It defines semantics for data and application integration by defining a simple and standard methodology or approach for applications and data sources to communicate with each other. This is done by creating a middleware layer, where all entities are connected and which serves as a bridge between them. This way all communication between two entities can be done without having to re-write code on any of them, eliminating the extensive programming necessary in the past. The middleware layer provides a simple interface to each of them to provide the communication (see Fig. 3).

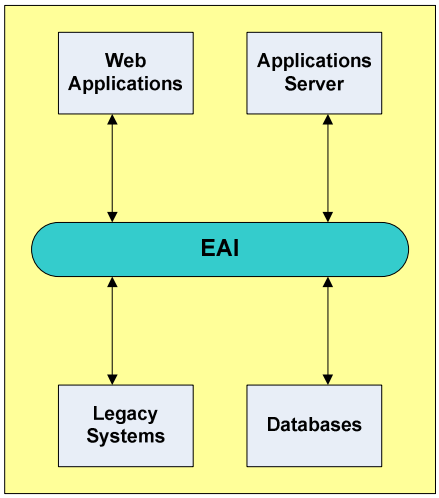

Figure 3 - System integration after EAI

So as we have seen this new kind of connection eliminates informational silos. Each of those silos had their own data so they could operate independently. But is all that data really necessary now? The answer is that most of the times it is not. What happens now is that the data necessary for each silo to execute independently is often repeated on multiple silos, because they also needed some of that data to execute their own functions. So now that all those silos are connected between them, the data redundancy can be easily reduced. So we can safely say that EAI strongly promotes the reduction of data redundancy. We must bear in mind that this is not a problem that EAI alone solves. It just encourages its resolution [13].

There are many steps necessary to execute real data integration. If we take as an example the customer information that an enterprise holds, some of these steps are:

- Modelling the "Customer" entity into its own subject area.
- Identifying all unique data elements for "Customer." (while excluding all duplicates)
- Assigning a unique primary key to each "Customer."
- Identifying the other entities related to "Customer" in the business.
- Assigning a unique primary key to these other objects.
- Building a new database structure to reflect the model. This should include tables, primary keys, foreign keys and other elements.
- Buying/building the application to populate the new database structure.

As we can see there is much more involved in data integration besides EAI.

2.2.2 Message-Based EAI

Above the usual data communication integration, EAI can also provide organizations with another layer, which is known as *message integration*. In this case it behaves as a message oriented middleware (MOM) to endow the communications with characteristics such as point-to-point and publish–subscribe messaging models, message filtering, transactional messaging, and once-and-once-only message delivery. As a result, we achieve a very cohesive and decoupled model to connect multiple systems (See Fig. 4) [4].

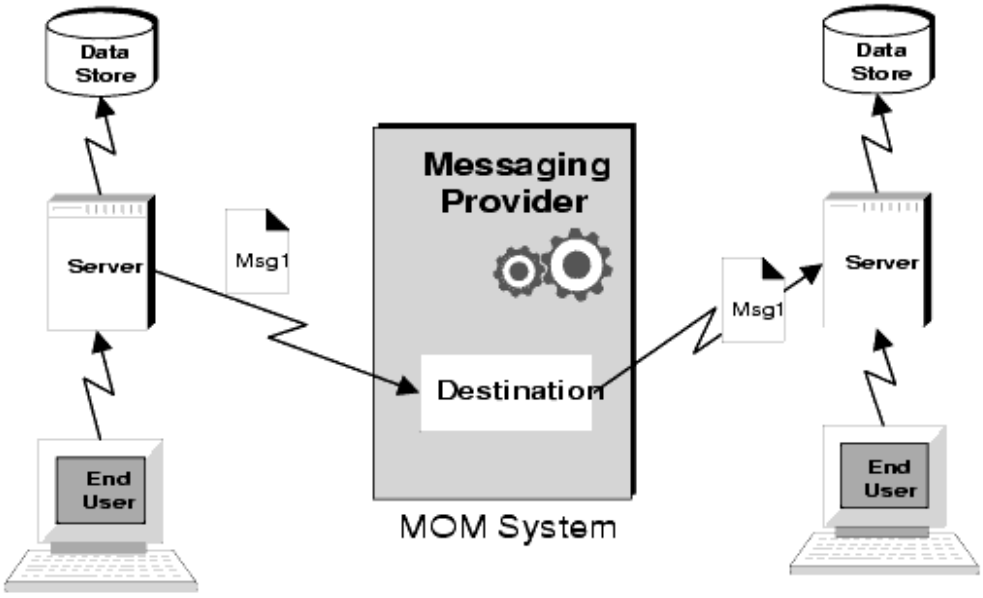

Figure 4 - Message-Oriented Middleware within Organization (source: Sun Java System Message Queue 3 2005Q4 Technical Overview)

With MOM, we have a client/server architecture, which increases the interoperability, portability and flexibility of any given application in the organization by allowing it to be distributed over heterogeneous platforms.

It also provides complexity reduction while developing applications that span multiple operating systems and network protocols by hiding the details of the various operating system and network interfaces to the developer. Usually the MOM provides the necessary APIs.

While using MOM we have the following advantages:

- **Storage**: MOM systems usually provide message backup by having some kind of persistent storage. This means that we can have asynchronous delivery which means that the sender and the receiver don't need to be simultaneously connected to the network (i.e. sender connects and sends the message to MOM which stores it until the receiver is connected). It also means that if receivers fail for any reason the senders are probably not affected as they can continue to execute and send messages (unless of course they need the receiver to respond);

- **Routing**: there is another important advantage through its ability to route messages within the middleware layer itself. Middleware messaging can deliver a single message to more than one recipient (broadcast, multicast). This upgrades the point-to-point network referred above to a more advanced network (one-to-many);

- **Transformation**: a MOM system can have a built-in intelligent system which transforms the messages en-route to match the requirements of the sender or of the recipient. If we add in the broadcast/multicast properties of MOM we can send the same message in different formats to different receivers. This is particularly useful because the applications that interact with

the MOM systems don't need to change their communication protocols and message formats.

However, this level of abstraction inserted with the creation of MOM has some disadvantages. First it might impose a new design on the organization's business and applications, defining the new way on how the applications will fit in the new scenario (how the existing ones will fit, which will cease to exist and how to insert new ones). Second, but also very important, is that it inserts a new element in the architecture which can lead to loss of performance and reliability. It also introduces a unique point of failure because the network becomes very dependent on the MOM system.

2.2.3 Process-Based EAI

But the EAI philosophy quickly evolved to become something more. It now implements another level of abstraction to provide business-level integration [10]. It is built over the message-oriented layer but it goes one step beyond. At this level we try to:

- Reuse the functionality of the existing applications under de EAI control while masking the technical details;
- Provide high-level business services on top of those applications.

But how can we achieve this? First of all the technical details of all the existing applications must be well defined and with some sort of interface to be used by the EAI solution. Either they have a previously built API or a wrapper will have to be created for us to be able to use the application's functionality. They must be technology independent so that even if an

application changes from one system to another the interface must remain the same so that this change is invisible to the process.

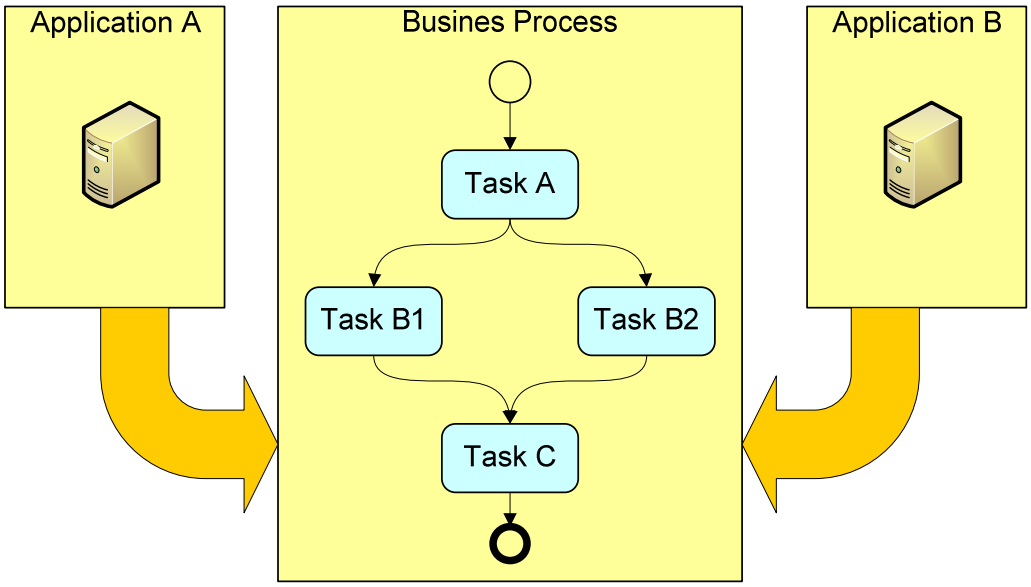

Figure 5 - Process-based integration

The second step is to aggregate the functionalities of the low-level in such a way so they constitute a higher level functionality that is needed by a process. In other words we put together several low-level functions to create a high-level function to be used by a business process, thus raising the abstraction level. The line which defines the right granularity level for the business-level services is often not well defined so one must be careful. If we have a service with a very small granularity it won't be useful to any process but if that granularity is too high it will probably just be used by one. This however falls out of context of this report.

2.2.4 Benefits of the New EAI

Before the evolution we had all the business logic contained on the applications or even on the people who operated them. This imposed an organization with strongly coupled applications which is highly inefficient for numerous reasons:

- Changes in the business logic were slow, costly and complex because they often required changes on an application itself (most of the times there was the need of doing a deep recoding);

- A change in an application would probably require a change in the applications to which that one had connections to.

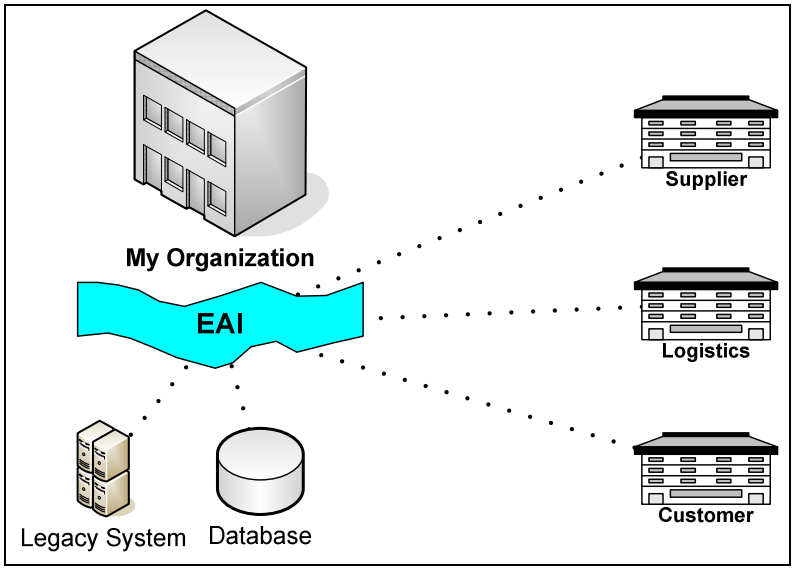

Figure 6 - Enterprise Integration scenario after EAI

After the evolution we have a scenario where all the business is application-independent. Because of the weakly coupled applications we can have a

configuration that is very flexible and easy to maintain, thus enabling the organization to possess a very agile business.

2.3 Business Process Management

Business process management has had accentuated evolutions along the last century. According to those evolutions we can separate BPM into three different generations.

2.3.1 Historical Background

It is said by many people that one way or another enterprises have always used Business Process Management (BPM). The terms 'Business Process' (BP) and "Business Process Management" are rather recent but the concept behind them has been around for quite some time. Their root was a formal discipline known as "Methods and Procedures Analysis" which appeared in the early 1920's. It outlined the theories of Frederick Taylor on management. These theories stated that the business processes were implicit on work practices and policy manuals. Its main goal was to improve workflow. [22]

So let us take on the Taylor example. His first step was to break a job (process) into several component parts (activities) and then he would measure them to the second, so he could come with an optimal way to do that job. However, Taylor believed that the industrial management was not mature enough and that management should be seen as an academic discipline, and that the best results would come from the partnership between good management and a cooperative and innovative workforce. As it turned out, he was right. As we can see, his ideas were way ahead of his time.

More recently, over the last decade, organizations thought that they could improve business while performing a one-time process-reengineering activity. With that perspective in mind they implemented those changes in a solid way over software. This trend originated applications that were very rich in content and features but that were very hard to change and maintain, such as ERPs (we discussed this subject above). It was obvious that they couldn't easily adapt to the more and more frequent business changes [21].

The third generation of BPM is something that organizations had always wanted. It is the ability to change their business process on the fly, with little effort and small costs. This is precisely the main focus of BPM now, the change. This capability to change is the one thing that allows the existence of agile business processes.

Next we will see in detail what Business Process Management means today.

2.3.1.1 What is a Business Process?

The term 'business process' is one which every organization uses but almost every single one of them applies a different meaning to it. So we are going to place ourselves in context and clarify the meaning of that term for the remaining of this text.

According to Webster's English Dictionary a process is: a series of actions or operations conducing to an end; a continuous operation or treatment especially in manufacture.

One thing we must say about this definition is that the 'end' referred must be a consistent one. That provides our process with predictability. If it isn't delivering consistent and predictable results then it is not a true process.

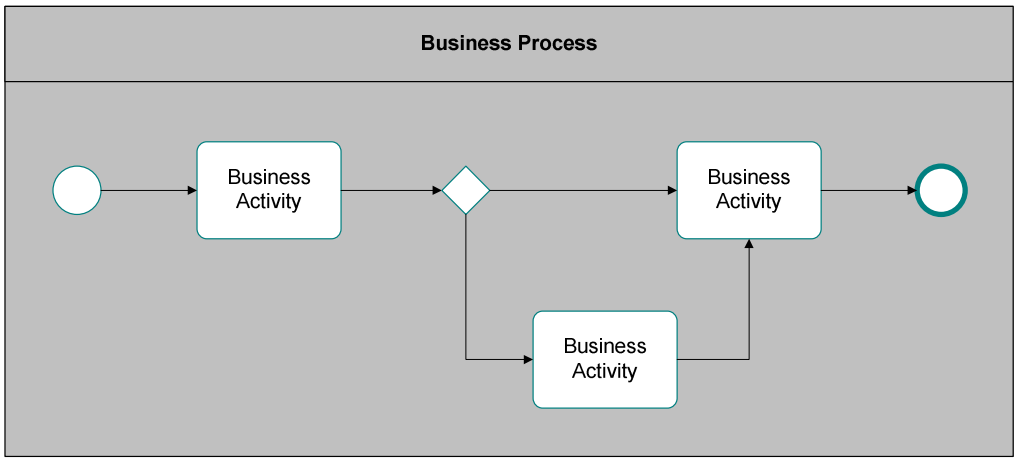

Figure 7 - Difference between a business-activity and a business-process

In the context of organizations, this definition can often be mistaken by a business activity, not a business process. The difference between them is that business activities are parts of the business process (an activity is something like "Produce Invoice" or "Answer the Phone"). This means that a business activity does not include any decision making and thus is not worth decomposing (although it would be possible to decompose it) as we can see in Fig. 7.

We can then define business process as organized work performed by people, systems or organizations and according to a predefined set of procedures and user interaction. This definition includes many important elements that may not seem that relevant at first sight.

One thing it states is that a business process can span across organizations. It is a very subtle yet important statement because in today's business environment, interaction between organizations is essential to their survival (see Fig. 8).

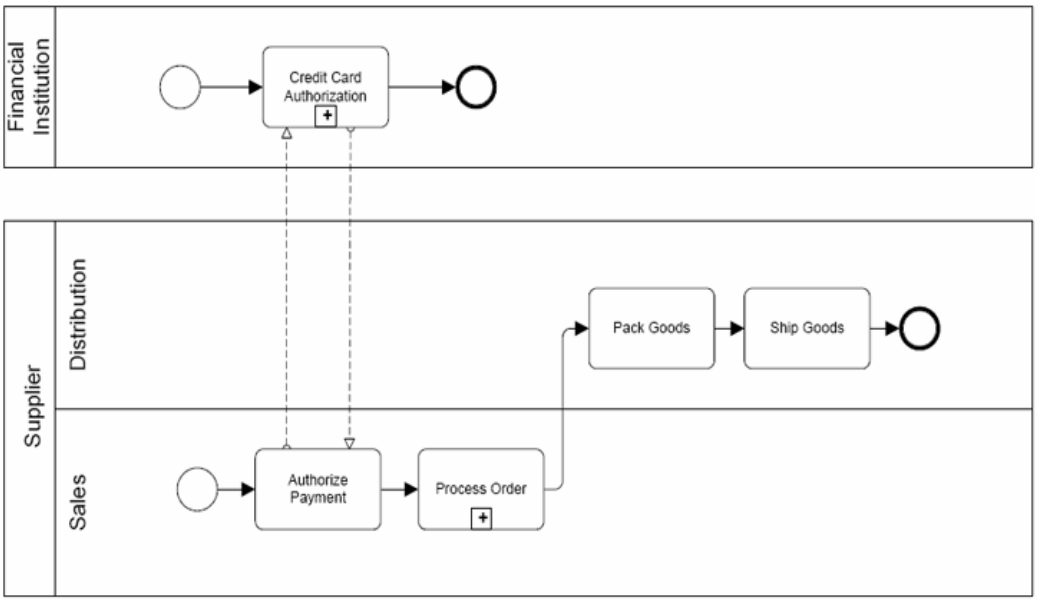

Figure 8 - Business process example

Another important aspect of this definition is that it clearly involves both people and systems. Although it may seem an obvious statement, most technology vendors have approached this process challenge of supporting business processes with solutions that focus only on a single dimension (i.e. workflow-centric solutions that focus solely on human interaction) forcing organizations to have separate, and often not linked, applications and methodologies to address to issues like workflow management and system integration management.

After all those definitions the meaning of BPM should be more or less clear to all. We say more or less because there is no such thing as a 100% accurate definition for BPM. We will however try to give you one that in our opinion resumes what is BPM.

Business Process Management is a discipline that contains a set of ideas, methodologies, activities and best practices that provide organizations with simple means to manage their business processes so they can be improved, making them more efficient, effective and capable of adapting to the constantly changing business environment. This improvement includes many points such as model the enterprise structure, (re)define their business processes, clearly map the interactions between them and align those processes with the business goals.

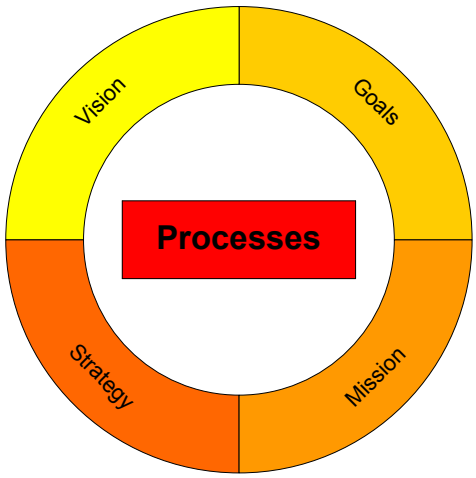

Figure 9 - Business processes' conditional factors

We cannot forget that BPM stands from Business Process MANAGEMENT, not Monitoring or Modelling as many people use it. So the main purpose of BPM is to manage the process from the very beginning of its existence until it is no longer present in the organization [18]. This existence of each business process is divided in a determined and iterative number of stages, called the *process lifecycle*, with each one of them having different function in the management of that process.

We must also make clear that BPM is not the use of technology as some people believe. It's not ERP Systems, EAI Tools or Workflow Management Systems (WFMS) [1] [8] [21]. But BPM also encapsulates all those technologies' objectives and philosophies. It promotes real integration

between people, resources, applications and organizations as means of enabling enterprises to manage all of them.

2.3.2 Business Process Lifecycle

BPM clearly states that a business process lifecycle continually undergoes several stages. Most organizations and writers have different (but yet similar) views on the definition of a business process lifecycle. They don't agree on the number of stages and not even on the names of each one but the essence is almost always the same. In this text we separate a business process lifecycle in six different stages: discovery, design, implementation, execution, analysis and optimization (see Fig. 10). We are going to review each stage in detail.

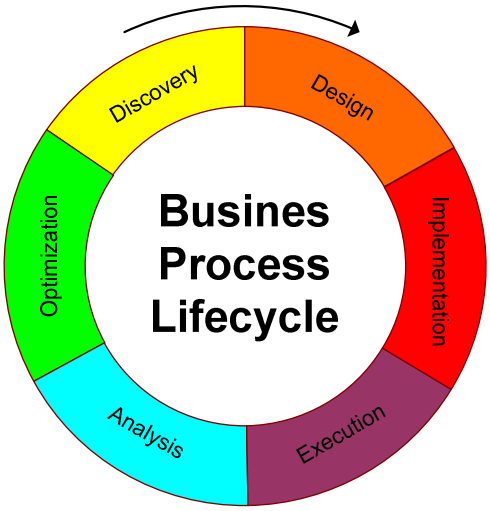

Figure 10 - Business process lifecycle

2.3.2.1 Discovery

The discovery phase of the business process lifecycle is where the current situation around the organization's business processes must be revealed [23]. The organization must make a study of their situation. A quick

analysis to the business goals, core processes and business drivers must be done. Once the processes are well known and the context of each one is defined they must undergo an analysis to identify and diagnose their weaknesses. The next step is to analyze the chosen process even further. This must also include the analysis of people's skills and aptitudes, system usage and also the interaction with other processes.

This phase is often hard [25] because the knowledge that exists in the organization is tacit. It exists in the mind of each of the individuals that compose it. So it is hard to have a global view on how things are done. Although this phase might not seem very important, we think that it is the most important phase of the whole lifecycle. It is at this phase that all the information is gathered and if this step fails it will affect the whole process.

2.3.2.2 Design

At this point we absorb the knowledge acquired in the previous phase and transform it into useful information. We use that information to perform all the activities that form the design stage such as the evaluation of potential solutions to support the business process under study, the design of the process itself and the modelling of the business process. One must take into consideration that a good design reduces the number of problems over the lifetime of the business process so this phase must be carefully executed.

It is at this stage that the process itself becomes well defined. One must clearly define the activities that compose the process, as well as the relations between them.

2.3.2.3 Implementation

In this stage we move from a more conceptual view to a practical one. This implementation includes, but is not restricted to, technology implementation as most people think. The major steps to perform process implementation in an organization are:

- Reshaping the organization to fit the new process;
- Using best-practice approaches to help achieve the optimum implementation;
- Mapping the business needs into the technology;
- Giving all the necessary training to the personnel so that their skills can be improved/shaped to meet the needs of the process.

The process can then be considered to be deployed at the organization.

2.3.2.4 Execution

This is the step where the real execution of the process starts. The organization carries out the deployed processes defined in the previous stages. At this stage the process receives its inputs, performs all the necessary activities and hopefully gives out the defined outputs.

2.3.2.5 Analysis

This is the step where we begin to monitor and analyze our business process execution and results. We keep track of the process so that information on its state and on statistics of its performance can easily be observed. As an example of an analysis stage, imagine we can consult the state of an 'order management' process (i.e. check if the state is 'order

request received', 'payment received', 'order dispatched'). The latest trend in this matter is Business Activity Monitoring (BAM), which provides organizations with a real-time summary of business processes to operations managers and upper management [26].

2.3.2.6 Optimize

At this final step we stop and look at all the information gathered in the previous stage and cross it with all the business process information. This way it is possible for the organization to maximize resource utilizations, to improve its efficiency and to identify the existing bottlenecks. Then the organization can take the correspondent corrective measures that enhance the current solution. These measures can be something like assigning more employees to execute the process, allocating more resources to a given activity, upgrade hardware that seems to be slowing the whole process, etc.

2.4 Chapter Conclusion

So we have already defined what BPM is and what are the measures that we must implement in an enterprise to achieve the desired results. But we took a very theoretical approach on this matter. In practice can we achieve the desired results with what we just described? In the following sections we will try to apply BPM in a very specific industry.

3 Problem

3.1 Service Providers

A service provider is an organization, which provides some kind of communication, storage or processing service to its costumers (or any combination of the above three). There are many important factors on this industry that we have to take into account.

Traditionally, in the telecommunication industry, the service providers delivered end-to-end services to their customers and so the value chain was controlled by a single organization (or, if necessary, via arrangements with other service providers). However, the current situation is one of a liberalized market, which forces service providers to respond both to the increasing demand for superior customer service and to a fiercer competitive environment. These factors led the providers to expanding their markets (beyond their self-contained boundaries) and their business relationships. This presents a problem to business management as we have to take more and more into account that BPM crosses the organizational boundaries.

Other important aspect of a service provider is their information and network technology infrastructure. Some service providers chose to operate their own infrastructures, while others choose to outsource that business task. Whether it is directly operated or outsourced, that task is a very important part of the business's value chain and its performance has a great impact not only on costs but also in quality of service. These two variables are well perceived by the end customer and they are without any doubt the

most important ones to them. Service providers need to become experts at performing that task.

Additionally, this industry presents their organizations with many different regulatory environments which make BPM a must to control the business so that the organization can respect all the regulations. [12]

Having listed some of the most important factors in this industry we can safely state that besides their differences in strategy and competition approaches, most service providers share many common traits, such as:

- service management approach;
- greatly dependent on network and information management;
- moving to more of an end-to-end process management approach developed from the customer's point of view;
- costumer care, service management and network management automation;
- integration between legacy systems and state of the art technology;
- focus on data services offerings and on total service performance;
- "Buy more, build less" approach (integrating systems from multiple suppliers).

With those similarities in mind, eTOM comes into scene.

3.2 eTOM

The eTOM (enhanced Telecom Operations Map) is currently the most used business process framework in the telecommunication industry. It describes the full scope of business processes required by a service provider, as well as business activities. It also tries to incorporate all the stakeholders in the process (organization, clients, suppliers, etc.).

The eTOM is a very stable framework for many reasons such as:

- very generic top-down approach;
- wide variety of enterprise processes operations and model views;
- service provider's business-oriented.

3.2.1 The framework

This framework consists on a hierarchy of several levels of process decomposition. Each level is a layer of abstraction. We will explain the first two levels as an example.

The first layer (level 0 or abstract view) is just a conceptual view of the framework. It consists of 3 parts:

- Operations (all the processes that are connected to the daily operations of the service provider);
- Strategy, Infrastructure, Product (as the name says, it contains all the processes that are more related to strategy, planning, I&D, etc.);
- Enterprise Management (all the processes that help manage the enterprise).

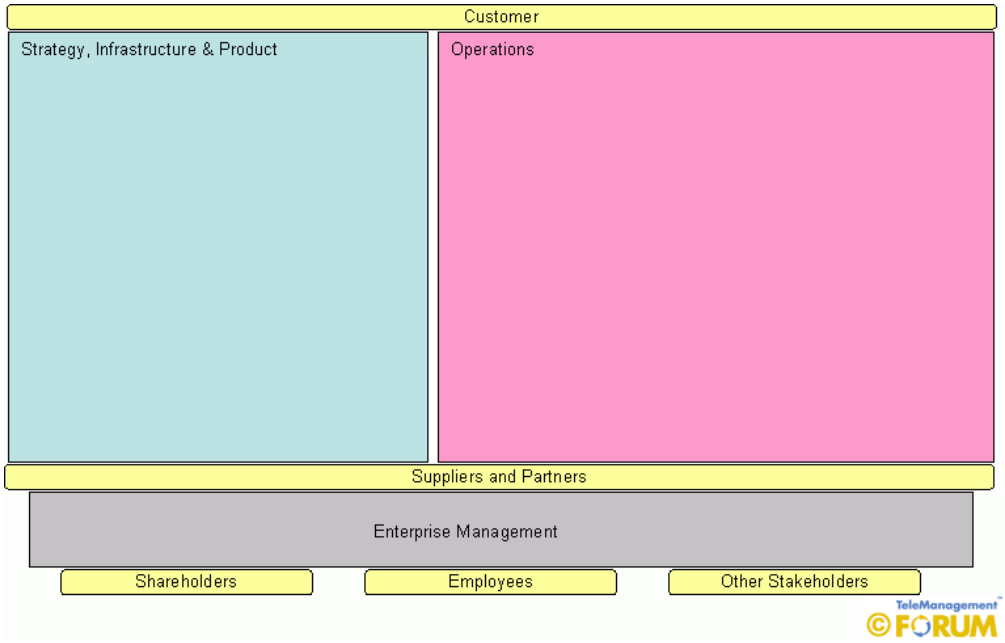

Figure 11- eTOM Level 0 (source: TM Forum)

The second layer (level 1) consists of two divisions: vertical and horizontal. The horizontal division represents a view of functional related processes while the vertical one is more of an end-to-end view. The complete level 1 view is represented in Figure 12.

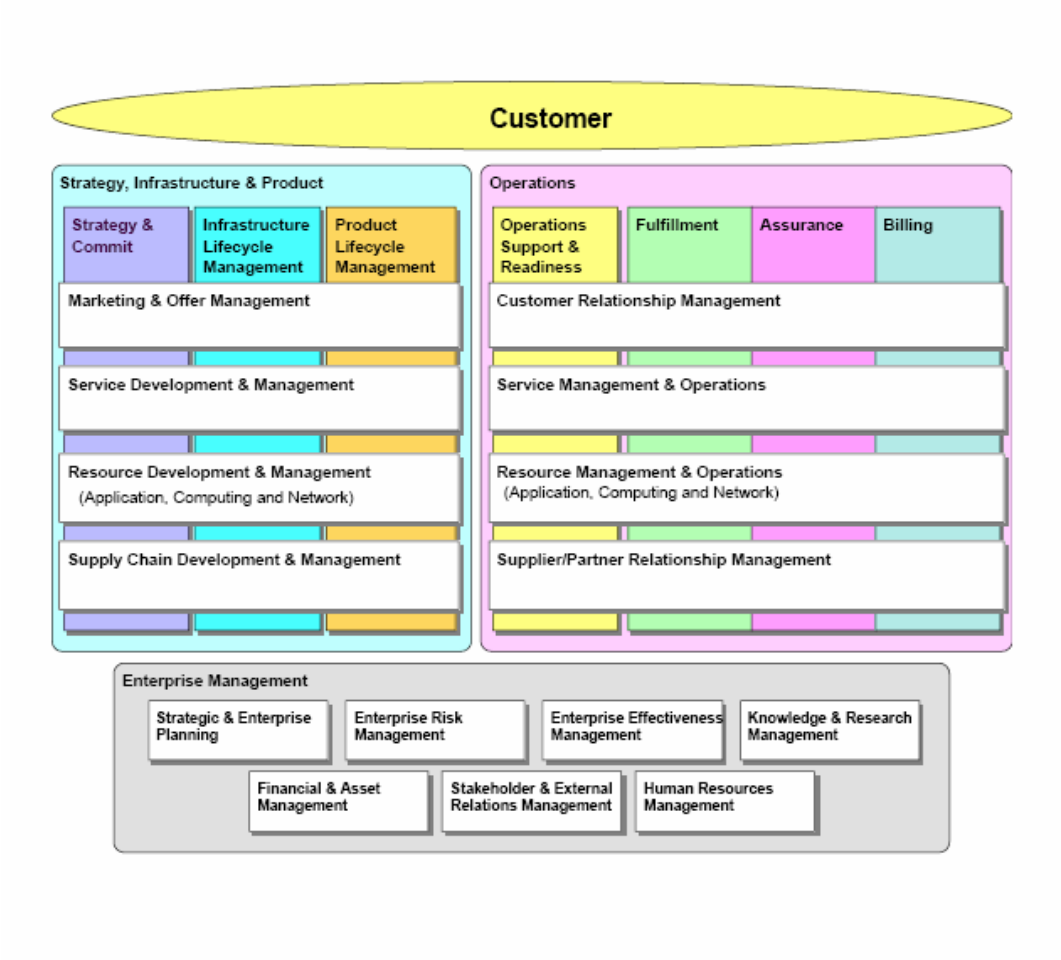

Figure 12 - eTOM framework level 1 (source: eTOM Framework)

3.3 The problem

So we have just seen that the telecom industry has many problems that don't exist in other industries. We currently have a liberalized market where the end-to-end business processes cross organization boundaries and where the organizations are heavily regulated. We have also observed that many of those organizations have many common traits and because of that a framework as appeared, from the effort of many of those organizations, as a mean to help them manage their business processes. But those are just best practices. They don't implement BPM by themselves.

At the same time EAI tools are on the IT spotlight, claiming they can help the organizations support BPM with their new solutions. They have evolved from a stage where those tools did only integration of applications to a stage where the implementation and integration of business level processes is now possible (or so they say).

The information systems that exist on the service providers these days can't handle all the BPM complexity with ease. Most business rules are currently spread among the webportals, CRM systems and other different systems and applications spread across the organizations. If an organization wants to change a process it is extremely difficult. One has to find out where all the business logic of that process is spread and change it in all the systems (incurring the risk of changing things that weren't supposed to be changed, of duplicating information or even of not being able to change the process at all). The business logic of a given process should be centralized and accessible for the managers to change it with ease.

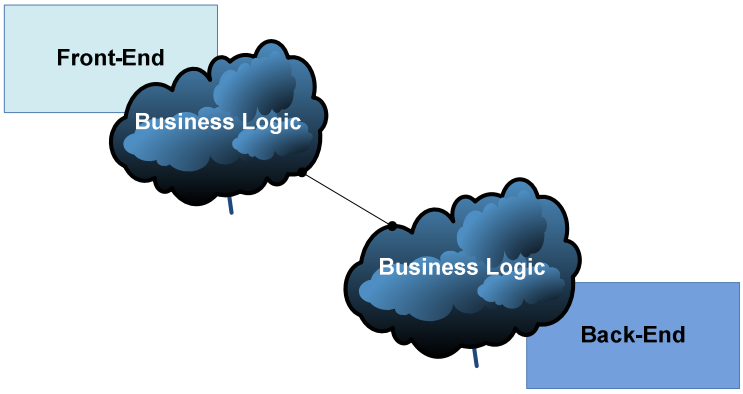

Figure 13 - Business logic problem

Having seen the problems with the current situation at service providers, will the new EAI tools bring life to BPM at those organizations? Will they support their business processes?

3.4 Proposal

Our proposal to the problem of business process management in the telecom industry is to use EAI tools and the eTOM framework to implement BPM. We will try to include all the stages of the BPM philosophy in our solution.

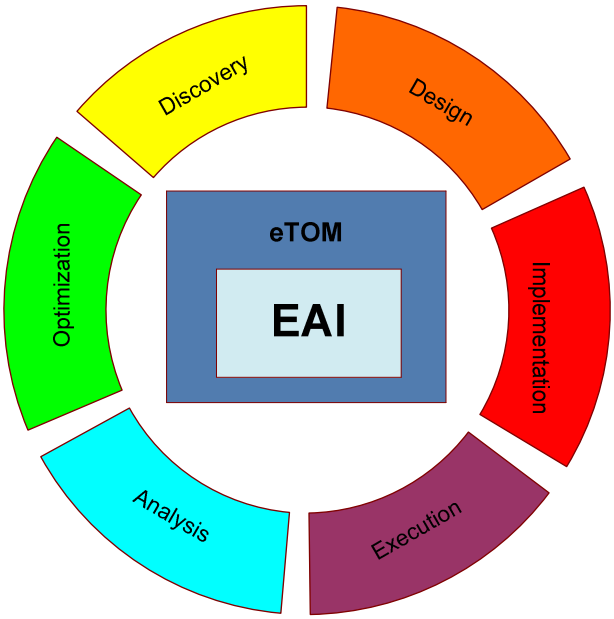

Figure 14 - Solution (BPM, eTOM, EAI)

3.4.1 Business Processes and Activities

All the business processes and activities will be designed to fit the eTOM framework. With this approach, our solution will try to take all the advantages of using this framework. This includes being able to reuse all the processes and activities related to this business process when implementing other business processes.

3.4.2 The Business Process

We will start by selecting a common business process, study it, and model it according to the framework. To do that we will read some documentation about processes currently at use at Vodafone © Portugal so we can understand not only the processes themselves but also the context they are used in.

3.4.3 EAI Support

After defining the process we will undergo (all?) the other BPM stages, with the assistance of EAI platforms. Two of the most common platforms will be used (Web methods© and Tibco©).

We will then analyze all the results and see if any of those platforms can really help organizations in the telecom industry to implement BPM. To finalize this project we will classify and compare the platforms in all of the BPM stages so we can conclude which one is best suited to solve our problem.

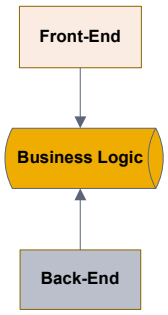

Figure 15 - Solution's Business Logic

3.5 Chapter Conclusion

We have defined the problem and its context and we have also described a possible solution to it. At this stage we were ready to try and implement that solution on a real world problem. A relevant process was chosen to verify the validity of our solution.

4 Implementation

4.1 Case Study

4.1.1 The Process under Study

Our case study consists on a very common business process in the telecom industry. The process, usually only available for corporate customers, will be named "Change Pricing Plan" process. This process has the goal of enabling corporate customers to change their pricing while in the middle of the contract (we will explain the process with more detail in the following section). We chose this process among many others by suggestion of people that work in the industry. This process is said to be a representative example of the problems that the industry face whilst managing their business processes.

The process which we are about to study was built from scratch but was based on a process used at Vodafone Portugal. We started by reading some documentation about that which is presently being used and some documents about the framework adopted by the organization. Although they use their own framework, that framework was based on eTOM and was then adapted to best suit their needs.

It was then simplified and adapted to become a suitable process for a more generic case study. Before we explain the process we will give some information so that we can understand the corporate pricing plan scenario.

4.1.2 Process Environment

In our service provider we have two kinds of customers: the regular customer and the corporate customer. Regular customers are individual clients with personal cell phones for personal use, just like us, while corporate customers are usually organizations, enterprises or institutions that own many cell phones (all of which are grouped by one or more contracts).

The first kind of customer is easy to manage. Each one usually has one account within our provider which is associated to a phone number.

The corporate customer is a bit more complex and so they require special attention, both in customer support and commercial offers. Each of those customers usually has one or more account packs of a given type. Imagine an organization with several departments. It is understandable that the need for cell phones on each department varies (for instance, a sales department needs more call minutes than an IT department). So the organization will purchase an account pack with different configurations for each department. Every account pack is characterized by having such traits as: a given type; a maximum of account packs it can hold; the number of available minutes to distribute among those accounts, etc.

Those account packs each contain a certain number of accounts, which are associated to a single phone number. This enables the customer to distribute the available minutes in many ways (for instance, assigning more minutes to the head of the department than to the average worker). The entities involved in this case study can be observed in Figure 16.

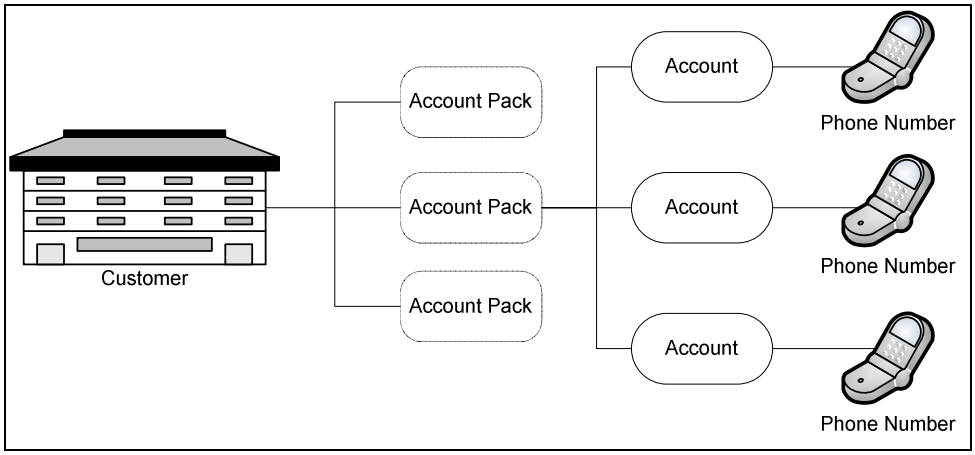

Figure 16 – Entities involved in the case study.

Our process considers that a given corporate customer can make two types of changes to its account pack: make some minor changes to the current plan, or change the actual type of pricing plan.

In the first scenario the customer can perform three kinds of operations on their account packs:

- add account to pack;
- remove account from pack;
- Transfer minutes between accounts of the same pack.

Those operations may be more or less strict, depending on the business rules applied by the service provider.

On the second scenario the customer can change the actual type of the account pack maybe forcing him to change its account structure (the business logic is different from provider to provider). Some providers only let customers change to types of plan that are more expensive and/or with more minutes while other let them break the contract and change to less expensive plans (and probably paying some kind of fine for that matter).

We can observe the resulting process in Figure 17. We then adapted the process so it would fit the eTOM framework. To start we studied the standard higher level process decompositions and tried to build the process at that level of abstraction (for more information see APPENDIX 1 and 2). We then made the process fit a lower level of abstraction (equivalent to an eTOM process of level 4 or 5).

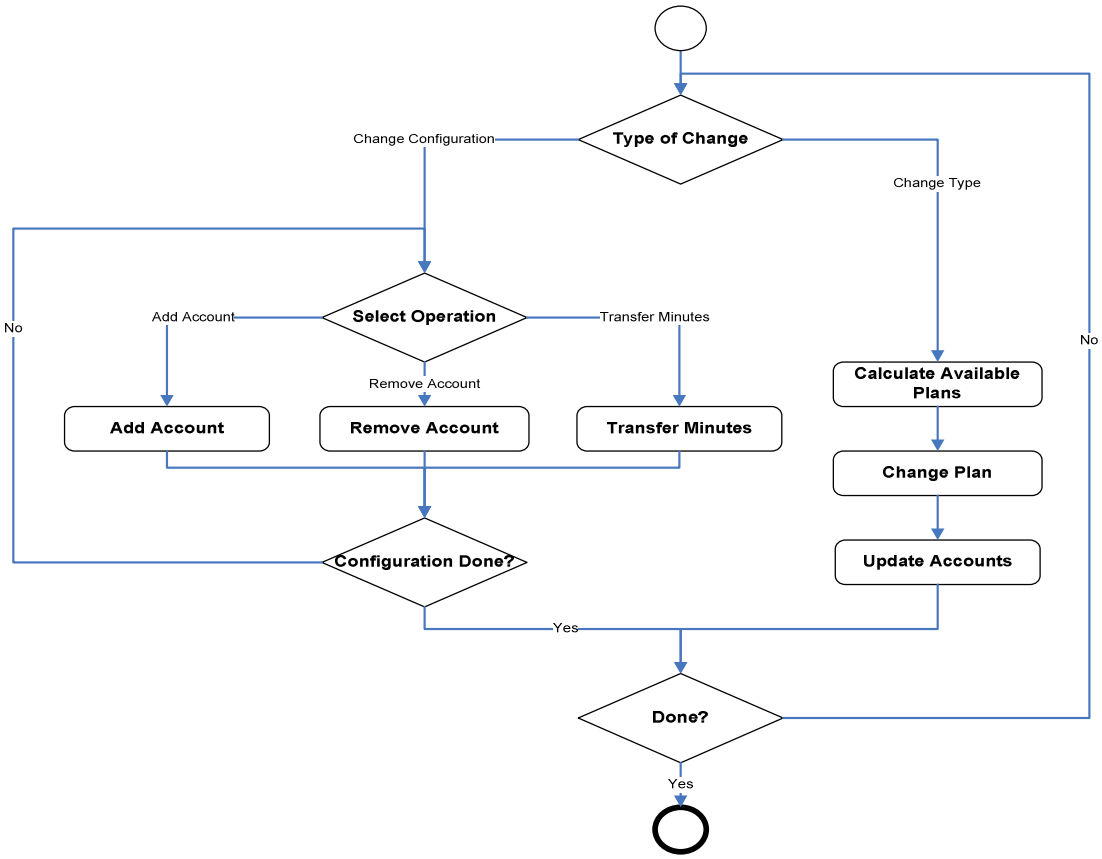

Figure 17 – The resulting process (our business process decomposed in all its sub processes).

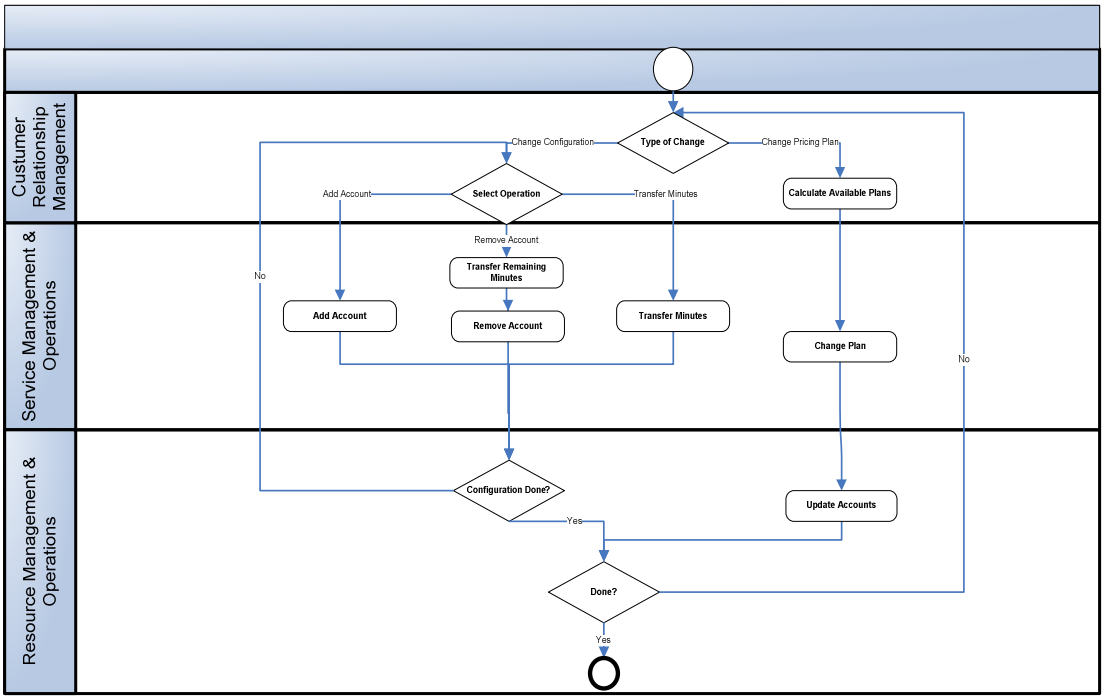

Figure 18 – Resulting process, fitting the eTOM framework

4.2 Business Rules

As we explained before, there are many ways to configure this business depending on the business rules of the service provider where the process is deployed. We will explain in detail all the rules and assumptions taken in consideration while implementing the process (Table 1 summarizes those rules).

Operation	Chosen Option
Add Account	Keep the pack structure. The account is added with 0 minutes associated.
Remove Account	Either the minutes are transferred to a target account or distributed evenly among the remaining accounts (we will allow the customer to decide).
Change Type	Can only be changed to a type with more minutes (and thus more expensive).
Apply Changes	The changes are only applied at the end of the month. Until then multiple changes can be made.

Table 1 - Business rules chosen for our process

4.2.1 Changing the plan type

We will assume that after a contract between our service provider and the customer has been signed, the plan type can only be changed to a superior one. By that we mean that the customer can only change to a plan that has more available minutes than the current one. We chose not to allow a reduction in the plan for two reasons: first because it would add some level of mathematical complexity into the process (that level would depend on the complexity of the rules themselves) and would be more difficult to adopt it as a case study that intends to remain simple. But bear in mind that our purpose is to create a solution which provides the organization great flexibility while managing the processes, so we will make it simple to add those options if one desires. Also, for the plan to be downgraded the organization usually has to pay some kind of fine.

4.2.2 Adding an account to the pack

When the customer adds a new account to his account pack, that account pack while have no minutes assigned to it. The customer will have to manually transfer minutes from another account to this one. An alternative would be to make this an option when adding the account but this way the process stays simple.

4.2.3 Removing an Account from Pack

When the customer chooses to remove the account from the account pack he will be given two options:

- Transfer those account's minutes to a target account;
- Distribute those minutes among all the remaining accounts from that pack.

We could choose to have a pool of unused minutes associated to each account pack and let the customer assign those minutes to other accounts later but with this solution the customer can achieve the desired distribution, even if it means to make some more 'move' operations with the advantage that at any given time the usage of the account's minutes is always maximized.

Also, he will not be able to remove an account if that account is the only one currently associated to that account pack.

4.2.4 Multiple Changes / Applying Changes

With our implementation it isn't obvious to see when the changes occur. We opted by letting the customer change the plan as much as he wants. The changes will only be made permanent at the end of the month, so the customer should be allowed to change it at will without any real immediate repercussions. An alternative option would be to let him change it only once in a certain period of time (typically a month) but if he made mistakes or regretted the change he made he would have to wait a whole month to change it again, so we choose to implement it this way.

4.3 Structure of the Solution

One of the problems we encountered while studying the business process at Vodafone was that there wasn't a clear distinction between the business process itself and all the other components of their implementation. This is a recurring mistake made by many service providers and by the majority of organizations around the globe. For instance, many service providers have all the data needed by the process stored with some kind of CRM application, like Siebel, and a large part of the business logic is also embedded within. The other part can currently be found at the presentation level, whether at a web portal, or some kind of management application. This makes BPM very difficult, if not impossible.

Bearing those past mistakes in mind, our solution will be implemented with a 3-layer structure (Figure 19). The middle layer will contain all the business logic (the business process itself), the bottom layer will only

contain the data needed by the business process and the top layer will only be used to present the results to the service provider and its customers.

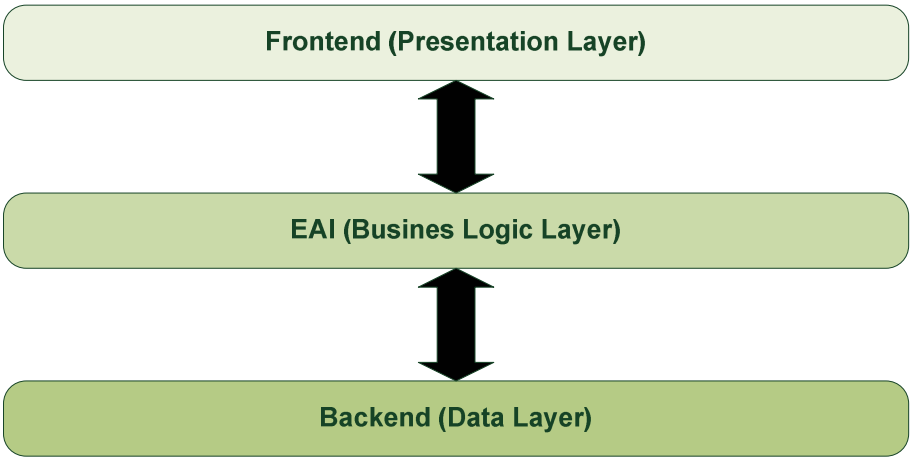

Figure 19 - Three layer solution

4.3.1 Presentation Layer

This is the layer used by the customer (and possibly by the service provider, with some changes and improvements) so they can easily manage their account packs with only the use of a web browser. This layer was simulated using a very simple Web Portal (which we labeled MyProvider) developed in ASP.NET.

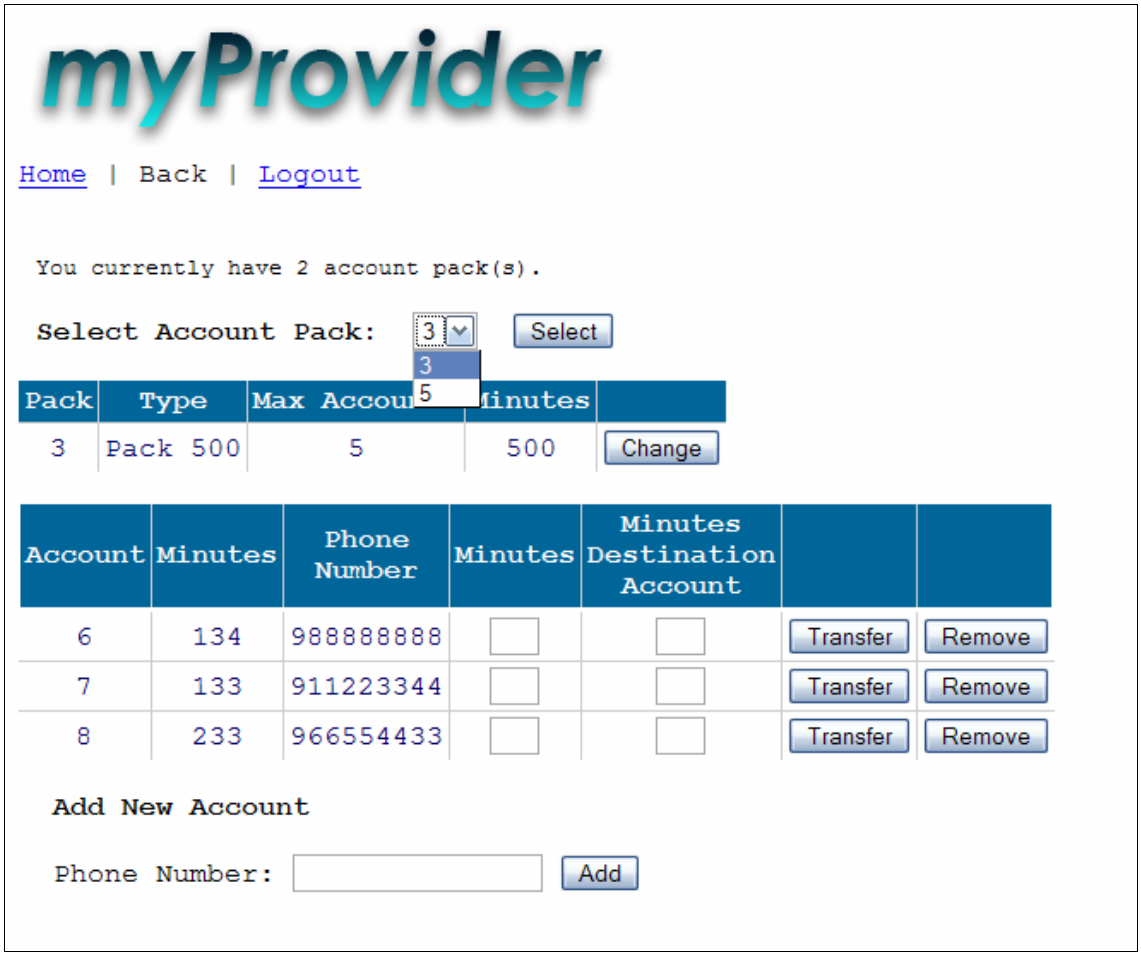

Figure 20 - MyProvider main screen

4.3.2 Data Layer

This is where all the information about our provider and their customers will be stored. We will simulate the backend using a database to store the all the needed information. The product used to achieve that end was the Oracle 9i Database. We will describe in detail the information present in each of the entities presented in our solution (for an overview please see Figure 21):

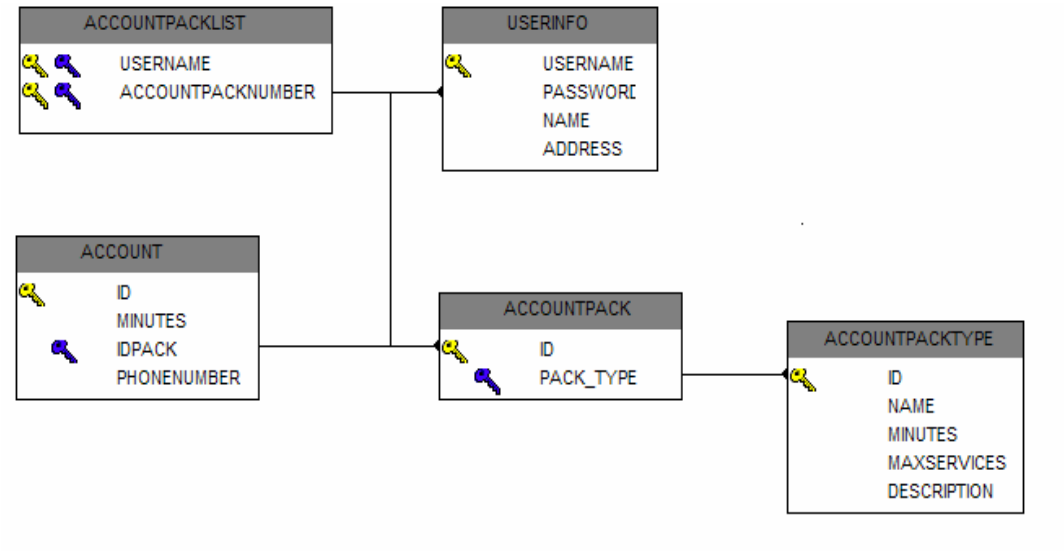

Figure 21 - Data layer entity's diagram

- **User**: this represents our client on the provider's point of view. He is characterized by a unique username and an associated a password, a name and an address. In this case the user represents a corporate customer (simple customers were ignored in this representation);
- **Account Pack List**: it it's a list of all account packs at our service provider, each of them connected to a single user. Each user can only have one associated account pack list ;
- **Account Pack**: this is the actual account pack, which is only characterized by an ID and its type. It contains all the accounts related to it;
- **Account**: the actual account which is identified by its ID and has also has the number of assigned minutes, the account pack to which it belongs and the associated phone number. These accounts are then distributed to the organization's employees.

- **Account Pack Type**: this defines the type account pack which is available to our clients. An account pack is defined by its ID, name, total minutes, maximum number of accounts and a brief description.

We completed this layer by creating several stored procedures, to be called by the middle layer. This wasn't actually necessary because EAI tools can easily access most databases but by creating them we will get much more independent layers.

4.4 EAI Platforms

In our solution, the business logic layer will be implemented with EAI platforms and we will use two different ones. The first one is Webmethods, from AG Software while the other is Tibco, from Tibco Software.

4.4.1 Webmethods

In Webmethods we used two tools from the platform to implement the business process: the modeler and the designer. This approach provides us with great flexibility by clearly separating the process modeling (design) and the implementation itself. It enables us to easily change the process but not the implementation of the business activities.

We started by modeling all the sub-processes with the Webmethods Modeler, and we ended up with a high level representation of what our sub-processes would end up. Unfortunately we couldn't model the process as a whole because it is the Web Portal itself (along with the client's interaction) that glues all the sub-processes together.

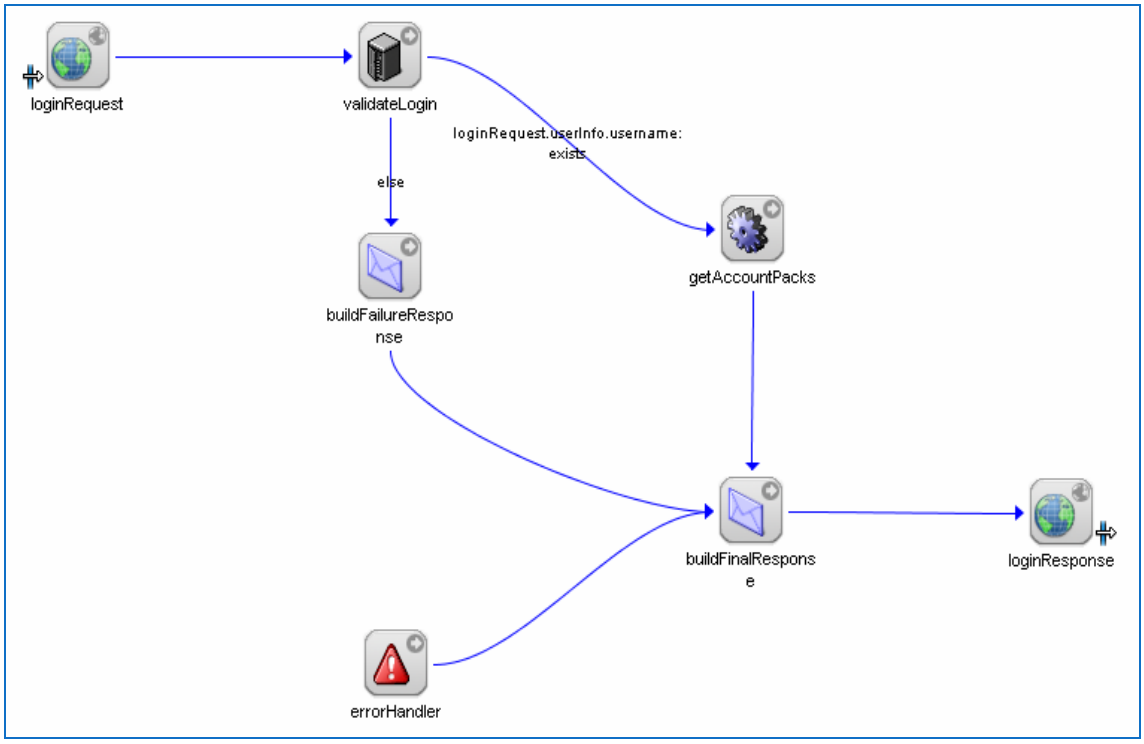

Figure 22 - Webmethods Modeler (Login sub-process)

After all the processes were modeled, Webmethods automatically generates the activities for each of one of them (Figure 23). We then did all the coding and integration with the data layer (by creating several services that invoked the previously created stored procedures - Webmethods itself provides several ways to integrate with Databases and other solutions). To finish up we exposed the processes as webservices, so they could be

invoked by the presentation layer, and deployed them at an execution engine so they could be used.

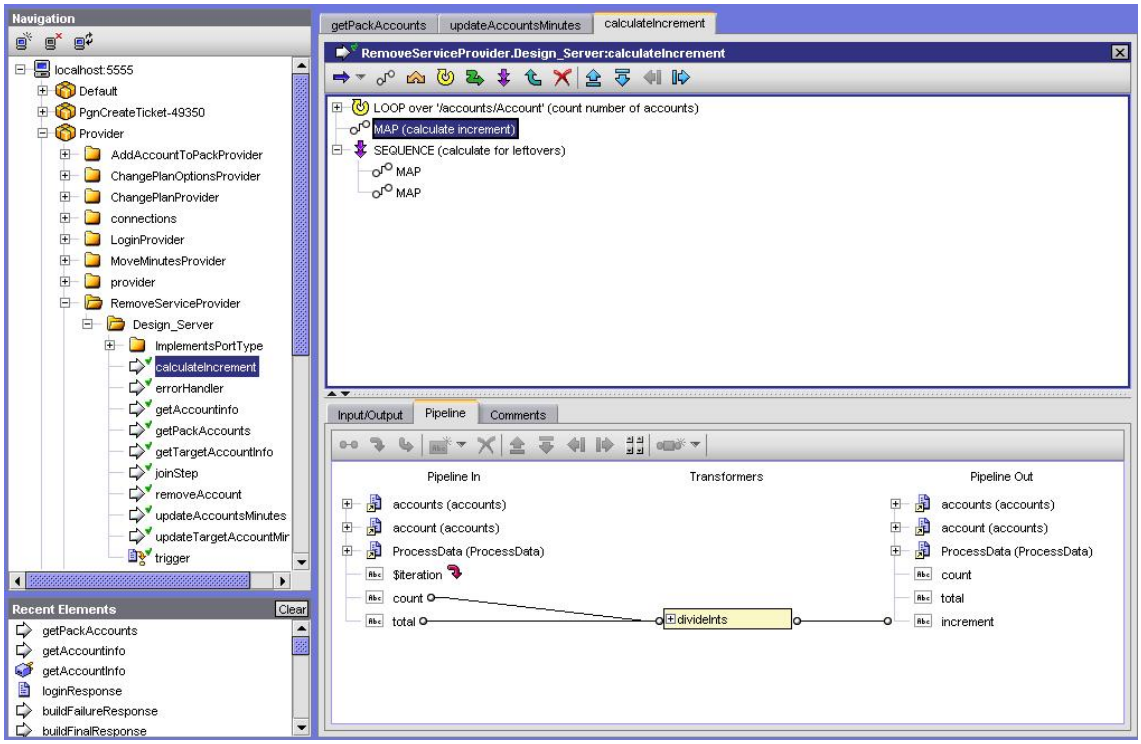

Figure 23 - Webmethods Developer (Remove Service Sub-Process)

4.4.2 Tibco

While with Webmethods we used two different tools (one for modeling and another for implementation) with Tibco we only had one tool available, so we did the modeling and the implementation in Tibco Designer. To overcome this difficulty we created a mini-framework so we could get a clear differentiation of all the sub-layers involved. We created all the layers that you see at Figure 24 so we could get a certain level of abstraction between them, for improved flexibility in the business logic layer.

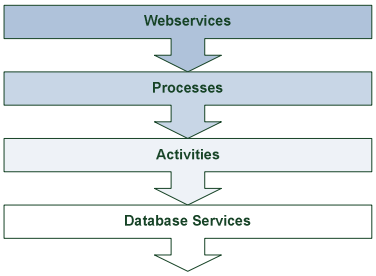

Figure 24 - Tibco mini-framework

The database services are very simple because they only invoke the stored procedures from the Database. The business activities are the most complex ones because they are the ones who implicated more coding and calculation. The business processes are fairly simple as they only invoke the business activities and implement the business logic. The webservices should also be very simple because they only expose the processes to the webportal, but they require some work in this platform.

After we have completed the implementation, the processes were deployed at the execution engine.

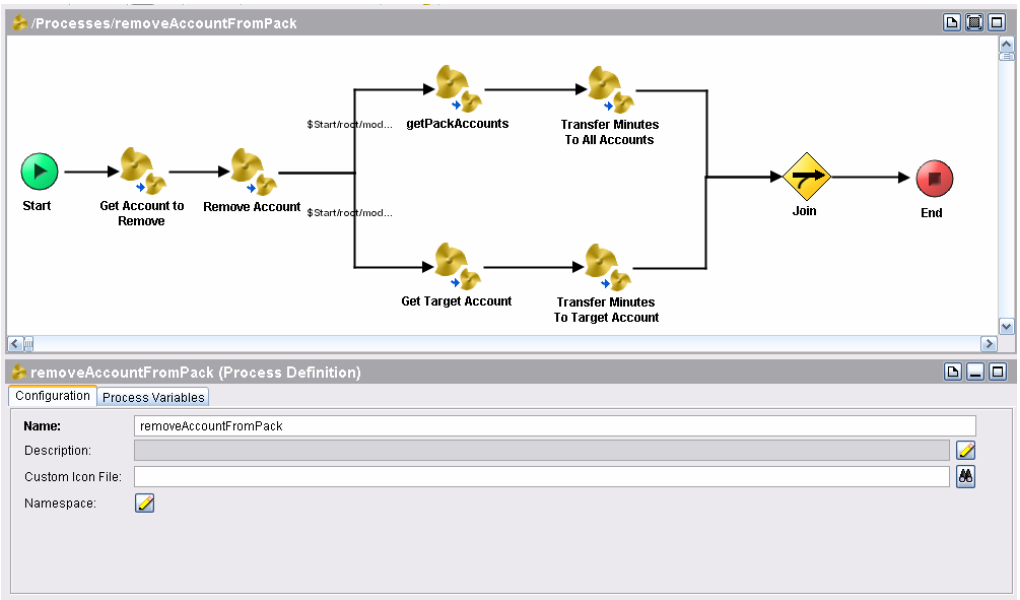

Figure 25 - Tibco business process (remove account)

5 Evaluation

5.1 BPM Stages Support

5.1.1 Discovery

This stage is more or less supported by EAI tools we tried. We can have a good overview of a single business process and we can also observe if that process has connections with other processes present at the organization. So we can safely say that all processes can be observed in great detail, enabling the user to have a clear view of the processes' context. This makes the identification of design flaws and weaknesses of the processes a little bit easier but still it could be a lot better, because there is a great flaw in those tools as we are about to explain.

One thing it misses tough is that we can't have a global view of the all the processes. This would be a great addition and would make a global planning of all the processes much easier.

5.1.2 Design

Every EAI tool in the market is said to contain a module that enables organizations to easily design their business process processes. The tools we used were not an exception and we can safely say that this phase is almost perfectly supported by both platforms.

They both allow the users to make quick changes to a process so that the organization can respond as soon as possible to a certain business change. The ability to create and modify their business processes in a graphical environment is also a must. Even a person who doesn't have a good IT background can easily model the processes (in Tibco this may not be such an absolute truth).

5.1.3 Implementation

At this stage the tools can provide organizations with an easy way to deploy all the business processes in a place where they can be controlled and executed. Most EAI suites have a module just for deployment because it makes it easier to deploy an extensive set of business processes and variables in a big and complex organization. It takes the processes from the development environment (from the Design phase) to the execution environment (the one used in the Execution phase of the lifecycle).

5.1.4 Execution

Another module designed to support BPM is the engine (commonly called 'process engine'). This engine provides a functional environment for the organization's business processes. After the process is deployed and started, the engine takes control of all its execution. This engine is responsible for receiving the inputs, orchestrating the necessary interaction between other modules (and also between all the necessary external applications), applying the business rules and generating the processes' outputs.

Both tools had this engine and they were quite user friendly. We could see on the spot if any process returned an error, why it returned the error, which user executed the process and much more information. We could also see the flow of information on any process.

All this information is useful so the organization can maintain the correct execution of all its processes. But all the data is also very useful for the next BPM stage.

5.1.5 Analysis

All the data used in the organization's business processes now flows through the EAI infrastructure. This means that all the data necessary to perform the business is available to EAI for monitoring and analysis. So we can safely state that EAI also provides an infrastructure that can be used for business process analysis.

We already observed that one of the aspects of BPM is the analysis of the business process itself. So by using EAI, the data that is flowing between

independent systems and business applications can be gathered to and analyzed. This analysis can be done in 2 ways:

- **Real-time analysis**: this is also called monitoring. While business processes are executing we can monitor the process itself (its state, inputs and outputs) to detect anomalies. Lets again take an "Order Management" process as example: by monitoring the solution we can for example raise an alarm if an order has been in 'pending' state for a determined amount of time, so we don't waste business resources, and we can solve that problem quickly, avoiding client satisfaction deterioration. This analysis is useful because it provides the personnel in charge of overseeing the process with means to quickly identify and solve any problem on the fly. In our case we could check if a process had gone into error, check the way the process flow went, if there were any forks in the process, check the data in the pipeline, etc (in Figure 26 we can see part of the Login sub-process; the bold lines represent the flow and if we clicked on the business activity we could see the data that was in the pipeline at that moment.

- **Statistical analysis**: with all the data gathered from the organization's processes execution, the EAI tools can generate statistical information, providing managers with a way to check the processes problems and bottlenecks. This analysis is useful because it provides managers with an overview of the process effectiveness over the time. This can, for instance, help the organization to see which processes are most problematic (in Figure 27 we can see how many times a user changed a pricing plan with success).

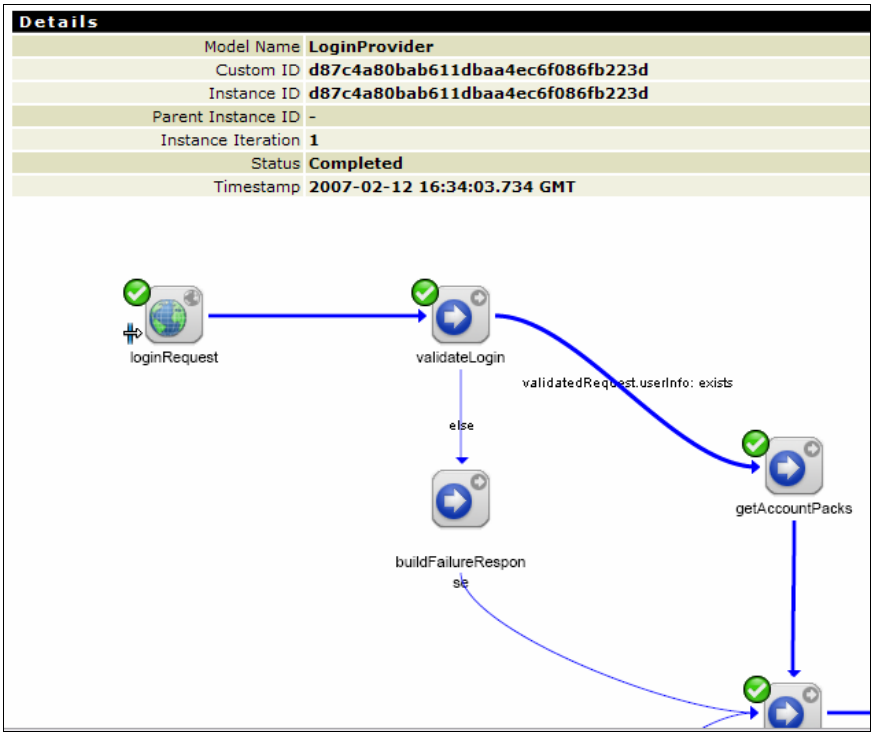

Figure 26 - Webmethods Monitor (Real-Time analysis)

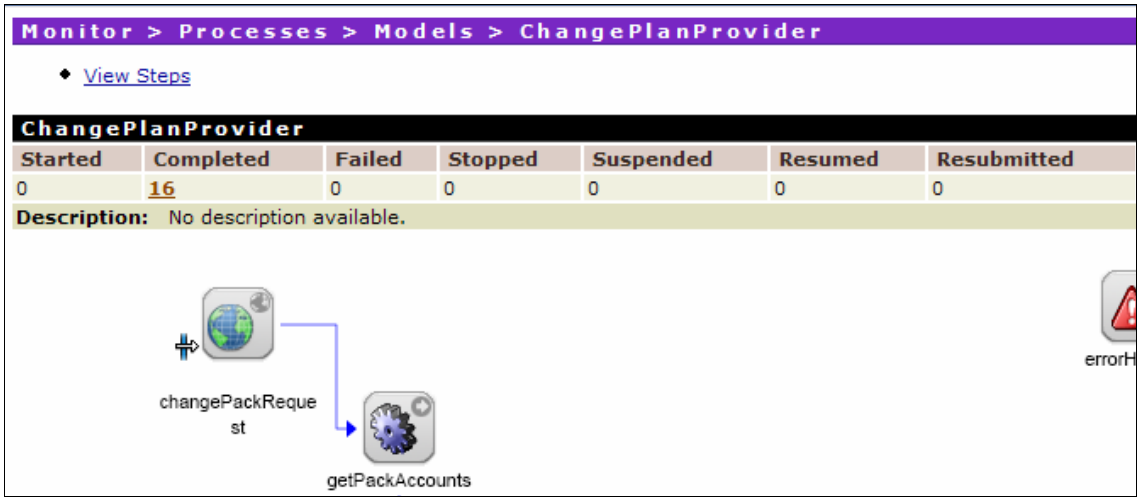

Figure 27 - Webmethods Monitor

5.1.6 Optimize

The analysis performed on the data gathered while executing the process can reveal that it could be optimized. That optimization could be achieved either by performing automatic optimization or by allowing someone to adjust some process parameters. [26]

EAI allows a certain degree of optimization as it allows the organization to spot the existing bottlenecks. For instance, we could be able to see the CPU and memory charges of each deployed process and so it would be possible for us to assign more resources to the ones who are most critical at a given time. But although this optimizes the execution of the process, it doesn't optimize the process itself.

A good example of automatic optimization of the process, one which is a real problem nowadays, is the variable pricing on airline tickets. The objective of those organizations is to sell all the tickets to a given flight while maximizing profit. They can do optimization at this stage in the following way:

- Tickets bought in advance receive a discount;
- The price of the tickets goes up as the flight date approaches;
- If we are very close to the flight date and there are still seats available those can be sold at a special price, or even auctioned at their website.

This would be a nice thing to do with EAI tools but we couldn't do it. In our case study we couldn't even find a situation where the process could be optimized by itself.

5.2 Tibco vs. Webmethods

We already concluded in each ways EAI can support BPM but which of the tools we studied is more appropriated for the process under study (and hence, maybe for the telecom industry)?

We classified both tools at the several stages using two criteria: simplicity and potential. *Simplicity* tries to rate how easy and how quickly one can use the tool to perform that stage. *Potential* rates the tool on how flexible the tool is, if he can solve complex solutions (and with how much effort). Table 2 classifies both tools on all the stages of BPM on a scale of 1 to 5 and according to the defined criteria.

	Tibco		Webmethods	
	Simplicity	Potential	Simplicity	Potential
Discovery	2	2	3	3
Design	2	4	4	3
Implementation	3	4	2	4
Execution	2	3	3	3
Analysis	3	3	4	5
Optimization	2	3	3	4

Table 2 - BPM Stages Tibco vs. Webmethods

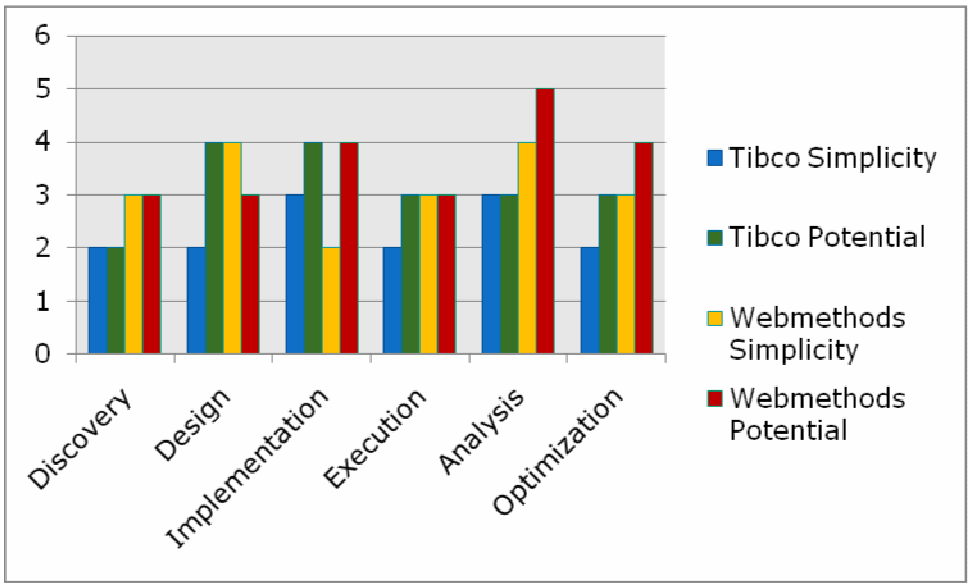

Figure 28 - Tibco vs. Webmethods

5.3 Chapter Conclusion

After we completed implementing the process in both tools we could conclude that, in our opinion, Webmethods supports BPM better than Tibco.

Tibco seems like a more old-fashioned tool, much more complicated than Webmethods and without a clear division between stages (like design and implementation for instance).

But Tibco doesn’t lose in all aspects. Both platforms have very flexible implementation capabilities but Tibco’s way is a little bit simpler than Webmethods’. Both have a good potential in implementing complex solutions.

6 Conclusion

Technology must never be seen as the real solution. It must always be a mean to achieve it.

After this project we can conclude that although EAI tools can provide some level of support to Business Process Management, those tools are just one of many steps necessary to implement serious BPM. For BPM to work organizations the main concern must not be the willingness to open their wallets and buy the tools. They must embrace the whole philosophy and be committed to spend time, money and resources so that after all is done they reap the fruits of their investment.

eTOM is surely a tool that service providers should adopt to help the organization manage their business processes and EAI tools can help a lot too but they have their limitations. They are not BPM but they do provide some level of support these days. They have evolved from simple integration of applications to a more sophisticated tool. They can now integrate applications, business units and even integrate the organization with its business partners. With the option of including the business logic within this design we can say that these tools can help the enterprise with their BPM philosophy. And even as this work evolved more and more EAI upgrades came out so we hope that this level of support will be increasing in the close future.

6.1 Application to other Processes

This work wouldn't be completed if we ended it without concluding if the process could be applied to other processes. And we can conclude that it can.

For new processes it can be done in an easy way. First we must start defining it in the upper level of the framework and then go down that chain of abstraction until you can clearly define all the business activities of the process. If we reach a point where you very similar activities in other business process we can use those same activities in this same process, if not we add a new one to the framework (it should clearly fit in the framework, if we are undecided in which category it belongs to we must go down another level).

For new processes it is the same thing as we already have it defined. We just need to find the right level of abstraction, place each activity in the right place and check for redundant activities.

After we have the process placed in the framework the implementation with EAI is the same as with this process.

6.2 Future Work

When we started this project we thought that we could study all the areas of EAI tools available in most platforms so we could conclude if EAI tools could support BPM in the telecom industry.

Although we covered many important parts there were some setbacks. First of all we couldn't get access to the full Tibco and Webmethods platforms. Many modules that could be useful were not studied by us and maybe those modules could also help the organizations support BPM. One other problem

was the use of a not so recent version of those platforms. We tried to install the latest versions but those were still full of bugs and Service Packs were being released in a rather frequent basis. So we opted to rollback to a previous version, one that would be more stable, so we could do a solid evaluation of the platform. One year later we think that we could extend the study to the later versions of the platforms, as many upgrades are said to be implemented. The new versions are supposed to have many improvements in the BPM approach and maybe those improvements can make the difference. We should try them and find out.

One thing that also lacks in this study is that we only studied two EAI solutions and although they are probably the most important ones in the market these days many were left behind. We think that in the future we could include at least one more in this study, the BizTalk Server from Microsoft.

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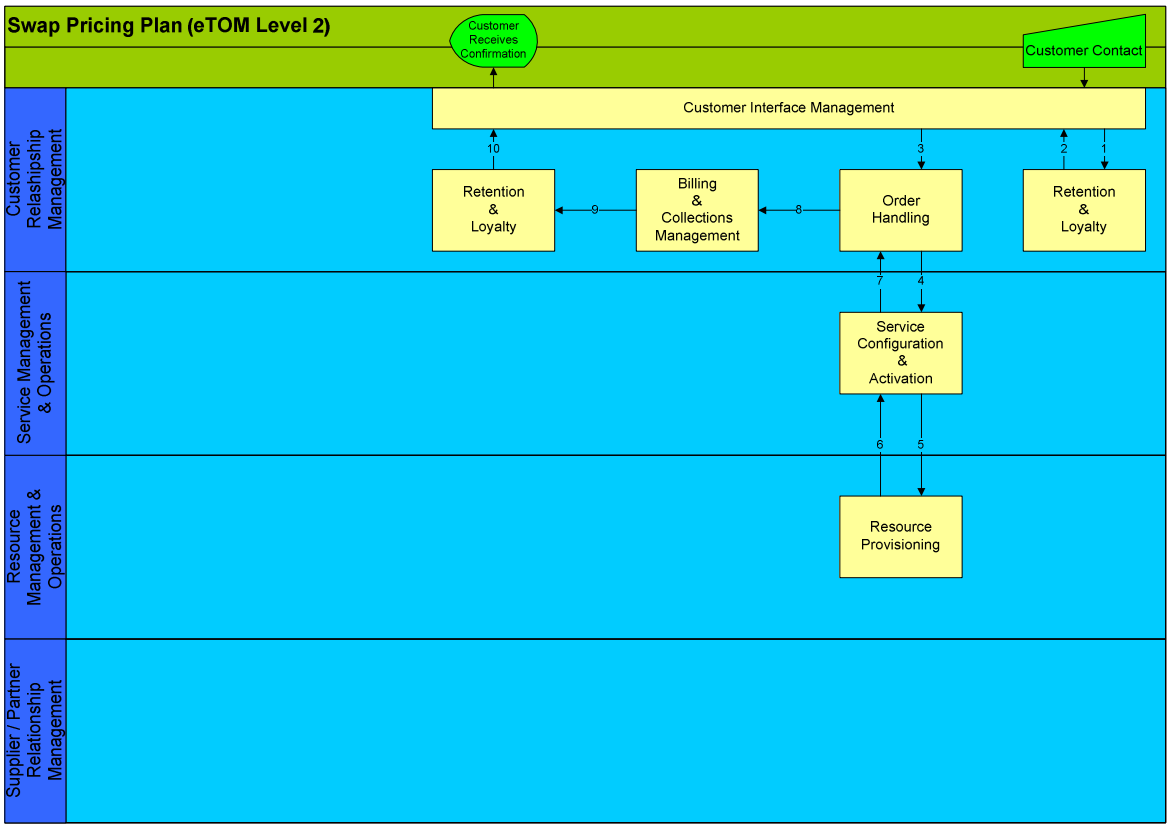
8 Appendixes

8.1 Appendix A: Our Business Process (eTOM level 2 representation)

This is the representation of our process, using level 2 processes from the eTOM framework. At this level the framework itself defines the processes. For level 4 and beyond there are no standardized processes. Each organization that adopts the framework decomposes level 4+ processes as they see fit. Each of our lower level business processes (or business activities) fit in one of those higher level processes from the framework. The cycle at this picture represents the process flow.



8.2 Appendix B: Our Business Process (eTOM Level 3 representation)

This is representation of our process, using level 3 processes from the eTOM framework. The only difference between this representation and the previous one is the level of abstraction used. As we can see, those processes are more specific than those in Appendix A. If we go down another level we will find our process activities, as defined in the chapter 4.