



CRM Business Integration in Accenture, SA

Pedro Jorge Braga Sousa

Relatório do Estágio Curricular da LGEI 2000/01

Orientador na FEUP: Prof. João Falcão e Cunha

Orientador na Accenture, SA: Eng.º Ricardo Almeida



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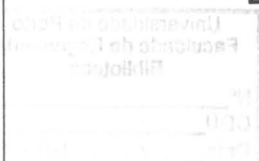
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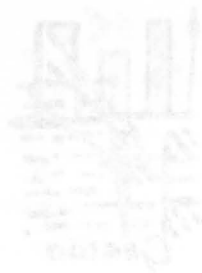
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CRM: Uma nova integração in Accenture, 2A

Prof. João Paulo Gomes

Relatório de Trabalho Curricular de LGEI 2000/01
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Aos meus pais

Summary

The project developed arises as part of the 5th year of the “Licenciatura em Gestão e Engenharia Industrial” of the “Faculdade de Engenharia da Universidade do Porto”. The project was developed in Accenture, SA Company, located in Lisbon. As this is a consulting project, it was realized in the facilities of the telecommunications company “X-Mobile”. This company prepares to enter the communications market having in scope the third generation mobile systems, also called UMTS (“Universal Mobile Telecommunications System”).

The entire project proposed by Accenture was an End-to-End solution for the BSS (Business Support System) implementation in “X-Mobile” Company. Having in mind that an implementation of this kind covers different and large areas, which will be briefly described later, this document is related to a part of this whole project, namely the CRM (Customer Relationship Management) Business Integration. But, in order to help the reader to position this CRM Business Integration in the whole BSS implementation project, a generic approach is given first, covering also a brief description of the “V-EAI” software, which has the responsibility to integrate all the support systems.

Finally, and related more specifically to the CRM Business Integration, this document gives a detailed description of the three phases of the project: the Fit Assessment, where the whole business analysis was made, the High Level Design, where the solutions were defined, and the Detailed Design, where the adopted solutions were developed and implemented.

As these six months were the first part of a project that will take one more year to be concluded, the product obtained from this period and also the future work planed for the next phases, regarding the CRM Business Integration, are referred in the end of this document.

Thanks

First of all, thanks to all the FEUP colleagues, which contributed for the fabulous years in the University, not only in terms of studies but also in term of friendship.

Second, and more related to this project, thanks to both supervisors, Prof. João Falcão e Cunha, in FEUP, and Eng.º Ricardo Almeida, in Accenture, who supported all these six months and helped to obtain this report. More generically, thanks to all the people in FEUP and Accenture who directly or indirectly helped the execution of this project.

Finally, special thanks to all the friends and family for the major support they gave.

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1 DOCUMENT SCOPE

Having in mind that the "X-Mobile" company pretends to enter in the market in the beginning of the next year, there's the need to implement all the Business Support Systems (BSS), such as CRM (Customer Relationship Management), billing, provisioning, etc, in only seven months (for the first phase), in order for the "X-Mobile" to be in production in the previewed data. The work done in this project was to be part of the team that will implement one of the systems required for the overall project, in case, a middleware software named "V-EAI".

This document is then the product of these six months of implementation of the BSS (Business Support Systems), focusing mainly the CRM Business Integration.

2 ACCENTURE

In a brief approach, Accenture first started in 1953 with the installation of the first computer for business application at General Electric. In 1989 the company was established as a separate and independent business unit devoted only to management and technology consulting services and solutions. In the beginning of this year the company changed its name to Accenture. In order to do that, the company entered a process described hereafter:

- Andersen Consulting separates from Andersen Worldwide and Arthur Andersen in August 2000.
- In January 2001, it changed its name to Accenture and launched a new brand and image in the marketplace.



Fig 1: Accenture's logo

- In April 2001, the company partners voted to pursue an initial public offering.
- In July 2001, it became a public company and began trading shares on the New York Stock Exchange under the symbol ACN.

Accenture believes that the following competitive strengths distinguishes the company in the marketplace:

- Seamless execution on a global scale
- Deep industry expertise
- Broad and evolving service offerings
- Enduring relationships with the world's leading corporations and governments
- Technology innovation and implementation
- Distinctive people and culture
- Proven, tenured and highly motivated management team
- Highly diversified business by industry, geography and technology

- History of staying ahead of industry trends

Accenture is the world's leading provider of management and technology consulting services and solutions for more than a decade. It has more than 75,000 employees in 46 countries delivering solutions to clients across all industries. It operates globally with one common brand and business model on a consistent basis around the world, serving more than 4,000 clients.



Fig 2: Accenture's clients

In a financial approach, Accenture's incomes in 1999 amounted up to 8.9 billion dollars, which can be associated to a medium growth of 20% per year in the last ten years.

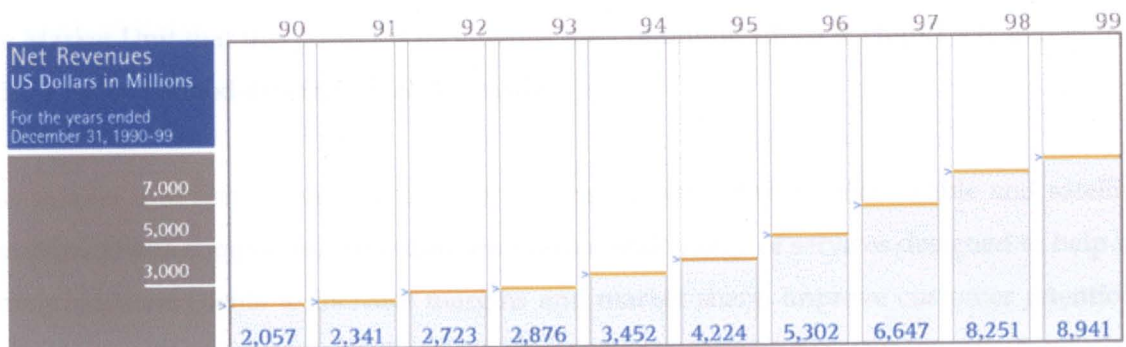


Fig 3: Accenture's revenues history

In terms of organizational structure, Accenture is divided in five major global market units, depending on the markets they are involved in. These markets units are:

- Communications & High Tech;
- Financial Services;
- Government;
- Products;
- Resources.

The role that each market unit plays in terms of revenues for the Company is shown in the next graphic:

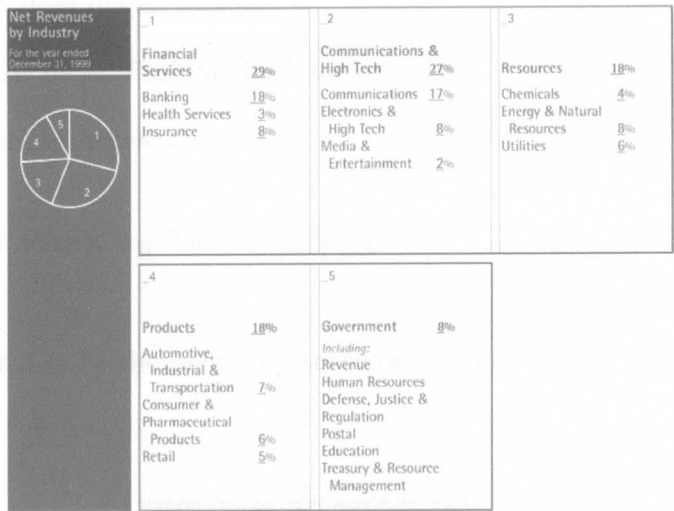


Fig 4: Accenture's Market Units revenues

The Market Unit that this project is included is the Communications & High Tech, and in that order a more detailed description of it is made.

This market unit serves many of the world's leading wire line, wireless, cable and satellite communications companies. Accenture provides a wide range of services designed to help its communications clients to increase margins and market share, improve customer retention, increase revenues, reduce overall costs and accelerate sales cycles. Accenture's functional experience in this communications market includes:

- Strategy;
- Process Reengineering;
- Customer Service;
- Billing System;
- Network Management;
- Administrative/Financial Management;
- Change Management;
- Commercial Management;
- Operators Access Billing;
- Productivity/Profitability Improvement.
- Business process change.

2.1 Accenture's Working Methodology

The Business Integration Methodology is Accenture's framework for driving and sustaining changes in an organization.



Fig 5: Accenture's BIM Methodology

Its Project Management approach is based on this methodology, which is here briefly detailed. The Methodology has four “phases” that englobe the entire life cycle of a project. Each phase reflects a flow of work from the diagnosis of business issues through the operation of new business capabilities.

The objective of the **Planning phase** is to help an organization define appropriate strategies and approaches for achieving competitive advantage and building value. Consequently, all work should begin with the Planning phase to ensure that the project team focuses its efforts on opportunities that have the greatest value to the organization, which will help that organization to succeed. The Planning phase defines new and improved business capabilities to support the organization's strategies, and creates detailed plans to help the organization effectively and efficiently implement changes during the Delivering and Operating phases.

The objective of the **Delivering phase** is to put the plans into action by building and deploying new capabilities based on the opportunities and plans defined during the Planning phase. The Delivering phase defines a multi-disciplinary approach for taking each business capability from its scratch to the deployment. It is defined in four stages:

- **Capability Analysis** defines the capability requirements, implementation constraints, and delivery options.
- **Capability Release Design** defines how business process, human performance, and technology 'interact to achieve the Business Performance Model. Completing this work resolves the detailed interactions within the capability through multiple design iterations. The resulting designs form the basis for detailed estimates for the Capability Release Build and Test stage.
- **Capability Release Build and Test** includes the detailed design, construction, and testing of the capability. This stage also includes the implementation of a pilot site.
- **Deployment** transitions individual operating units to the new capability. Deployment teams perform the local unit customizations, activate the capability, and stabilize its operation.

The objective of the **Operating phase** is to operate the new business capabilities that were created in the Delivering phase. Operating is based on the definitions of sourcing strategies, service providers, and customers, which were established in the Planning phase. The work in this phase must meet the formal service targets and metrics established in earlier phases, and must provide feedback for improvements based on measurements of actual performance against those targets.

Finally, the **Managing phase** directs, coordinates, and monitors the activities outlined in the other three phases of the methodology (Planning, Delivering and Operating) in order to achieve improved business results. This phase is the entry point to the methodology, and it provides a set of tools and techniques necessary to guide change efforts over their entire life cycle.

2.2 Accenture V-Model Procedure

The Accenture V-Model defines an overall approach to testing and a number of key “best practices” (e.g. verification, validation, test quality practices).

The V-Model framework is shown in the picture below.

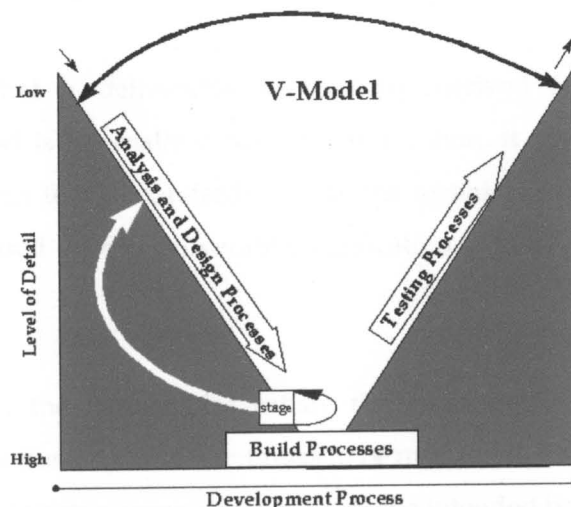


Fig 6: Accenture's Testing Methodology

A development effort begins on the left-hand side of the V-Model with analysis and design activities. The project is specified top down, making decisions and adding more detail at each new specification stage. When the design is complete, the build processes begin. Once construction is complete, the product moves through the verification, validation, and testing activities on the right hand side of the V.

In the beginning, the main goal is centred on individual components. As testing progresses, the goal is on functionality and the achievement of the Business Process.

2.2.1 Basic Concepts

The V-Model calls for each deliverable to be verified, validated, and also tested for the implementation of each specification. The process of verification and validation is an attempt to catch problems as early as possible in the development life cycle and ensure that the specifications are complete and according to the business requests. Testing ensures that the specifications have been properly and correctly implemented and that the solution meets the business and performance requirements.

Verification checks that a deliverable is correctly derived from the inputs of the corresponding stage and is internally consistent. In addition, it checks that both the output and the process conform to the standards. While the techniques used for verification and validation will vary based on the deliverable, verification is most commonly accomplished through an inspection.

Validation checks that the deliverables satisfy the requirements specified in an earlier deliverable, and that the Business Case continues to be met; in other words, validation ensures that the work product, is within scope, contributes to the intended benefits, and does not have undesired side effects. While the techniques for validation will vary based on the deliverable, validation is most commonly accomplished through inspections, simulation, or prototyping.

Testing checks that a specification is properly implemented. Ideally, testing should only uncover problems made in translating the specifications into the product, rather than problems in the specifications themselves. The problems in the specifications themselves should be found as the result of verification and validation of the specifications when they were created.

A key concept inherent in the V-Model is that development and testing processes must be structured and repeatable. It is essential that the stages of the V-Model, and the processes to complete each stage, are well defined, structured, and standardized.

Once the objectives of one test stage are met, there is no need to repeat the same testing in subsequent stages. It is, however, very important that the testing done in each stage is well organized, documented, and repeatable.

The V-Model is the Accenture model, which defines an overall approach to perform verification, validation, and testing across all business process.

There are several stages in the Accenture's *V-Model Methodology*, defined hereafter:

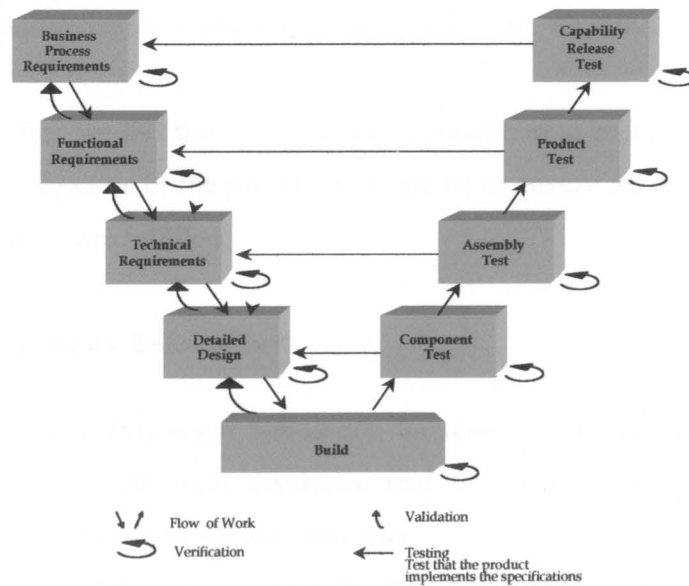


Fig 7: Accenture's V-Model Procedure

A test "stage" refers to the process of producing a specification or planning and executing a test as defined by the V-Model.

➤ **Component Test**

A component test is the test of an individual system / application module. The objective of this test is to ensure that the module can function as designed.

➤ **Assembly Test**

In assembly test, we test the interaction of related components to ensure that they function properly when integrated.

➤ **Product / System Test**

Product/System Test is a critical stage in the implementation of Business Support System. System Test focuses on system functionality, technical performance and integration of Business Support System with external interfaces and equipment. It contributes to ensure that the application requirements (Functional, Technical and Quality) have been correctly implemented.

During product testing, we test the entire system/application to ensure that all requirements have been met. The objective of the product test will be to ensure that both the technical and functional requirements are fulfilled.

➤ **Business Capability Release Test**

Capability Release Test (or Business Simulation Exercise, or Acceptance Test) provides the business users of the system with assurance that the system behaves and performs in accordance with the business process requirements.

The business capability release test exercises the interaction among capability components by using various business scenarios. These scenarios seek to mimic the real-world environment, so they are more comprehensive than the product tests (Application and Technology Infrastructure).

By using the V-Model throughout a project, the following benefits may be gained:

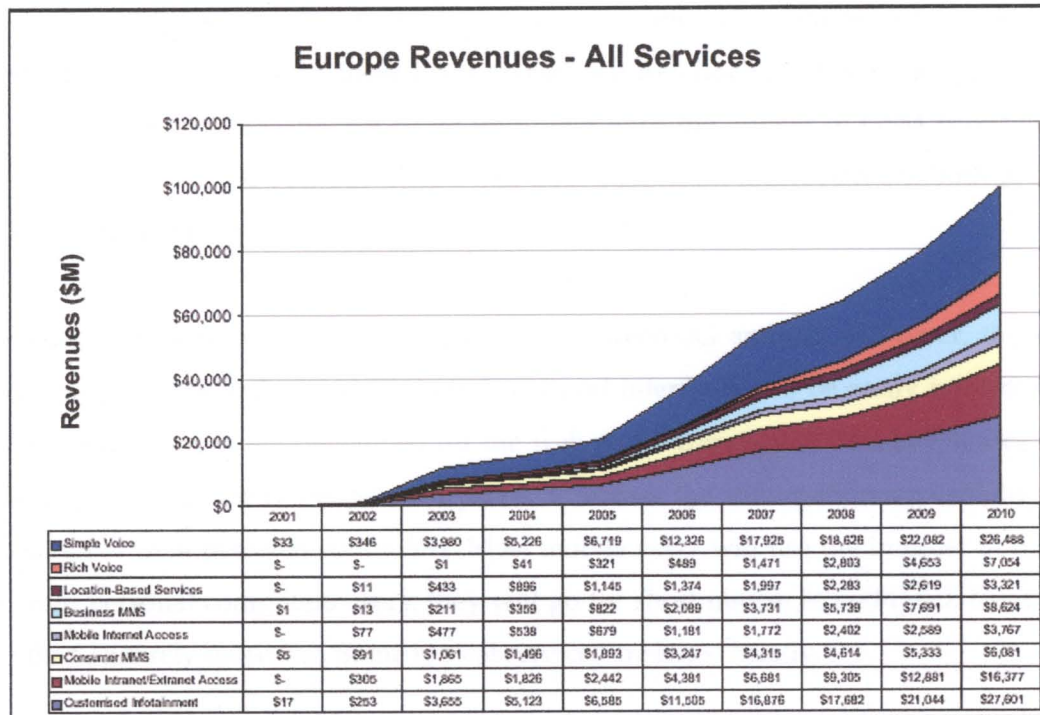
- Improved quality and reliability.
- Reduction in the amount of rework.
- Reduction in the cost of problem correction.
- Efficient testing by focusing on the objectives of the various tests.
- Requirements trace ability allowing informed scope decisions.
- Improved risk management.
- Delivery on schedule.

3 UMTS (UNIVERSAL MOBILE TELECOMMUNICATIONS SYSTEM)

The world of communications is evolving at an exciting rhythm, driven by European successes such as GSM, and global phenomenon such as the Internet. Meeting complex and growing user demands as we enter into the 21st century is the major challenge for the telecommunications industry. By assessing excellence in cellular, terrestrial and satellite technology, the Universal Mobile Telecommunications System (UMTS) will guarantee access, from simple voice telephony to high speed, high-quality multimedia services, regardless the physical location of the user.

UMTS will be a mobile communications system that can offer significant user benefits including high-quality wireless multimedia services. It will deliver information directly to users and provide them with access to new and innovative services and applications.

Customers will want to combine mobility with multimedia, resulting in higher demand for the existing technology. UMTS will cater for different kinds of mobility. Terminal mobility means that a user will be served while on the move. Personal mobility allows a user not to be restricted to a special terminal when wanting to access his or her services. Service mobility means that a user can access his or her personalised services independently of the terminal and serving network. A key driver for UMTS is the increasing demand for multimedia services. Demand is also increasing for access to multiple types of media, often used in various combinations. Thus UMTS will need to provide both narrow and wideband services (e.g. voice, data, graphics, pictures and video), in combination, on demand and on the move.



Source: Telecompetition Inc., February 2001.

Fig 8: Europe Telecommunications revenues

This demanding and exciting future is based in part on the continuing rapid growth of mobile. In Europe, mobile penetration is forecast to reach over 50% in the next ten years, and UMTS services, even though they will still be in their infancy, will play an important role in developing and enhancing that market. It is predicted that the annual market revenues in Europe for mobile multimedia will be at least 34 billion ECU (services and terminals) by 2005 with at least 32 million users using mobile multimedia contract services.

3.1 UMTS services and applications

The new business opportunities with UMTS are adding new market segments to the existing and traditional telecommunications market. Services on demand will be common in UMTS. High quality entertainment services, downloading of large files or on-line surfing are possible services in this context. In addition to the provision of multimedia, the users' needs for the present telecommunication services will also be satisfied inside UMTS.

Below are examples of new or enhanced services and applications, which should be supported by UMTS. Some of these mass market services have already been applied in the fixed network or in GSM and are being improved with the advent of GSM based General Packet Radio Service (GPRS), but UMTS will offer significant improvements both in service provision and delivery performance.

In general, basic service concepts are common between 2G and 3G. However, the service delivery mechanisms and user device attributes and interfaces will be easily improved with 3G. The applications being developed for the web and intranets will be a key source for 3G mobile applications. Many people will prefer to access the information superhighway via mobiles rather than personal computers. Most mobile users will use the Internet in different ways from personal computers users: they will go for short messages and quick transactions rather than leisurely browsing. Some typical services are listed briefly.

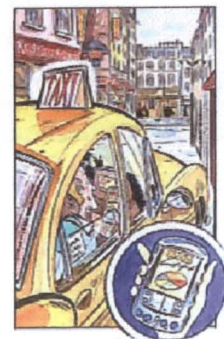
- **Information Services**

- Browsing the WWW
- Interactive shopping
- On--line equivalents of printed media
- On-line translations
- Location based broadcasting services
- Intelligent search and filtering facilities



- **Education Services**

- Virtual school
- On-line science labs
- On-line library
- On-line language labs
- Training



- **Entertainment Services**

- Audio on demand (alternative to CDs, tapes or radio)

- Games on demand
 - Video clips
 - Virtual sightseeing
- **Community Services**
 - Emergency services
 - Government procedures
- **Business information Services**
 - Mobile office
 - Narrowcast business TV
 - Virtual work-groups
- **Communication Services**
 - Video telephony
 - Videoconferencing
 - Voice response and recognition
 - Personal location
- **Business and financial Services**
 - Virtual banking
 - Online billing
 - Universal SIM-card and Credit Card
- **Special Services**
 - Telemedicine
 - Security monitoring services
 - Instant help line
 - Personal administration
 - Monitoring



4 “X-MOBILE” BSS IMPLEMENTATION PROJECT

After giving a description of Accenture’s history and working methodology and an approach of the future in the telecommunications market, regarding UMTS, it’s time to enter in the project I was included. This project was, and is, a major bet for Accenture, since it’s the biggest project in Portugal in this area, and one of the first ones in Europe regarding UMTS.

Accenture, counting with its knowledge in this area and its alliances all over the world with service and software providers, reunited an End-to-End solution for the “X-Mobile” telecommunications company. This solution proposed by Accenture was considered by “X-Mobile” as the most capable of providing a capable solution for facing this competitive market of mobile communications.

This End-to-End solution can then be divided into these sub-areas, detailed hereunder:

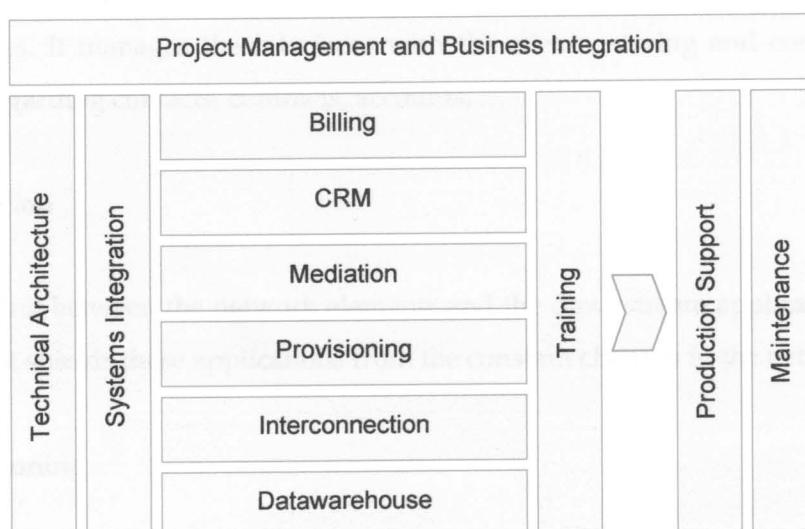


Fig 9: “X-Mobile” BSS project

➤ Project Management and Business Integration

Includes the tasks related with assuring that the products are delivered on time and on budget with the required quality. It also assures communication between the different systems components and teams.

➤ **Technical Architecture**

Includes the definition and deployment of the architecture infrastructure, providing the required support to the development teams related with architecture issues.

➤ **Billing**

The Billing solution integrates all the resources and product management, rating and billing engines, the accounts receivable and the prepaid management components. It manages all the customer bill activity.

➤ **CRM (Customer Relationship Management)**

CRM solution provides all information and transaction support to manage the customer data and its services. It manages the interfaces with the clients, storing and controlling all the information regarding contacts, contracts, accounts, ...

➤ **Mediation**

Provides the link between the network elements and the downstream applications (customer care/billing). It shields these applications from the constant changes in the network.

➤ **Provisioning**

Integrates the BSS (Business Support System) and the OSS (Operation Support System) in the provisioning service and communications perspective with the network elements (service routing, activations and service assurance).

➤ **Interconnection**

Interconnection is defined as interaction of networks between national or international telecom operators, where two or more operators interconnect their networks together so that the customers can communicate or use services from other customers network.

➤ **Data warehouse**

Provides a powerful database model used to quickly analyse large and multidimensional data.

➤ **Training**

This sub-project will handle all the training activities for trainers, operations. It will work in straight connection with the system implementation teams and process definition team, providing the integration between Applications and User procedures during the training sessions.

➤ **Production Support**

This will handle all the tasks related with running, tuning and controlling the different systems. This is especially important in the early phases of systems deployment to production.

➤ **Maintenance**

This includes the activities related with Application Management, once the applications are in production. For the systems implementation projects, the development life cycle will be accordingly to the already presented Business Integration Methodology (BIM).

➤ **Systems Integration**

This sub-project will be responsible for the integration platform on the "V-EAI" software, working in close connection with the different architecture components. Since the main goal

of this document is to explain the integration work developed, mainly regarding the CRM application, a specific and detailed description of the software and of all the processes defined will be given.

4.1 System Integration platform

For the system integration proposed by Accenture to provide “X-Mobile” an End-to-End solution, an emerging software, Enterprise Application Integration (EAI), was chosen. In this section the main advantages on using this kind of software will be described.

4.1.1 Enterprise Application Integration Platform

This platform is mainly used to define and automate business processes that integrate different applications. This class of software provides a pack of services that combine aspects of low-level messaging middleware, data transformation and formatting, intelligent routing, workflow and business process automation, custom and pre-built application interfaces, and flexible development tools. EAI software is a relatively new area and both the vendors and their capabilities are rapidly emerging.

4.1.1.1 Value Added with EAI Solutions

The value added with EAI is based on agility in the management of business processes across different systems. Specific benefits include:

- Increased quality of decisions/ reduce time to “think” and react;
- Increased ability and speed to adapt to change;
- Increased speed to market with new products and services;
- Enhanced customer service and self service;
- Expanded capabilities to deliver new products and services;

- Increased utilization of critical assets;
- Increased flexibility and agility;
- Decreased implementation and operating costs.

Also, one of the benefits added with an EAI solution is the time/effort necessary for implementation, as shown in this graphic.

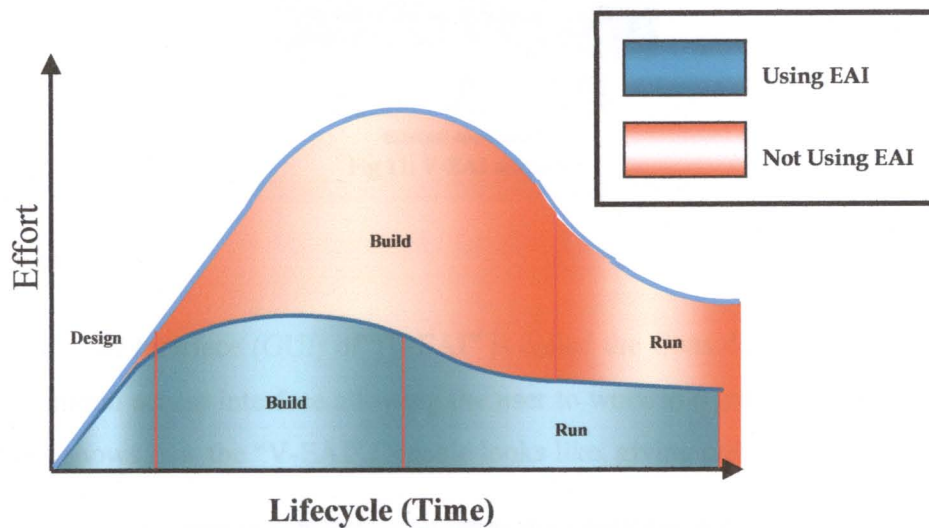


Fig 10: EAI implementation effort

So, and since the “X-Mobile” company wants to be in production until the end of this year, the time factor arises a critical aspect of the project. That’s why a system like this (EAI) provides the best way to achieve that objective.

4.1.2 “V-EAI” Software

The software chosen by Accenture in the Enterprise Applications Integration area was the “V-EAI”. It combines communications, application integration (connectivity to internal and external systems), business process automation and real-time analysis. This product enables companies to automate their business operations by allowing the information technology systems that support these operations to automatically exchange information using a variety

of networking technologies. The major components of the “V-EAI” are: the Console, the Communicator (channels), the Connectors and the Automator. These major components are described hereunder.

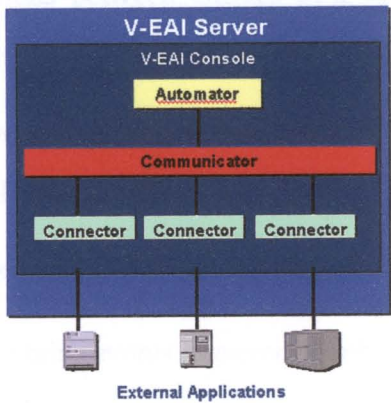


Fig 11: V-EAI software

4.1.2.1 Console

The Graphical User Interface (GUI) of “V-EAI” is called the Console. The “V-EAI” Console provides a common access interface allowing the user to work in a graphical environment. The figure bellows shows how the “V-EAI” Console looks like, giving one idea of its capabilities.

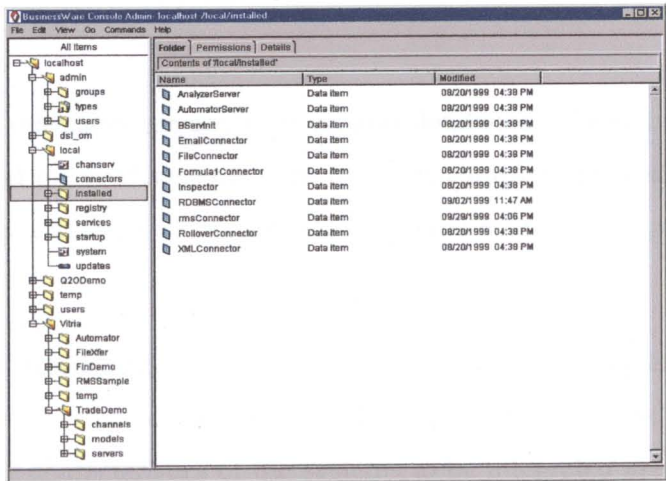


Fig 12: V-EAI console

4.1.2.2 *Communicator (Channels)*

The Communicator provides a high performance, publish and subscribe messaging backbone for asynchronous communications between entities in a secure and reliable environment using the established standards CORBA IDL and XML.

Communicator message events are published and maintained into channels. They may be created and/or destroyed using the Console)

There are 3 classes of channel services:

1. Reliable service that maintains events in memory only.
2. Guaranteed service that persists all events to disk so that they may be recovered after a system failure.
3. Transactional service that provides a means of defining a series of individual events as a single transaction that may span multiple channels and which may be rolled back.

4.1.2.3 *Connectors*

Connectors provide interfaces for applications and databases. These interfaces are used to integrate internal and external systems with those that implement business processes. "V-EAI" has several types of connectors, depending on the connected application to chose the correct one.

Connectors publish events into the "V-EAI" Communicator channels and subscribe to receiving events from the same channels. They also support protocol and data transformation services. The unique characteristics of the systems to be integrated are encapsulated in the Connector interface. Therefore, business services applications may be changed without impacting other applications integrated by Connectors.

In practice, the Connector is used to convert applications specific information into enterprise common information. For example, when customer services information is published by the

CRM application, the connector must transform it into common information, in order for the Billing and the Provisioning applications to subscribe it.

The Console allows creation, configuration and control of Connectors. Connectors are made up of a sequence of “flows.” These flows are “wired” together in the modeler. It also allows inspection and debugging of events flowing through the Connector.

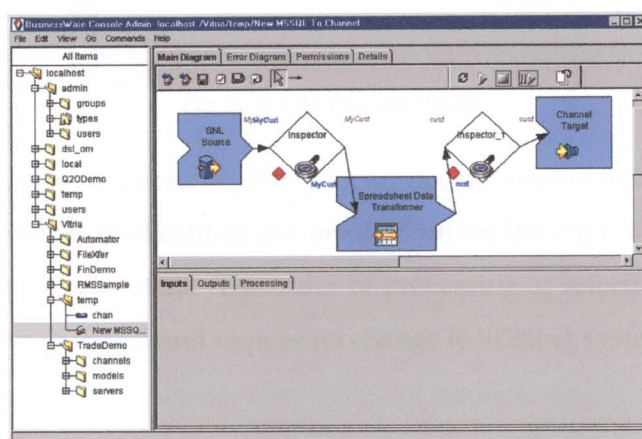


Fig 13: V-EAI Connection Model

4.1.2.4 Automator

The Automator is V-EAI's implementation of a process automation engine. The Automator supports business process automation by maintaining the state of a Business Process Object (BPO) and managing transitions between states. A BPO is a transition object that stores data to be used in the same process model. The Automator allows adding intelligence to the processes, making V-EAI as the controller of them, in spite of being the other applications. With this, the level of integration is even superior. The Automator model is based upon the Unified Modelling Language (UML) type diagram. The modeling interface allows the user to create process flows that represent business processes. A point and click interface allows for easy development of visual diagrams called “Process Models”. This was one of the most important tasks I was assigned inside the project, and thereafter I will come to it later.

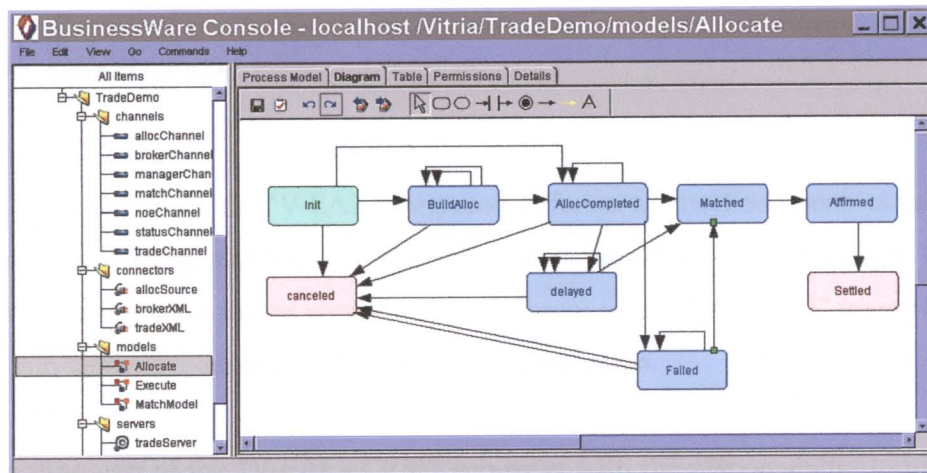


Fig 14: V-EAI Process Model

Interactions with other applications to provide a service are performed by publishing events. In this way, the individual applications are invoked under the control of the Process Model and interfaced through Connectors. The order of processing or selection of applications can be changed in the process model and require no change to existing systems.

5 WORK DEVELOPED

In the “X-Mobile” Project, the “V-EAI” integrated different applications, such as the CRM, the Billing, the Provisioning and also ICP (“Instituto de Comunicações de Portugal”). Since the connections to these applications were made in different ways, the “V-EAI” team was divided into three sub-teams depending on the interfaced application.

Having become part of the “V-EAI – CRM” sub-team with the responsibility to integrate the CRM application with the other applications, in order to make sure that all the “X-Mobile” business requirements were always fulfilled, a detailed description of the work developed is useful and needed.

This section, used to give the proper description, was divided into three parts. First, a plan was made listing the work areas in the whole six months of the project, after, a brief explanation of the V-EAI – CRM connectors, and finally, a detailed description of all the tasks assigned, since the beginning of the project and following the project plan.

5.1 Project Plan

	April	May	June	July	August	September
Fit Assessment						
High Level						
Detailed Design						

Fig 15: “X-Mobile” Project plan

5.2 CRM Integration

5.2.1 CRM Connector

When a change happens in the CRM database and if this change is important for the knowledge of the other applications, a trigger fires. This trigger inserts registers into a Table, which has all the operations performed. This Table, called Time Bomb Shadow table, includes columns for the type and id of database objects (tables or views) where the changes occurred.

Using the “CRM-V-EAI” Connector, which reads directly from the Time Bomb Shadow table (this connector is a “V-EAI” product and has the functionality of reading registers directly to databases), it gets all the necessary information to provide to the other applications. This information is retrieved by constructing an SQL statement, which performs a SELECT * to the database, based on the Object Id where the change occurred. This data is then transformed into a “V-EAI” event, which will have its own treatment in order to perform the necessary operations.

5.3 Tasks

5.3.1 Fit Assessment

As referred before, the first phase of the project was the Fit Assessment, which comes immediately after the acceptance of the proposal by the client, in this case the “X-Mobile” telecommunications company. During this period of time, which was about two months, the main role was to become aware of all the project business requirements, mainly the ones that needed integration between applications.

In order to do that, it became necessary to read and investigate all the existing documentation (Accenture’s proposal and Fit Assessments of all the areas defined in the “X-Mobile” Implementation Project) to find and define the processes, which need integration with the CRM application.

Also during this phase, it was needed to start to become aware of “V-EAI” functionalities in order to develop solutions in future phases.

Since the main goal is to explain the interfacing CRM application, the Client Hierarchy used in this project is needed for the reader of this document to understand the processing involved.

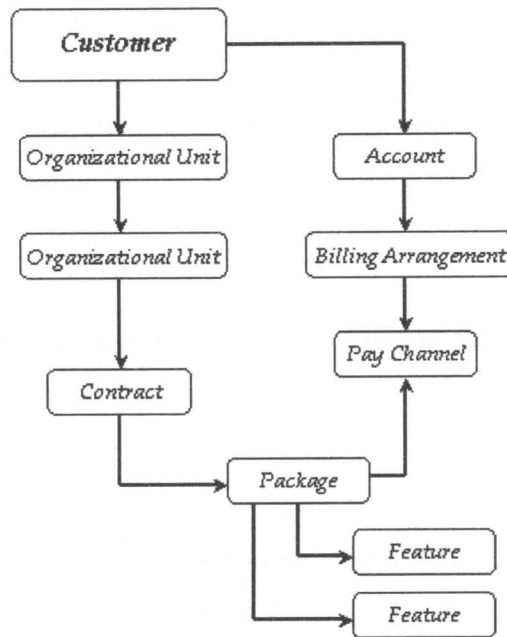


Fig 16: Client Hierarchy

- **Customer** – higher entity in the Client Hierarchy. It defines the responsible for all the contracts under it. This Customer is defined as residential (for particulars, like Pedro Jorge Braga Sousa), or corporate (for companies, like Accenture, SA).
- **Organizational Unit** - entity that defines the branches of the Client Hierarchy tree. For a corporate Customer, it can be, for example, the Financial Department of Accenture, SA.
- **Account** – entity associated directly to the Customer, being responsible for its payments. Has a direct billing contact (name and address), and it collects all the information we can encounter in an invoice.

- **Billing Arrangement** – entity that interfaces the Accounts and the Pay Channels for a specific Customer. It gathers all the data used in the Account level.
- **Pay Channel** – entity directly associated with a contract, defining which is the payment channel and responsible for it. It can be pre-paid or post-paid, depending on the option the client made (recharges or invoices).
- **Contract/Subscriber** – entity that represents the commitment between a client and the “X-Mobile” telecommunications company. It’s associated with a mobile device (IMEI) and a phone number (MSISDN).
- **Package** – this generic naming refers to all the services provided by “X-Mobile”. These packages can be discounts, price plans, roaming, etc, associated to a specific contract.
- **Feature** – minor entity of all the hierarchy, which defines the parameters of a service. For example, a feature can be the voice, the language of a voice mail, etc.
- **Number Portability** – process that allows the subscriber to change its telecommunications company without changing the contract’s number (MSISDN).
- **Charge Distribution** – process that allows the subscriber to change the pay channel of a specific package associated to its contract.

These are the entities used to describe a Client hierarchy in the “X-Mobile” BSS Implementation Project. After the identification of the entities of the CRM application, the list of the needed CRM integration processes was defined. The result was the following table:

Interfacing Applications	Business Area	Process
CRM-Billing	Contract Publish	Create Customer

CRM Business Integration		
		Add Organizational Unit
		Add Account
		Add Billing Arrangement
		New Pay Channel
		Activate Subscriber
	Customer Update	Change Customer Data
	Organizational Unit Update	Change Organizational Unit Location
		Create organizational Unit Agreement
	Billing Entities Update	Change Account Data
		Change Billing Arrangement Data
		Change Pay Channel Data
	Subscriber Update	Change Price Plan
		Change Subscriber Data
		Change Subscriber Status
		Migrate Pre-Paid to Post-Paid
		Migrate Post-Paid to Pre-Paid
	Package Update	Add Package
		Remove Package
	Feature Update	Change Feature Data
	Distribution	Change Event Distribution
		Change Charge Distribution
CRM-Provisioning	Subscriber Update	Migrate Pre-Paid to Post-Paid
		Migrate Post-Paid to Pre-Paid
CRM-ICP	Portability	Number Portability Request
		Number Portability Cancellation
		Number Portability Rejection

Fig 17: Business Events

5.3.2 High Level Design

After the definition of all the processes that will need “V-EAI” integration in order to fulfil all the business requirements gathered on the previous phase, comes the time of thinking and developing possible solutions for the presented problems.

This phase of High level Design, also called Functional Design, is the second step to take in a project of this type. Here, people define different functional solutions based on the capabilities

and functionalities of the software components they are working. The pros and the cons of the proposed solutions are then considered, in order to obtain the best solutions possible.

In this phase, the work developed was divided into different fronts. First, and continuing the work initiated in the previous phase, the necessity of making the "V-EAI" knowledge more consistent, in order to develop the most profitable solutions. Second, to gather and study the interfacing applications technical specifications, in order to assure that the solutions developed were according to the requirements and capabilities of them. Finally, and because the "V-EAI" team is the responsible team of making the others "talk" to each other, it became necessary to start defining which was the data the CRM team should provide to fulfil the other applications requirements.

Since this was a High Level Design period, na approach of the processing used for each business area defined in the previous Fit Assessment phase is needed. The detailed description of the global and individual solutions adopted will be given in the next Detailed Design phase.

➤ **Contract publish**

This Contract publish is the main business area and the most complicated one. This event is sent to "V-EAI" when a client accepts a new contract, which is the beginning of a relation between that client and "X-Mobile". When the contract is accepted, the whole client hierarchy detailed in the Fit Assessment phase needs to be sent to the Billing application. Since the "V-EAI" team needs to assure sequence in the creation of the client hierarchy entities, a Process Model was defined in order to sustain that business requirement.

➤ **Customer Update**

This business area only regards the change of specific customer data, like his contact, address, type (residential or corporate), etc.

➤ **Organizational Unit Update**

Organizational Unit Update business area covers two different events. One, the change of the Organizational Unit in the client hierarchical level, the other, the creation of a new agreement at this level, which is the addition of discounts (or other packages) to a new Organizational Unit. The first one is used when, for instance, there is a new department in a company (corporate customer) that will be the new payment responsible for the company's contracts. The second, when the "X-Mobile" pretends to give a discount to all the contracts under that Organizational Unit, for example.

➤ **Billing Entities Update**

This Billing Entities Update area regards changes in any of the three billing entities defined in the client hierarchy (account, billing arrangement and pay channel). For account update, it covers the change on the billing contact/address, for billing arrangement update, changes in the billing agreement with the client, and finally, for pay channel update, it can be changes in specific data, like the bank account, bank name, etc.

➤ **Subscriber Update**

This Subscriber Update business area is a very complex and involving area. It covers four main event areas: a change in the contract's Price Plan, in specific subscription data, in the status of the contract (suspend, restore or cancel), and the migration of a contract from pre-paid to post-paid, or vice-versa.

As the event area names tell, the first one occurs when there is a change in the services and in the tariffs that a contract is associated, the second, when there is change, for example, in the number or in the mobile of a contract, the third is when the status of the contract is requested to change, for example, when there's payment problems, and the last one when the client requests to change its payment methodology, from recharges to invoices, or vice-versa.

➤ **Package Update**

Package Update area is a simple one, covering only the addition or removal of packages of a contract, which can be discounts or any other type of packages.

➤ **Feature Update**

This business area covers only one simple event, and in terms of process this can be defined as a change, for example, of the language of the voice mail or the space in the mailbox.

➤ **Distribution**

Distribution is a generic name given to describe the process of associating a different pay channel to a package or a feature. This processing is used, for example, if you want that your company pays your roaming services, being you the responsible of all the other payments.

➤ **Portability**

Portability is the process that allows a client to change his network provider without changing his MSISDN, or mobile number. As it is now in the Portuguese communications market, imagine that you have the "931111111" mobile number from one network provider, and you want to change to another network provider. Using the Portability process you can perform the change, keeping the same "931111111" number.

In this area, the request, the confirmation and the cancellation of the portability process will be allowed.

5.3.3 Detailed Design

This is the main area of the "X-Mobile" BSS implementation project, where all the development was made. The possible solutions thought in the previous phase have become consistent and developed in this period of time. Some generic handling solutions were developed for the majority of the business areas, but some special business events like

Contract Publish, Change Price Plan or Migrate Subscriber needed more effort and specific process design.

The “V-EAI – CRM” team development effort followed the processing defined hereunder:

- a) CRM trigger definition, to detect when the data should be sent to the Billing application;
- b) CRM views definition, to detail the necessary data “V-EAI” needed to provide to the Billing applications;
- c) “V-EAI” CRM connection models, necessary to do its own processing and routing to the correct applications;
- d) Java classes to perform data transformation, in order to put it in the correct way to be subscribed by the other applications;
- e) “V-EAI” Process Models, for the specific cases that need special handling (Contract Publish; Change Price Plan);

This processing was followed for all the events that the CRM application needed to publish in a “V-EAI” channel. In that order, the next sections describe and detail all the work developed.

5.3.3.1 CRM Data Model

Before going to the description of the processing the team developed, it's necessary to have a slight understanding on the CRM Data Model, specially the mapping between business entities and database objects.

The next screenshot gives an understanding on the objects and the relations on the CRM database.

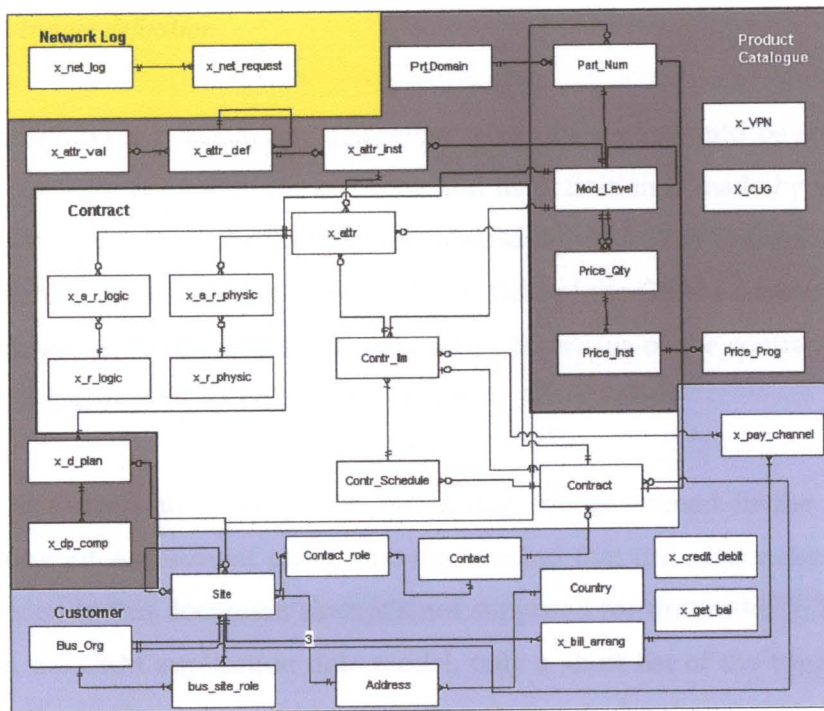


Fig 18: CRM Data Model

So, according to the business entities defined in the Fit Assessment phase and these database objects, the following table becomes a very useful mean to understand as much as needed the CRM application.

Business Entity	Database Object
Customer	Bus_org
Organizational Unit	Site (non-payment responsible)
Account	Site (payment responsible)
Billing Arrangement	X_bill_arrang
Pay Channel	X_pay_channel
Contract/Subscriber	Contract
Package	Contr_itm
Feature	X_attr

Fig 19: Business Entity – Database Object mapping

This analysis on the mapping between Business Entities and database objects allows the “V-EAI” team to perform its work, regarding the trigger and the view definition on the CRM application.

5.3.3.2 CRM trigger definition

The trigger definition is necessary to determine when the data should be sent to the other applications. A trigger is a set off for an event, and its definition is made by saying which is the field and on which table the “inspection” should be made. For example, in the case of Contract Publish, a trigger was set in the STATUS field of the CRM’s contract table when it passes to “Activation”. This assures that only when the status of the contract passes to that specific value, it gets sent to the billing application.

A definition was made to cover all the publishing events defined in the business areas described during Fit Assessment phase. Having in mind that the trigger detailed definition doesn’t add value to this document since it’s not supposed for the reader to have a detailed knowledge on the CRM application data model, only a short list of the triggers is given in order to allow the reader to have a knowledge on the work developed. This is also adopted for CRM custom views and Java Classes.

Business Area	Trigger
Contract Publish	Tbl_contract_trg
Customer Update	tbl_bus_org_trg
Organizational Unit Update	tbl_site_chng_loc_trg
	tbl_site_trg
Billing Entities Update	tbl_account_trg
	tbl_x_bill_arrang_trg
	tbl_x_pay_channel_trg
Subscriber Update	tbl_contact_trg
	tbl_contr_chng_pp_trg
	tbl_mov_subs_trg
	tbl_mig_pre_post_trg
	tbl_contr_status_trg
Package Update	tbl_contr_itm_pkg_update_trg
Feature Update	tbl_attr_srvc_update_trg
Distribution	tbl_chng_charge_dist_trg
Portability	tbl_request_port_trg
	tbl_cancel_port_trg
	tbl_confirm_port_trg

Fig 20: Triggers

5.3.3.3 CRM view definition

The same way as for trigger definition, it was necessary to decide the necessary data to respond to the subscribing applications requests. The decision made was by developing custom CRM views. A task was to define the fields of those views, based on the field description requested by the Billing application. For example for the activation of a contract in the Billing application it was necessary to provide its contact (name and address) and the subscribing Price Plan. So, a mapping was required to populate the Billing database fields with the existing fields in the CRM database. The product of this mapping was the definition of the custom views, which the following table lists:

Business Area	View
Contract Publish	X_account_view
	X_org_unit_view
	X_subscriber_view
Customer Update	X_bus_org_upd_view
Organizational Unit Update	X_chng_ou_loc_view
	X_agreement_view
Billing Entities Update	X_account_upd_view
	X_bill_arrang_upd_view
	X_pay_channel_upd_view
Subscriber Update	X_subscriber_upd_view
	X_chng_pp_view
	X_create_entity_view
	X_move_subs_view
	X_chng_subs_stat_view
Package Update	X_add_pkg_view
	X_remove_pkg_view
Feature Update	X_feature_upd_view
Distribution	X_chng_charge_dist_view
Portability	X_np_request_view
	X_np_cancel_view
	X_np_confirm_view

Fig 21: Views

5.3.3.4 "V-EAI" CRM Connection Models

On the contrary of the triggers and the views definition (this work was developed in close connection to the CRM team), the "V-EAI" Connection Models were developed uniquely by "V-EAI - CRM" sub-team. Five (four for the source and one for the target) connection models were developed to handle the CRM publishing business areas. However, two of them (CRM_Contract_Aggregator and CRM_PricePlan_Aggregator) were developed to handle special events, respectively Contract Publish and Change Price Plan.

The first Connection Model is CRM_toChannel, which gets its data from the CRM application by following the description made for this connector (see section 5.2.1). All the views set off by the triggers that were defined get published in the "V-EAI" application in the form of events, after passing by a Java transformation to process it. After the publishing by the CRM application, it performs the separation of the events that need special handling from the ones that go directly to the next and final source connection model. This separation is made by a Simple Router flow, which is based on the name of the event and the next process flow.

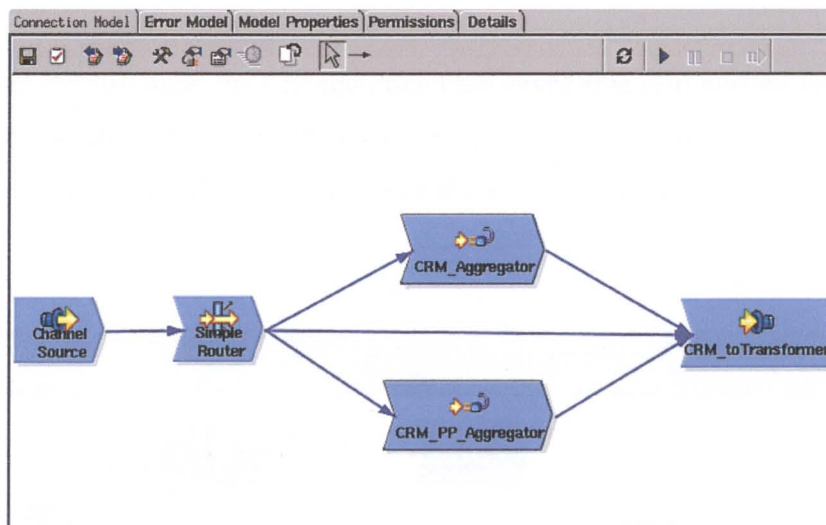


Fig 22: Screenshot of CRM_toChannel Connection Model

The ones that need special handling by the Connection Models go to two specific ones, where they will be aggregated and transformed.

The CRM_Contract_Aggregator, which handles the Contract Publish event area, has two major functionalities. Since the publishing data defined for this area was divided into three

different views, due to CRM data model restrictions, an aggregation of the three events was made to obtain a unique event that had the whole CRM Client Hierarchy, necessary to create the same entities in the Billing application side. That is the function of the Aggregator flows that can be seen in the screenshot of the CRM_Aggregator connection model. The seen Simple Data Transformers are Java Classes that put the fields of the event in the correct way for the subscribing Billing application acceptance.

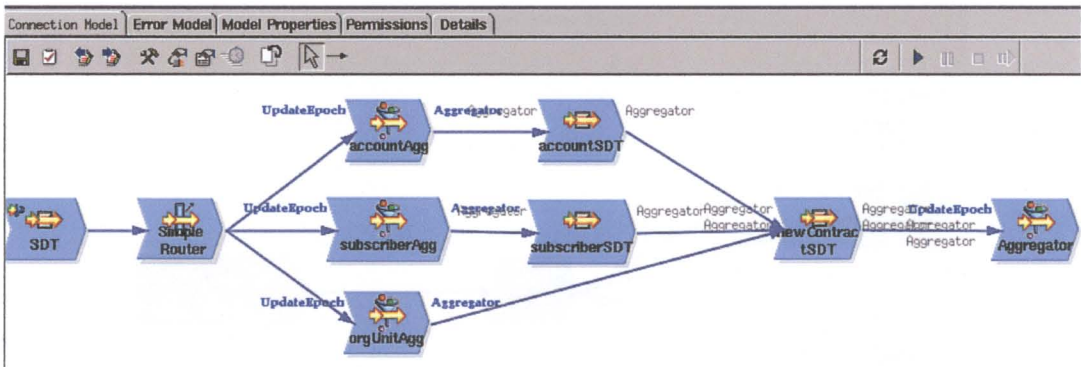


Fig 23: Screenshot of CRM_Contract_Aggregator Connection Model

As for Contract Publish area, the Change Price Plan event area also needed special handling, which is made in this CRM_PricePlan_Aggregator. This handling is similar to the prior model, but only with two different views, since the amount of requested data is smaller in this case.

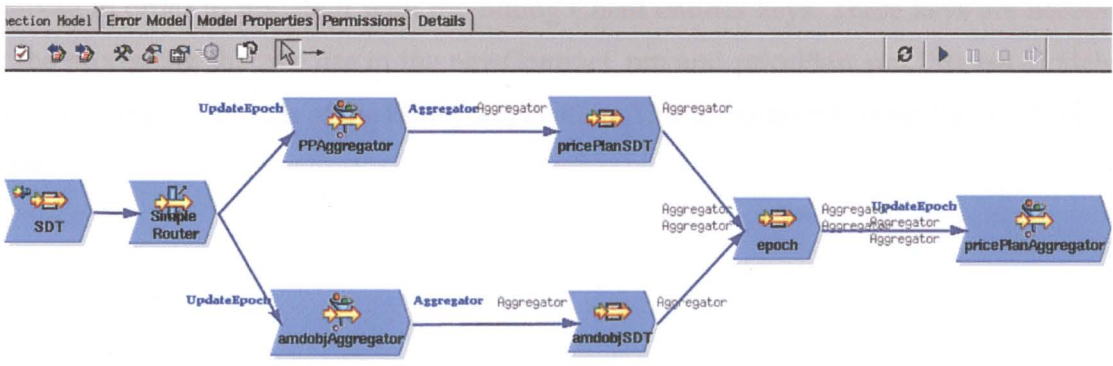


Fig 24: Screenshot of CRM_PricePlan_Aggregator Connection Model

Finally, after all the Java transformations and special handling made for all the publishing CRM events, the fourth and final CRM Source Connection Model, the CRM_toTransformer, only does the routing of the events for the proper target applications (Billing, Network and ICP), or, in case again for the Contract Publish and Change Price Plan, for the proper Process Model (newContract_pm or pricePlan_pm), based again in the naming of the incoming event and the following flows.

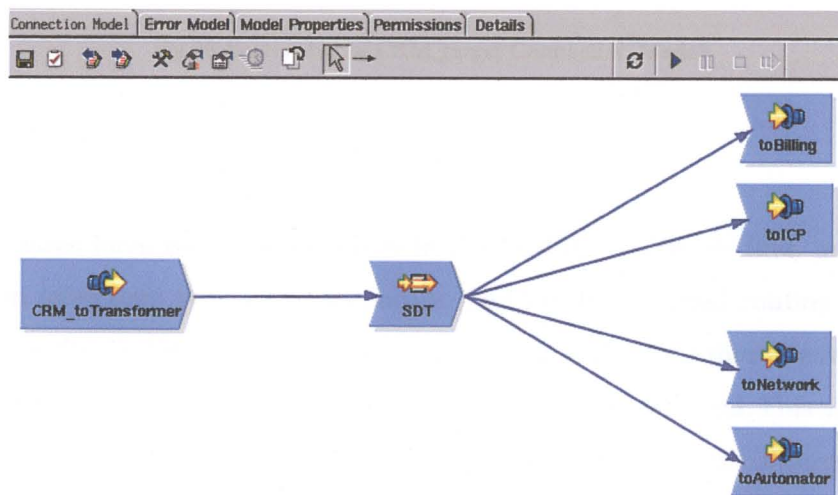


Fig 25: Screenshot of CRM_toTransformer Connection Model

On the other side, the Target Connection Model, called CRM_target, does the call to the CRM database in order to update it with the Billing Client entities keys. These keys are necessary for the processing that we use in the newContract_pm and pricePlan_pm Process Models to reduce the number of calls of the Billing application. This is made only regarding performance issues.

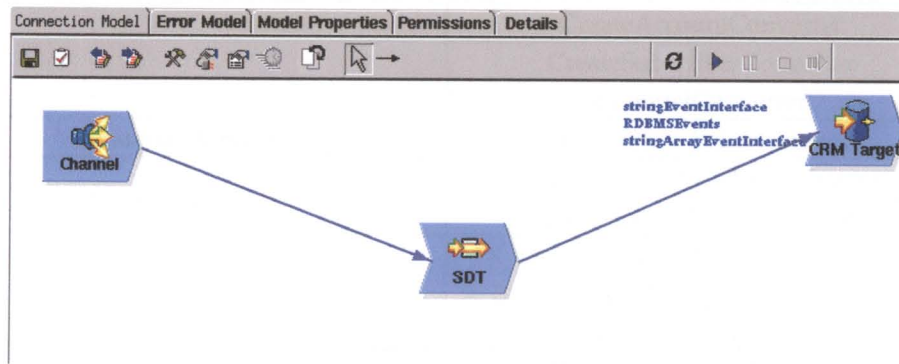


Fig 26: Screenshot of CRM_target Connection Model

5.3.3.5 Java Classes

These Java Classes have two functionalities in the “V-EAI” software: first, to perform data transformation (also data types) and second, to perform the referred routing to the correct applications. As the “V-EAI” is a middleware application, the data that “travels” through it should be generic data, and not specific source or target application data. This allows “V-EAI” to be the neutral layer and to the other applications not to have more concerns on the other applications requests. A critical example of this is, for instance, when the source application sends one field with a string value as “YES” or “NO”, and the target application requests a “1” or “2” byte value for the same field. It is “V-EAI” responsibility to do this transformation work. Another use of this application, and in order to create that neutral layer, is also the naming of the events and fields that should be as generic as possible. For that, a field that for the CRM application is the “CRM Customer No”, and for the Billing application is the “External Id”, should be transformed generically as “Customer Id”.

As for trigger and view definition, the detailed description of the Java Code would be boring and unnecessary for the reader to understand the processing and development made. So, only the list of the developed Java Classes was necessary for the correct execution understanding of the process.

Business Area	Java Classes
Contract Publish	X_ACCOUNT_VIEWConverter
	X_ORG_UNIT_VIEWConverter
	X_SUBSCRIBER_VIEWConverter

	CreateAccountConverter
	CreateSubscriberConverter
	ContractConverter
Customer Update	X_BUS_ORG_VIEWConverter
Organizational Unit Update	X_CHNG_OU_LOC_VIEWConverter
	X_AGREEMENT_VIEWConverter
Billing Entities Update	X_ACCOUNT_UPD_VIEWConverter
	X_BILL_ARRANG_UPD_VIEWConverter
	X_PAY_CHANNEL_VIEWConverter
Subscriber Update	X_SUBSCRIBERER_VIEWConverter
	X_CHNG_PP_VIEWConverter
	X_CREATE_ENTITY_Converter
	ChangePricePlanConverter
	X_MOVE_SUBS_VIEWConverter
	X_CHNG_SUBS_STAT_VIEWConverter
Package Update	X_ADD_PKG_VIEWConverter
	X_REMOVE_PKG_VIEWConverter
Feature Update	X_FEATURE_UPD_VIEWConverter
Distribution	X_CHNG_CHARGE_DIST_VIEWConverter
Portability	X_NP_REQUEST_VIEWConverter
	X_NP_CANCEL_VIEWConverter
	X_NP_CONFIRM_VIEWConverter

Fig 27: Java Classes

5.3.3.6 “V-EAI” Process Models

These Process Models were where most of the work during this Detail Design phase was done, along with the necessary Java Classes. They needed to be developed to assure sequencing in the creation of the Client entities in the Billing application, since, in order to create, for instance, an account, the Billing Customer Identification is required, and for a new customer, the CRM application doesn't still has that number. So, the “V-EAI”, using the BPO (Business Process Object), already explained before (see section 4.1.2), creates the Customer, stores its identification in the BPO, and then creates the account using it. The two areas where the Process Models were necessary were the Contract Publish and the Change Price Plan. A detailed description of the processes is made hereunder.

Contract Publish

As referred, this Contract Publish business area was the major and the most complicated one in the project, regarding the CRM integration. Two Process Models, the newContractModel and the accountModel, were necessary to design to fulfil those business purposes. When the whole aggregated event gets to the first Process Model, the first operation to accomplish is to store all the data in the BPO, which is made during the first transition. After, storing the data, it's time to add some intelligence to the process. Checking is made along the whole process model to know if each one of the Client entities need to be created in the Billing application, or, in other end, they are already there. This checking is made by verifying if the Billing Entities Ids are, or not, in the incoming event. An explanation of the Process Model is made for the case of the need to create all the Client entities.

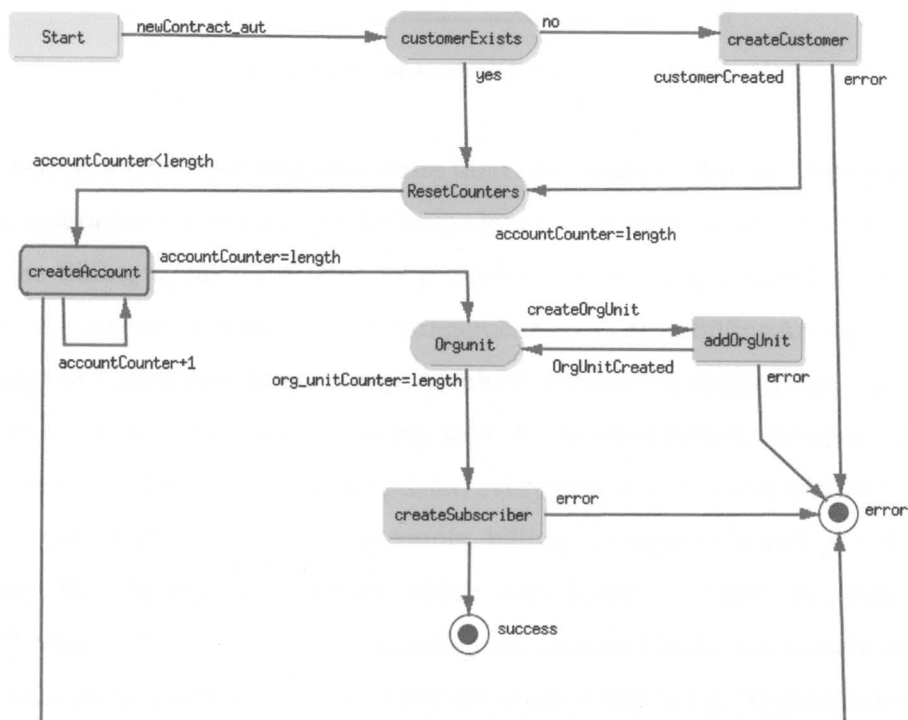


Fig 28: Screenshot of newContractModel Process Model

After checking the need of creating the Customer entity in the Billing application, a CreateCustomerEvent event is sent to the Billing Target Connection Model. That model, with the data in the event, creates the Customer in the Billing database, returning to the

newContractModel the Customer Billing Id. When this Id is returned, it's stored in the BPO and a transition is made that will make the modelling enter the accountModel.

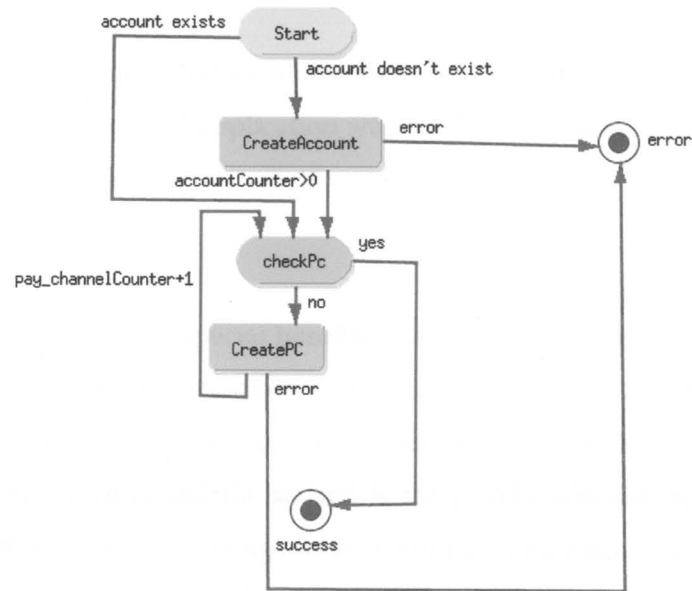


Fig 29: Screenshot of accountModel Process Model

As spoken before, a Customer can have more than one Account, Billing Arrangement or Pay Channel. In that order, the Process Model keeps looping on these entities until all of them are created in the Billing application. This loop is made by sending CreateAccountEvent (this event creates the account and the billing arrangement, so a CreateBillingArrangementEvent is not necessary) or CreatePayChannelEvent events to the Billing application, waiting for the responses, in order to pass to the following step. As referred before, the data sent in these events is gotten from the BPO, which is updated every time a response is returned.

After the creation of all the necessary accounts, billing arrangements and pay channels, it's time to create the Organizational Units, which will define the hierarchy level where the contract will remain. As for the prior processing, the Process Model will remain in loop until all the Organizational Units are created. They are created following the descendent order, to assure that we always know the "parent" Id, which is the superiorly direct Organizational Unit.

Finally, and after the creation of all the Client Hierarchy in the Billing application, the Contract is sent to activate. This contract event, called ActivateContractEvent, has all the

packages and services that are associated to it, to assure that all the services subscribed by the client are given. This ends successfully this process.

A reference must also be made that each time an entity is created in the Billing application, a responseEvent is sent to the CRM application with the identification of the entity.

Change Price Plan

The second process that needed special handling and Process Model treatment was a change in the Price Plan of a subscriber/contract. This business area also uses two Process Models. One of them is the same used for the Contract Publish area, accountModel, which handles the creation of the billing entities, and the second is the pricePlanModel, where we can choose which is the operation required, a change in the Price plan or a migration from a Pre-Paid to a Post-Paid plan, or vice-versa. As for Contract Publish, when the whole aggregated event gets to the first Process Model, the first operation is to store all the data in the BPO. As seen in the next figure, after storing the data, the model goes directly to the accountModel to check and to create, if needed, the billing entities. This process was already explained before in the Contract Publish business area.

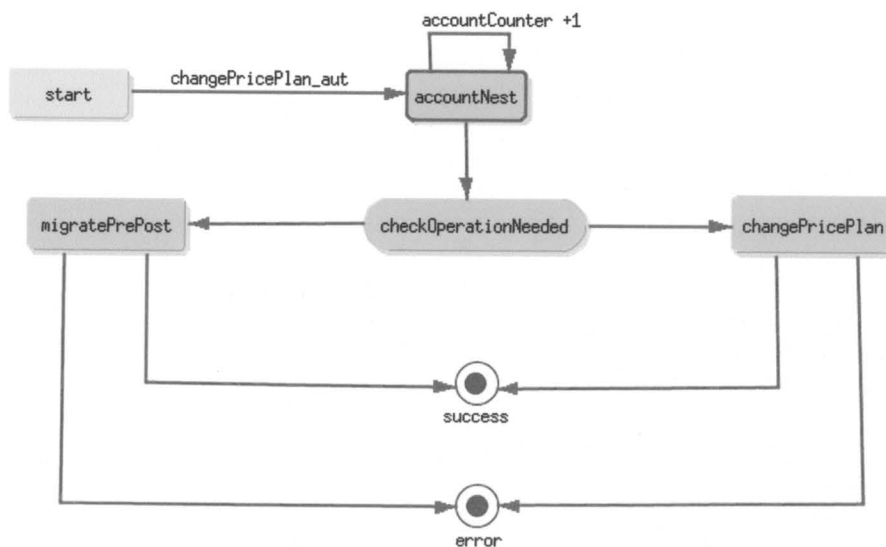


Fig 30: Screenshot of the pricePlanModel Process Model

As referred, and after the creation of the billing entities, this Process Model sends to the Billing application a ChangePricePlanEvent or a MigrateSubscriberEvent, depending on the

business request. The condition to send one or the other event is based on OrderId field. If it is set to "1", the event that gets sent is the ChangePricePlanEvent, and if it's set to "2" or "3", it's a MigrateSubscriberEvent that goes to the Billing application.

Finally, and depending on the answer got from the Billing application, the Process Model ends in the Success or the Error state. Also like Contract Publish, each time an action is made, a responseEvent is sent to the CRM application.

6 CONCLUSIONS

As it was already referred, this document is related with the work developed in the CRM Business Integration for the first six months of a one and a half year project. These six months covered the business analysis, the design and the implementation of the functionalities proposed by Accenture for this period, which were mainly two: first, to assure that the Client Hierarchy along with its network services (packages and features) were replicated correctly in the Billing application and the requested changes were always accomplished, in order to assure at least the minimum requirements for the "X-Mobile" to prepare itself for production, and second, to assure Portability, which will be one important way of the "X-Mobile" to get clients from its market competitors.

The processes that will support these functionalities were fully developed and implemented, as completely described in the section 5, and at the time this document was concluded, the Testing phase was beginning. This Testing phase is planned to take one month and it evolves according with the Accenture's V-Model Procedure, which is the testing procedure for all Accenture projects, as it is described in the section 2.2.

After all the testing is concluded for this first phase, a new phase will arise. This phase of the project, especially for the CRM Business Integration, will be a phase to redefine some processes regarding implemented solutions, and to progress on the integration with other business applications, mainly the Provisioning application.

In the redefinition of implemented processes, the main concern is performance. After the assurance given in the first phase that the developed processes were profitable solutions for the requested functionalities, performance arises as a priority to accomplish. Reducing the quantity of unnecessary data that gets published by the CRM application, and refining some processing are the main issues for the future.

Regarding the progress on the integration, the main issue is to accomplish that the orders sent by the CRM application have the same repercussion, both in the Billing and in the Provisioning applications. This pretends to assure that the CRM, the Billing and the network (Provisioning) are always correctly connected.

CRM Business Integration

Finally, the complete product of the whole BSS Implementation project made by Accenture will only be a reality when the "X-Mobile" telecommunications company enters into the market, and it is only then when the global project conclusions can be taken.

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8 APPENDICE

A. Glossary of terms and Abbreviations

In order to clarify the document, and to standardise the various naming conventions, the following notation was used:

- **FEUP** – Faculdade de Engenharia da Universidade do Porto;
- **BSS** – Business Support Systems;
- **OSS** – Operating Support Systems;
- **CRM** – Customer Relationship Management;
- **EAI** – Enterprise Applications Integration;
- **UMTS** – Universal Mobile Telecommunications System;
- **GPRS** – General Packet Radio Service;
- **BIM** – Business Integration Methodology;
- **GUI** – Graphical User Interface;
- **BPO** – Business Process Object;
- **ICP** – Instituto de Comunicações de Portugal.



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