

A Practical Approach to the Operation of Telecommunication Services driven by the TMF eTOM Framework

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Abstract

Nowadays, the gap between data communications and telecommunications disappears rapidly, which leads to augment of the complexity and size of supporting networks. This calls for the software developers to embrace a new way of developing management software. This is the impetus for the TM Forum's New Generation Operations Systems and Software (NGOSS) initiative. It aims to deliver a framework for rapid and flexible integration of Operation and Business Support Systems in telecommunications and throughout the wider communications industry.

The enhanced Telecom Operations Map (eTOM) is a key part of NGOSS. It plays an important role as a guidebook built on TM Forum Telecom Operations Map (TOM). The eTOM model describes the full scope of business processes required by a service provider and defines key elements and how they interact.

This thesis is aimed to the following objectives:

- Know the challenges a service provider or network operator have to face in order to provide services to their customers.
- Understand the role of eTOM in the context of the NGOSS framework and the benefits brought by its potential use by service providers.
- Know how to express the needs of service providers and network operators in terms of eTOM artefacts.

For this reason we undertook a set of activities that are reported in the memory as follows:

First of all it was necessary to understand eTOM in the context of NGOSS through the study of selected TMF documents. A summary of this learning phase is reported in Chapter 2.

In addition to the concept of eTOM we also wished to know up to which extend the work based on eTOM background was supported by design tools. Therefore we undertook a search activity in related business processes supporting tools that has been summarized in Chapter 3. Also part of this activity was the selection of the most appropriate ones in our current context.

In the remaining we focus into the design of a scenario representing the goals of a service provider and its solution in terms of business processes to be implemented according to the eTOM framework. Hence, in Chapter 4 we illustrate the important role of eTOM based on the business process supporting tools of Chapter 3. According to the scenario design, we are able to implement a solution that is presented in Chapter 4 as well.

Finally, Chapter 5 summarizes all the efforts and the achievement of this project. At the end, we also point out the development and future work in this area.

Keywords:

NGOSS eTOM Business Processes Service Management Operation
Support Systems

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1 General introduction

Nowadays, a plethora of service providers - communications, entertainment, applications, Internet service providers, etc - emerge with everyday newer products with the trend of combining data services and communication services. In order to have quick response and to be competitive in the current market, these companies have to base their organization and operations on a set of well defined and efficient business processes which is a collection of related, structured activities or tasks that produce a specific service or product for a particular customer. Moreover, in the current business scenarios there is an increasing need to make business establishing coalitions among different enterprises. This makes necessary a common view and understanding of business processes to allow for an efficient business to business cooperation.

Being aware of that needs, the Telemanagement Forum (TMF), an organization, promotes the Next Generation Operation Systems and Software (NGOSS). In short, NGOSS is a view of how the key actors of telecommunications have to manage their services. Constituted by four building blocs, namely the extended Telecommunications Operation Map (eTOM), the Shared Information and Data model (SID), the Telecommunication Neutral Architecture (TNA) and the Telecommunications Application Map (TAM), we will concentrate in the former because it provides a framework for business processes design and deployment. In fact, TMF aims that service providers utilize the Business Process Framework (eTOM) to analyze their existing business processes, identify redundancy or gaps in their current strategies, and re-engineer processes to correct deficiencies and add automation. Currently, eTOM is a well accepted and used standard in the industry which provides a map and common language of business process with different hierarchy. Based on the current hierarchy of the framework, it also enables to be used to invent processes at a service provider.

eTOM is a well documented de facto standard. More than ten documents describe it along with other white papers and guidelines. With the spirit to be generic enough to be applicable to any context, eTOM has then to be somehow interpreted to each real scenario. And this is not really straightforward. In fact, to use eTOM to describe the business processes of a company, it is necessary to gather a good understanding of the enterprise needs as well as a good understanding of the concepts laid down in the norm.

1.1 Thesis objectives and expected contribution

In line with the above paragraphs, this thesis is aimed to the following objectives:

- Know the challenges a given service provider has to face in order to provide services to their customers.
- Know how to express the needs of the service provider in terms of eTOM artefacts.
- Understand, in summary, the role of eTOM in the context of the NGOSS framework and the benefits brought by its potential use by service providers.

In this thesis, we will address the introducing background of NGOSS and eTOM Business Process Framework to provide an overview of the knowledge based on the research in TMF documents. The use of eTOM entails the manipulation of a lot of nested concepts. The eTOM processes are articulated in a tree-like structure through which is taught to move around unless a navigation tool is provided. The main aim of this browsing tool is similar to the Explorer in Windows. A search activity in related business processes supporting tools is carried out and introduced.

By utilizing the most appropriate ones in our current context, we will define a scenario to serve as the driving element of design and implementation based on eTOM Business Process Framework concepts. As one of the important sections in the thesis, we will present several supporting tools for business processes specification and assistant tools to implement the scenario.

The scenario will represent the needs of a specific service provider to offer their services. It will be identified according to a common current situation in the nowadays telecommunication market. The needs of this service & network provider are figured out, understanding the business processes defined in eTOM.

Last but not least, we pretend that the report coming out from that thesis project constitutes a complement to the official eTOM documents existing today for practitioners and students wishing to get closer to the eTOM concepts especially under the point of view of one of its potential applications.

1.2 Thesis structure

Due to the objective of this project, we undertook a set of activities that are reported in the memory as follows:

At the beginning, Chapter 1 General introduction is aimed to introduce the objective, contribution and the structure of this thesis, in order to provide an overall idea of this thesis.

Following with the main content, first of all, it was necessary to understand eTOM in the context of NGOSS through the study of selected TMF documents. A summary of this learning phase is reported in Chapter 2. It describes the background of NGOSS and eTOM which is a brief knowledge for the development, benefit and purpose of eTOM.

In addition to the concept of eTOM we also wished to know up to which extend the work based on eTOM background was supported by design tools. Therefore we undertook a search activity in related business processes supporting tools that has been summarized in Chapter 3. In order to accomplish the project and reach a clear presentation of the scenario implementation, the supporting tools play an important role in the whole thesis. At the same time of doing research on the Architecture of eTOM, before the scenario design, we made a search in the tool area which includes diverse tools. The selection of the most appropriate tools in our current context is one of the issues discussed in Chapter 3. It also describes the contribution of each tool in different areas and the comparison as well.

In the remaining, we focus into the design of a scenario representing the goals of a service provider and its solution in terms of business processes to be implemented according to the eTOM framework. According to the scenario design, we are able to implement a solution that is presented in Chapter 4. As for the scenarios, we focus on a case with a starting company called Media to implement on eTOM. This chapter is related not only to the design and filtering of all the existing processes from level 1 to level 3 according to different priorities, but also to creating and adjusting the processes in level 4 to move deeper in the eTOM Architecture.

Finally, Chapter 5 summarizes all the efforts made and the achievement of this project. At the end, we also point out the development and future work in this area. Inside the Appendix A, there are two mail parts. First part is the table listed all the eTOM processes from Level 1 to Level 3, and the second part relates to the process decomposition implemented in Chapter 4. It illustrates the eTOM navigation in the context of the supporting tool.

2 Background

2.1 NGOSS background

Nowadays the gap between data communications and telecommunications becomes blurred. There is a boom in the number of users along with the increasing diversity of services provided. This calls for the service provider to think over the way to manage their business. Evidently, the ability of current Operation Support Systems (OSS) to manage the information and communication networks is not able to meet the challenges of the above depicted scenario. Therefore, a new generation of OSS is a necessity to adapt the situation characterized by an increasing complexity and sophistication of services.

The TM Forum frameworks known as New Generation Operation Systems & Software (NGOSS) enable users to analyze their business operations against industry processes, applications and information standards. They also provide a framework to support the procurement, development and implementation of a comprehensive operations environment. *NGOSS is a set of guidelines and specifications for industry to build software in a more structured and complementary way based on industry experience and previous and ongoing TM Forum activities [1].* In this way, the problem is solved with the new generation OSS which enables to adopt the rapid emerging of new technology, the boom of users, and the increasing complexity of the networks.

The TM Forum's four foundational NGOSS frameworks include Business Process Framework (eTOM), Information Framework (SID), Integration Framework (TNA), and Application Framework (TAM). In the following paragraphs we present each of these key components [2].

The enhanced Telecom Operations Map (eTOM) is a guidebook built on TM Forum Telecom Operations Map (TOM). Currently, eTOM is the most widely used and accepted standard for business processes in the telecommunications industry. The eTOM model describes the full scope of business processes required by a service provider and defines key elements and how they interact. Among its advantages we can mention that it establishes a common vocabulary for both business and functional processes. The Framework enables to map the business processes into a language that all parts of an organization can understand, thus supporting a business-driven approach to manage enterprise processes. It also helps to identify and prioritize which operational areas are most critical to given business objectives.

The Shared Information/Data (SID) model can be viewed as a companion model to the eTOM, in that it provides an information/data reference model. If the eTOM helps to standardize the processes within telecommunications operations, then the Shared Information/Data (SID) model, also part of the NGOSS program, provides a common

vocabulary defining more than 1,000 industry standard business entities. The benefit of using the NGOSS SID and its common information language is that it enables business benefits relating to cost, quality, timeliness, and adaptability of enterprise operations, letting the enterprise (i.e. the service provider enterprise) to focus on creating value for its customers. SID and eTOM collaborate to illustrate how the business process works to contribute to the enterprises as a commonly accepted standard. In this procedure, SID plays a role to provide the definition which is to be affected by the business processes defined in the eTOM.

The Telecom Application Map (TAM) effectively provides a bridge between the NGOSS framework building blocks (eTOM and SID) and real, deployable, potentially procurable operational systems by grouping process functions and information into recognized Operation Support Systems (OSS) and Business Support Systems (BSS) applications or services. There can be no categorical solution in this area; the TAM provides a common frame of reference that allows suppliers, customers, and their partners who operate in this area to understand one another's viewpoints. From an integration perspective, TAM provides a canonical model of the underlying operational systems and provides generic endpoints for the business functions and processes defined within the eTOM. It builds on the success of the eTOM and SID which together with the TAM make up the heart of NGOSS [3].

The whole NGOSS picture is completed by the Technology Neutral Architecture (TNA) which leads to the physical implementation of Telecom Technology Solutions. Technology Neutral Architecture (TNA) is an architecture that is sustainable through the technology changes. The NGOSS TNA defines component-based, distributed system architecture and an associated critical set of system services [4].

Figure 2.1 illustrates the overview of the Tele Management Forum's NGOSS Framework. In our project, we focus only in the eTOM Business Process Framework.

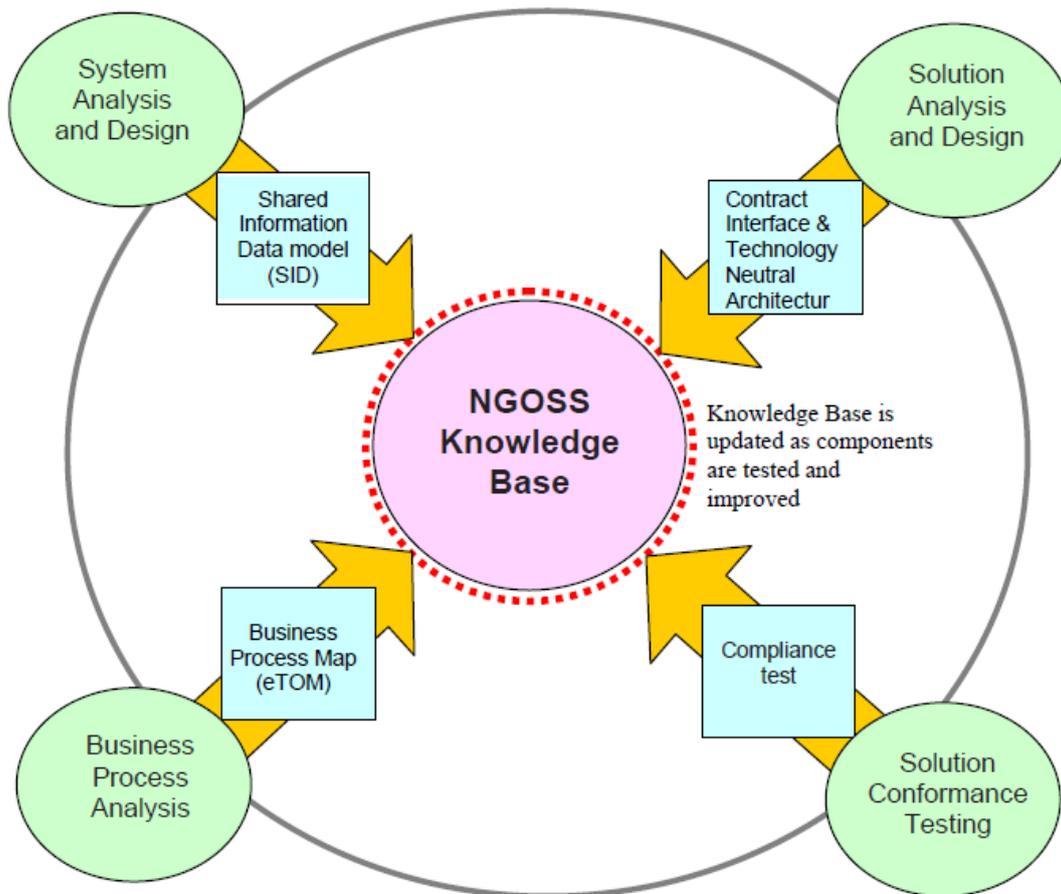


Figure 2.1: TM Forum NGOSS Framework

2.2 eTOM background

eTOM brings the industry with a common structure to define and share business processes, the Business Process Framework enables service providers and their suppliers to work together to understand the current state of business activities, identifying improvement, and define new processes to streamline their business. As it is the convergence of networks and services, there are enough challenges.

Service providers in many sectors simultaneously feel great competition growing customer expectations, fully market share, and increasing price pressures. As a result, they feel pressure to clearly define and understand the business processes they use to deliver convergent services in the competitive environment. All the members in the value chain need a business driven approach to managing their enterprises, if they are to develop the complete understanding of their customer ,that understanding depends on the OSS, vital to support their customers. Only by gaining this kind of understanding, can service provider integrate the OSS, and improve the enterprise among its own systems.

In order to provide a common process language that is open and flexible enough for all to use, the TM Forum Business Process Framework (eTOM) provides a reference

framework for categorizing all business activities at all levels of enterprises. The focus of the Business Process Framework are the business process the linkage among processes, the identification of interfaces and the use of customer, service, resource, supplier partner and other information by multiple processes.

The analysis of all phases of business processes makes the Business Process Framework a critical tool for improving ongoing development. In review where different processes deliver the same business functionality while the service providers can eliminate duplication, review gaps to improve process design. For suppliers and partners trying to identify category process used in business to business attraction, the Business Process Framework serves to assist relationship by identifying where the interdependence exists; the most efficiently deliver services to customers. For planner, manager and strategists, the Business Process Framework helps in the assessment of process structure, process component, process interactivity and the business roles in responsibility to which they rely. This assessment ability gives them advises for setting accurate requirement for solutions, technical architectures, technology choices and implementation tasks.

The Business Process Framework has been widely adopted in the current industry. According to the statement of one member, they reach the 50% faster time to market through using the process framework as the guarding principle for billing systems and product management. Another report indicates that a company has an amount of saving of 400,000 dollars per month by using the process framework. All of this is spotting the success of eTOM [5].

The eTOM Business Process Framework can serve as the blueprint of standardized business activities which helps the enterprise to set a starting point and future develop directions.

eTOM framework develops a scope addressing all enterprise processes.

- *It distinctly identifies marketing processes to reflect their heightened importance in an e-business world.*
- *It distinctly identifies Enterprise Management processes, so that everyone in the enterprise is able to identify their critical processes, thereby enabling process framework acceptance across the enterprise.*
- *It brings Fulfillment, Assurance and Billing & Revenue Management (FAB) onto the high-level framework view to emphasize the customer priority processes as the focus of the enterprise.*
- *It defines an Operations Support & Readiness vertical process grouping that relates to all the Operations functional layers. In integrating e-business and making customer self-management a reality, the enterprise has to understand the processes it needs to enable for direct and (more and more) online customer operations support and customer self-management.*
- *It recognizes three process groupings within the enterprise that are distinctly different from operations processes by identifying the SIP processes, i.e., Strategy*

& Commit, Infrastructure Lifecycle Management and Product Lifecycle Management.

- *It recognizes the different cycle times of the strategy and lifecycle management processes and the need to separate these processes from the customer priority operations processes where automation is most critical. This is done by decoupling the Strategy & Commit and the two Lifecycle Management processes from the day-to-day, minute-to-minute cycle times of the customer operations processes.*
- *It moves from the older customer care or service orientation to a customer relationship management orientation that emphasizes customer self-management and control, increasing the value customers contribute to the enterprise and the use of information to customize and personalize to the individual customer. It adds more elements to this customer operations functional layer to represent better the selling processes and to integrate marketing fulfillment within Customer Relationship Management. Note that Customer Relationship Management within the eTOM framework is very broadly defined and larger in scope than some definitions of CRM.*
- *It acknowledges the need to manage resources across technologies, (i.e., application, computing and network), by integrating the Network and Systems Management functional process into Resource Management & Operations. It also moves the management of IT into this functional layer as opposed to having a separate process grouping.*
- *It recognizes that the enterprise interacts with external parties, and that the enterprise may need to interact with process flows defined by external parties, as in e-business interactions [6]*

2.2.1 eTOM introduction

The eTOM is a Business Process Framework, but not a service provider business model. Since it doesn't focus on the strategic issues to give a marketing point of view for the enterprise, it can not be a so called business model. However, it can be treated as an essential part in the strategic business model which provides the detailed processes that the enterprise needs to follow.

The eTOM framework is consisted of different horizontal and vertical process areas. Figure 2.2 shows the highest conceptual view of eTOM framework. As it can be appreciated, there are two main vertical slices, namely Strategy, Infrastructure & Product in one hand and Operations in the other, with four functional horizontal layers across. In addition, there is another main area called Enterprise Management in the bottom of the diagram. Customer, Suppliers/Partners and other relevant external actors are shown in that picture. eTOM is better regarded as a Business Process Framework, rather than a business process model, since its aim is to categorize the process elements and business activities so that these can then be combined in many different ways, to implement end-to-end business processes (e.g. Fulfillment,

Assurance, Billing & Revenue Management) which deliver value for the customer and the service provider.

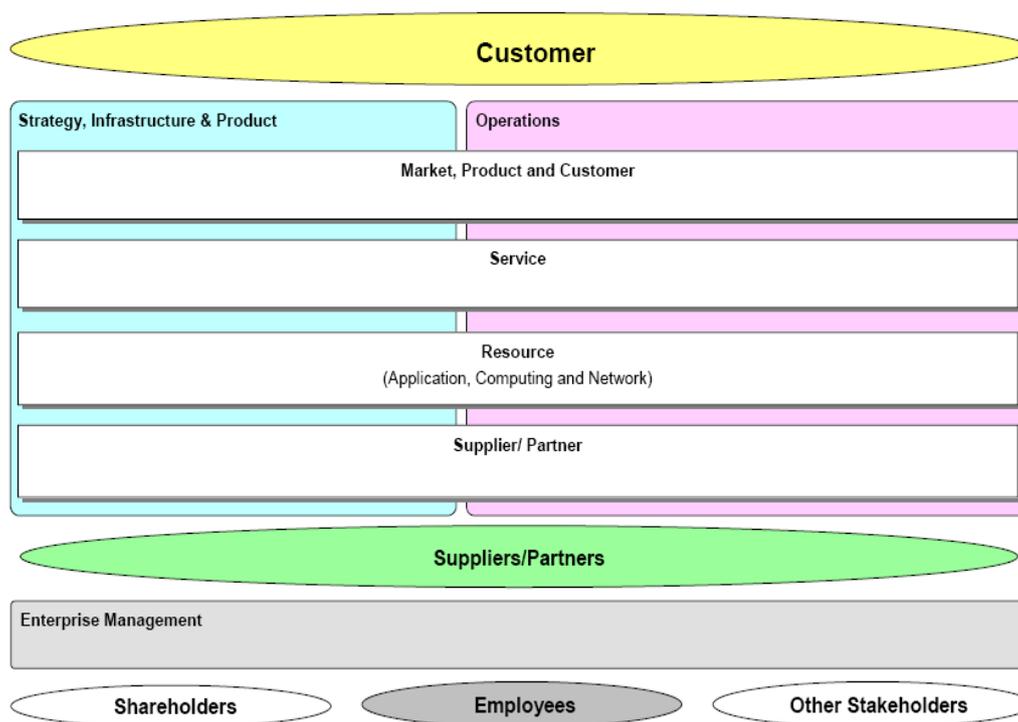


Figure 2.2: Conceptual overview of eTOM framework

The eTOM work undertaken by the TMF has potential to develop further, in areas such as lower-level process decompositions and flows, applications in specific areas of business, guidelines and assistance in using the eTOM framework, cost and performance issues associated with the processes, etc. In addition, ongoing feedback from the industry, together with its linkage with the wider NGOSS program, can be used to guide future priorities for continuing work. It should be noted that the development of a full process framework is a significant undertaking, and the work must be phased over time based on member process priorities and member resource availability. This effect is visible in eTOM's history, from the early work on a business process map that carried through to the eTOM framework itself, broadening along the way to a total enterprise framework and the current Release.

The TM Forum initially identified business processes as a consensus tool for discussion and agreement among service providers and network operators. This encouraged convergence and general support for a broad common base in this area, which has been built on and extended with the eTOM framework, to enable:

- Focused work to be carried out in TM Forum teams to define detailed business requirements, information agreements, business application contracts and shared data model specifications (exchanges between applications or systems) and to review these outputs for consistency
- Relating business needs to available or required standards

- A common process view for equipment suppliers, applications builders and integrators to build management systems by combining third party and in-house developments

The anticipated result is that the products purchased by service providers and network operators for business and operational management of their networks, information technologies and services will integrate better into their environment, enabling the cost benefits of end-to-end automation. Furthermore, a common industry view on processes and information facilitates operator-to-operator operator-to-customer and operator-to-supplier/partner process interconnection, which is essential for rapid service provisioning and problem handling in a competitive global environment. This process interconnection is the key to e-business supply chain management in particular.

The eTOM work also provides the definition of common terms concerning enterprise processes, sub-processes and the activities performed within each. Common terminology makes it easier for service providers to negotiate with customers, third party suppliers, and other service providers.

2.2.2 Benefits of using the eTOM framework

The ability to utilize a standard set of telecommunication industry processes covering all operational areas is an increasing requirement from Telecommunication customers. The eTOM framework fills this need by providing a real solution for cycle time reduction, improved customer satisfaction and overall operational efficiency resulting in long-term revenue growth. There are several main benefits of using the eTOM framework:

- *It makes available a standard structure, terminology and classification scheme for describing business processes and their constituent building blocks*
- *It supplies a foundation for applying enterprise-wide discipline to the development of business processes*
- *It provides a basis for understanding and managing portfolios of IT applications in terms of business process requirements*
- *Its use enables consistent and high-quality end-to-end process flows to be created, with opportunities for cost and performance improvement, and for re-use of existing processes and systems*
- *Its use across the industry will increase the likelihood that off-the-shelf applications will be readily integrated into the enterprise, at a lower cost than custom-built applications [6]*

2.2.3 Purpose of the eTOM Business Process Framework

Traditionally, telecommunication service providers supply the end-to-end services. Therefore, a single enterprise controlled the entire value chain; if necessary it can be interconnected with other service providers. Nevertheless, in the liberalized market,

service providers, for example the internet service providers need to cope with the situation of an increasing numbers of customers, and at the same time, provide superior and competitive services to the customer. Thus, they keep expanding their markets and business relationship.

Service Providers face very different environments and their business strategies and approaches to competition are quite distinct, nevertheless they share several common characteristics:

- *Heavily dependent upon effective management of information and communications networks to stay competitive*
- *Adopting a service management approach to the way they run their business and their networks*
- *Moving to more of an end-to-end Process Management approach developed from the customer's point of view*
- *Automating their Customer Care, Service and Network Management Processes*
- *Need to integrate new BSSs/OSSs with legacy systems*
- *Focusing on data services offerings*
- *Focusing on total service performance, including customer satisfaction*
- *Integrating with current technology and new technologies*
- *Emphasizing more of a “buy” rather than “build” approach that integrates systems from multiple suppliers [6]*

There are two ways for the service providers to run their business, one is to operate their own network or information technology infrastructure; the other is to outsource some part of their business. All of these ways cast influence on the service quality and cost issues which have a direct relationship with the customers. Therefore, no matter they are communication service providers, application providers or internet provider in any phases of their business, from the very beginning to the growth of the enterprise, there is an intensive drive to enable end-to-end process automation of the business and operations processes in the information and telecommunication areas.

In this case, we are able to move from a manual-intensive, inconsistent, inflexible environment to one that provides significant improvement in customer focus, service quality, unit cost, and time to market. eTOM is a well integrated standardized framework which also allows specific case to be applied. Based on the specification, the framework enables to be customized to meet the diverse needs of the service provider during implementation in specific cases.

There are some major goals of applying eTOM. First of all, it captures consensus industry agreements on reference business process structure and decompositions (i.e. the “static” process view) down to an appropriate level. Secondly, it applies these in typical business scenarios to show process flows in which these process elements are used (i.e. the “dynamic” process view). Moreover, it recommends methodologies that

assist users to extend eTOM in their own applications to include local process details. Finally, it also gathers results from all this to validate the core eTOM model and approach.

eTOM is an 'industry standard' Business Process Framework which provide a common definition to describe process elements of a service provider. The framework depends closely on the information and telecommunication industry agreement to identify the priority of the processes and interfaces in integration and automation. Service providers are in need of this standardized framework to run their business effectively and efficiently. In an e-business environment, it is essential to have a common understanding and using of process, especially in the current market with the boom of the number of customers and the increasing complexity of the services and network.

2.3 eTOM architecture

eTOM is the most widely used and accepted standard for business processes in the communications industry. It delivers a business process model/framework for use by service providers and others organizations within the communications and related sectors industry. It describes the full scope of business processes and provides a commonly used business language for the whole industry to enable compatibility. The Business Process Framework can serve as a tool to analyze the existing process, by assessing the value, cost and performance of these processes. With the review the existing processes, it enables the service providers to eliminate duplication where different processes deliver the same business functionality, thus leading to cost saving. The Business Process Framework can find missing steps in process and simplify procurement, serving as a common language between service providers and suppliers.

The highest conceptual view of the eTOM framework was showed in Figure 2.2. In the upper two major boxes in the diagram, it provides an overall context that differentiates strategy and lifecycle processes from the operations processes in two large process areas. The key functional areas horizontally lay across these process areas. Moreover, the third major process area, concerned with management of the enterprise itself, is shown as a separate box in the lower part of the diagram with different interfaces. In addition, Figure 2.2 also shows the internal and external entities that interact with the enterprise such as customer, suppliers/partners, shareholders, employees and other stakeholders.

After the conceptual overview of the eTOM architecture, there is a need to dedicate into deeper levels of eTOM framework to master the mechanism of utilizing eTOM to solve problems.

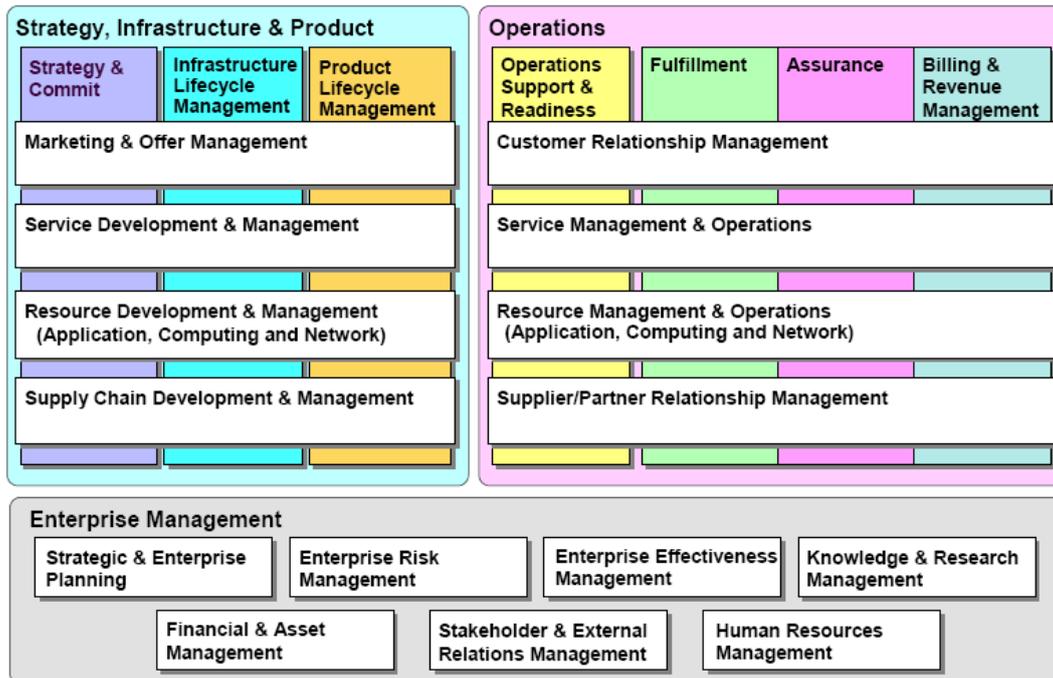


Figure 2.3: eTOM Business Process Framework - Level 1 processes

Thus, Figure 2.3 illustrates how the three major process areas – designated as Level 0 processes of the eTOM Business Process Framework - are decomposed into their constituent Level 1 process groupings. This view thus provides the Level 1 decomposition of the Level 0 processes and gives a more detailed overall view of the eTOM framework. However, in practice it is the next level – the Level 2 decomposition of the Level 1 processes - at which we tend to work, as this degree of detail is needed in analyzing the specific businesses. Later in the thesis, there will be a series of diagrams examining one of the main parts of the framework according to our scenarios.

Figure 2.3 also shows seven vertical process groupings. They are the end-to-end processes which play a role as a support for customers to manage the business. Among these vertical process groupings, operations processes of Fulfillment, Assurance and Billing & Revenue Management (FAB) are the most crucial part in the eTOM framework.

- Fulfillment

This vertical end-end process grouping is responsible for providing customers with their requested products in a timely and correct manner. It translates the customer's business or personal need into a solution, which can be delivered using the specific products in the enterprise's portfolio. This process informs the customers of the status of their purchase order, ensures completion on time, as well as ensuring a delighted customer [6].

- Assurance

This vertical end-end process grouping is responsible for the execution of proactive and reactive maintenance activities to ensure that services provided to customers are continuously available and performing to SLA or QoS performance levels. It performs continuous resource status and performance monitoring to proactively detect possible failures. It collects performance data and analyzes them to identify potential problems and resolve them without impact to the customer. This process manages the SLAs and reports service performance to the customer. It receives trouble reports from the customer, informs the customer of the trouble status, and ensures restoration and repair, as well as ensuring a delighted customer [6].

- **Billing & Revenue Management.**

This vertical end-end process grouping is responsible for the collection of appropriate usage records, determining charging and billing information, production of timely and accurate bills, for providing pre-bill use information and billing to customers, for processing their payments, and performing payment collections. In addition, it handles customer inquiries about bills, provides billing inquiry status and is responsible for resolving billing problems to the customer's satisfaction in a timely manner. This process grouping also supports prepayment for services [6].

Operations Support & Readiness (OSR) is differentiated from FAB real-time processes. It highlights the focus on enabling support and automation in FAB, i.e. on-line and immediate support of customers, with OSR ensuring that the operational environment is in place to let the FAB processes do their job. Outside of the Operations process area - in the Strategy, Infrastructure & Product (SIP) process area - the Strategy & Commit vertical, as well as the two Lifecycle Management verticals, are differentiated. These are distinct because, unlike Operations, they do not directly support the customer, are intrinsically different from the Operations processes and work on different business time cycles.

The horizontal functional process groupings in Figure 2.3 distinguish functional operations processes and other types of business functional processes, e.g., Marketing versus Selling, Service Development versus Service Configuration, etc. Among these Horizontal Functional Process Groupings, those on the left enable, support and direct the work in the Operations process area.

Many process groupings within Enterprise Management (see Figure 2.3) will contain elements that relate to both policy setting and support of the enterprise. For example, Human Resources Management is concerned with both strategy and direction as well as supporting the management of Human Resources throughout the enterprise. These processes are sometimes collectively considered as the “corporate” functions and/or processes.

According to this project, we only consider the FAB crossed with the four horizontal groupings functional process in Level 1, Customer Relationship Management (CRM), Service Management and Operations (SM&O), Resource Management and Operations (RM&O) and Supplier/Partner Relationship Management (S/PRM).In

deeper levels, we will make a process selection based on the need of the processes and carry out analysis.

From the Level 0 to Level 5 of eTOM framework, there are different manifestations and functionality for each level. There is a brief introduction to the different levels of the framework (shows as Figure 2.4).

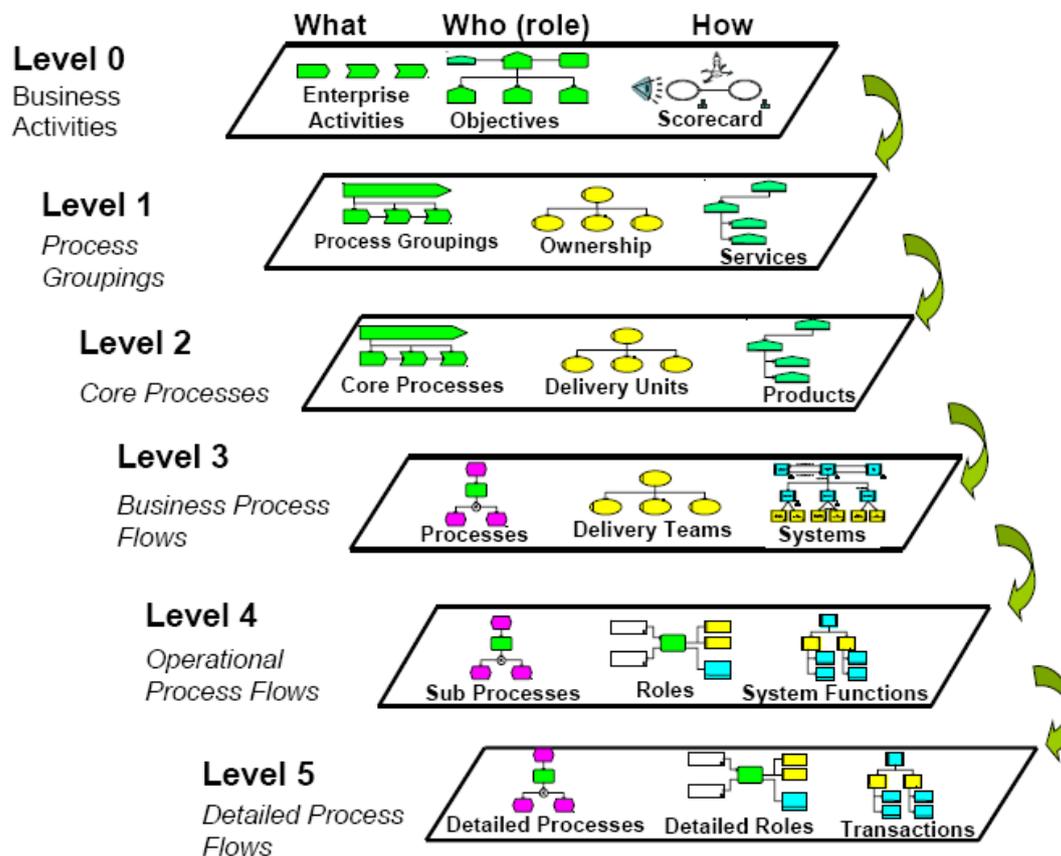


Figure 2.4: Process hierarchy

- Level 0 Business Activities

Identify and model: business objectives, value streams, environmental and fiscal constraints; develop balanced scorecard and product lines. These are the business goals that process and systems solutions must deliver [7].

- Level 1 Process Groupings

Design: product structure, product delivery and support process chains, enterprise-level data model, organizational structure. Identify business knowledge. This is the functional structure that delivers your business [7].

It refines the Level 0 entities, such as operations, into more specific functional areas, such as Customer Relationship Management (CRM), service management, and resource management.

- Level 2 Core Processes

Identify industry standard reference models; develop: generic processes, process hierarchy; identify and model business data definitions, system structure; define business roles. Processes are the key to delivering business objectives [7].

It provides a further level of decomposition into specific processing areas, such as order handling or loyalty retention.

- Level 3 Business Process Flow

Design detailed processes; assign business roles; identify supporting systems, data flows. Map business data models to systems data models. Consider failure paths; queues and bottlenecks. The detail is essential to ensure every action adds value to the business (which means to the customer) or is an essential requirement [7].

It defines the process flows of the Core Processes defined at Level 2, such as issuing customer orders, authorizing credit, and tracking order handling. As the thesis introduced in Chapter 3, the supporting tool we select to use provides the processes only until Level 3.

- Level 4 Operational Process Flow

Develop detailed sub-process design; define operational roles; link processes to written procedures; identify detailed systems, equipment and resource usage [7].

It defines in more detail the business process flows which should base on the specific case of the enterprises. Normally there is no more standardized process in the eTOM framework; the main task is to create the processes in Level 4 according to the scenarios and problems emerged in the enterprises.

- Level 5 Detailed Process Flow

Deliver the process flow automatically through workflow systems, e-business solutions and systems development. Link process and data models to systems and software development environments [7].

It defines in more detail the operational process flows defined at Level 4.

From the perspective of process hierarchy, the Level 0 and Level 1 can be integrated as business level whereas Level 2 and Level 3 are process level and Level 4 and Level 5 are operations level. In our project, Level 5 was not taken into account by the implementation of the scenarios. We will work on the framework until Level 4. It already enables us to go through all the business, process and operations levels to develop our scenarios.

3 Supporting tools for business processes specification

In order to carry out the design of the business processes and flows that a service provider has to instrument, there is a need of supporting tools with the functionality to demonstrate the entire framework and assist to implement the project. At the beginning phase of this project, we devoted effort looking at supporting tools to lead a bright way to the ultimate objectives. This chapter summarizes the search we did on tools that could be useful for the above purpose

The supporting tools for business processes specification are in need to implement the scenario design. According to different functionality of these tools we will introduce later, we divide them into three groups:

- Ad hoc business process design tools (Casewise, ARIS, Enterprise Architect)
- Data structuring tools (MG-SOFT, ArcheTOM)
- Assisted drawing tools (Visio)

3.1 Casewise

The core of the eTOM work is the eTOM Framework, and associated artifacts such as process flows, all of which need to be captured and managed in a process analysis and design tool environment.

Casewise [8] is able to support eTOM from the point where a process analysis tool was needed to handle the expanding scope and detail of the eTOM Framework Model. Corporate Modeler [9] is used for the development of the eTOM Framework, and the resulting Model is made available for use within a wide variety of other tools and environments.

The eTOM work has benefited from the consistency and control that tool-based modeling provides. It has also been possible to evolve to use the variety of publishing options in Corporate Modeler to deliver a document output that follows past practice when the core eTOM development was document-based. This has allowed continuity for the huge variety of users for the TM Forum output, as well as allowing easy options for delivery of other types of artifact, such as browser-based web information.

Corporate Modeler is the easy-to-use visual modeling tool at the heart of the Corporate Modeler Suite. By linking together organizational, process, IT architecture and data technology modeling through dynamic object linking, the tool enables teams to capture and understand the relationships between people, processes and technology. Through this multi-dimensional view, users can highlight the impact of change, find

and eliminate inefficiencies, identify and rollout best practices and implement IT solutions that truly support an enterprise.



Figure 3.1: Corporate Modeler, repository-based business process modeling

Repository-based business process modeling and analysis tool in the Casewise Corporate Modeler Suite, as the Figure 3.1 shows, supports various business process modeling notations, approaches, and methodologies as eTOM, to allow users to define and map visual representation of an organization's strategy, plans, and goals, and the business processes required to support these goals.

This tool is extensible to support a wide-range of methodologies and frameworks. It provides a very capable repository that supports team development and interaction, and Web publishing of models. It also has a very intuitive and rich visual modeling environment.

Casewise offers different frameworks, templates, models, and guidance that organization can use to jump start a range of enterprise architecture projects using Corporate Modeler. These visualized frameworks provide a "holistic" project management vision that can be modified to meet the user's requirements. In addition, templates can be integrated and used in other models providing standardized objects types and artifacts, bringing consistency throughout modeling and documentation projects. Moreover, Corporate Modeler is highly extensible, allowing organizations to modify existing frameworks, or create new ones, to suit their specific needs. Accordingly, the toolset ships with the Casewise Framework – a step-by-step guide to creating enterprise architecture models based on the Zachman Framework, ITIL Best Practice Framework, ArchiMate Framework, eTOM, etc.

A full featured license for one user costs about 11000 Euros whereas for universities they offer 20 licenses for 1500 Euros.

3.2 ARIS

The software and consulting company IDS Scheer [reference the web site] is a provider of business process management related products and consulting services. IDS Scheer develops Business Process Management solutions for corporations and public authorities.

With its ARIS Platform [10] provided by IDS Scheer for Process Excellence, the company offers integrated and complete software tool portfolio for strategy, design, implementation and controlling of business processes and enterprise architecture management approaches.

ARIS Platform supplies integrated software products which help enterprises to continuously improve their business processes. These products cover every phase of a BPM (Business Process Management) project—from strategy definition and process design to transferring the models into IT systems and monitoring process execution.

However, tapping into improvement potential as part of a BPM project should not be a one-time activity. Over the mid-term, only continuous BPM can yield sustained competitive advantages, which is why ARIS also supports the process of Business Process Management itself.

Based on IDS Scheer's approach to BPM projects, the ARIS Platform products are assigned to four specialized modules:

- ARIS Strategy Platform: For defining business strategies, implementing them in operational processes, and performing continuous monitoring of target systems which includes ARIS Business Optimizer, ARIS Balanced Scorecard, etc.
- ARIS Design Platform: For distributed modeling, simulation, optimization, and publishing of business processes and managing IT architectures which includes ARIS Business Architect, ARIS Business Designer, ARIS Business Simulator, etc.
- ARIS Implementation Platform: For executing process models in IT systems, configuring SAP systems, managing business rules, and creating service-oriented architectures which include ARIS UML Designer, ARIS Business Rules Designer, etc.
- ARIS Controlling Platform: For dynamic monitoring of current business processes and establishing an enterprise-wide compliance management system which includes ARIS Process Performance Manager, ARIS Process Event Monitor, etc.

IDS Scheer has developed an ARIS reference model based on Information Technology Infrastructure Library (ITIL) to document, analyze, and implement IT processes. For companies wanting to align their IT processes with ITIL, ARIS ITIL offers a customizable graphical reference model and user-friendly modeling and analysis environment. After carefully research, there is no existing special eTOM

method or method content in ARIS. However it is possible to use the standard ARIS Model types to describe eTOM content, the ITIL content is compatible with eTOM to some extent.

In addition, ARIS offers several ways to model processes, with each method applying semantics that enforce process integrity. We can model the process flow, process rules, actor, systems, inputs and outputs, and other resources needed in the process.

Processes are defined using ARIS Business Architect or ARIS Business Designer – graphical design tools for modeling and documenting business processes, organizational views, and data. Users can also describe process models in text format. Only if models meet certain requirements are they processed further by other ARIS components, such as ARIS Business Simulator or ARIS Business Optimizer.

ARIS supports over 150 notations for modeling processes, data, systems, organizations, products, and services. Users can also create own-defined, tailored notations and frameworks, such as eTOM framework needed in our project. This is accomplished using the ARIS Configuration component, which provides facilities for configuring ARIS Business Architect and ARIS Business Designer to meet organizational and end-user needs. For example, by using special configuration functionality and by creating the appropriate filters, end-user organizations can adapt the ARIS Methodology to special requirements (for example, to rename model types, object types, symbols, attribute type groups, etc.). Figure 3.2 shows a Business Process Modeling Notation (BPMN)-Model, which is available in ARIS as an additional modeling notation.

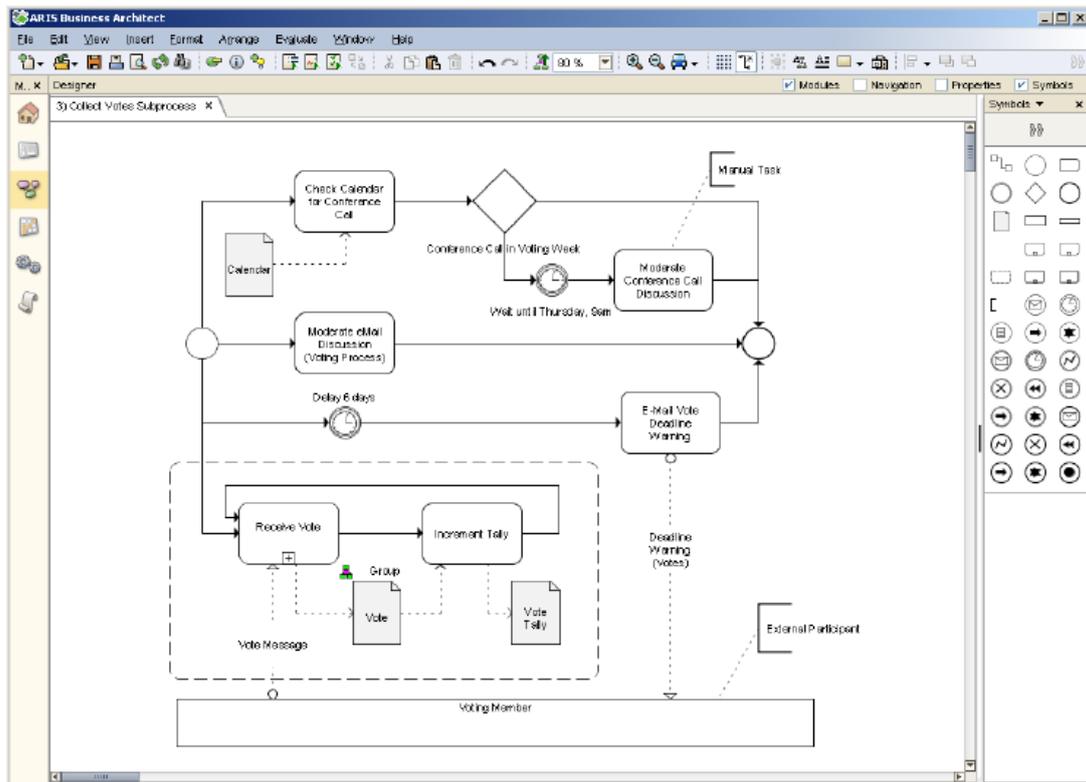


Figure 3.2: BPMN Model in ARIS business architect

Besides, ARIS provides a drill-down capability for representing and managing sub processes. Through this, we are able to undertake eTOM framework and deal with the decomposition into deeper levels.

As for the price of license scheme, ARIS Business Architect costs 650 Euros, whereas ARIS Business Designer costs 260 Euros, and ARIS Business Server with an amount smaller than 235 users cost 790 Euros.

Since we are not able to implement the eTOM infrastructure directly with this tool, even though there are diverse advantages, we still prefer to carry out our scenario on other tools which is mentioned in rest of the thesis.

3.3 Enterprise Architect

Enterprise Architect [11] is a Computer Aided Software Engineering (CASE) tool for designing and constructing software systems, for business process modeling, and for more generalized modeling purposes.

This Unified Modeling Language (UML) tool is based on the latest UML 2.1 specification. UML defines a visual language that is used to model a particular domain or system.

Enterprise Architect is a progressive tool that covers all aspects of the development cycle, providing full traceability from the initial design phase through to deployment and maintenance. It also provides support for testing and change control.

With EA we can:

- Model business processes with industry standard UML (shows as following Figure 3.3)
- Easily take advantage of the Business Process Modeling Notation (BPMN)
- Model processes, information flows and data stores
- Manage requirements at a very detailed level
- Take advantage of UML Profiles for business process modeling
- Reverse engineer legacy code and database models
- Produce great looking reports in standard RTF and HTML format (shows as following Figure 3.4)
- Connect business process model to use case and software design models for end to end traceability. Hierarchy window is a most useful and versatile traceability tool which can present a model to enable traceability.

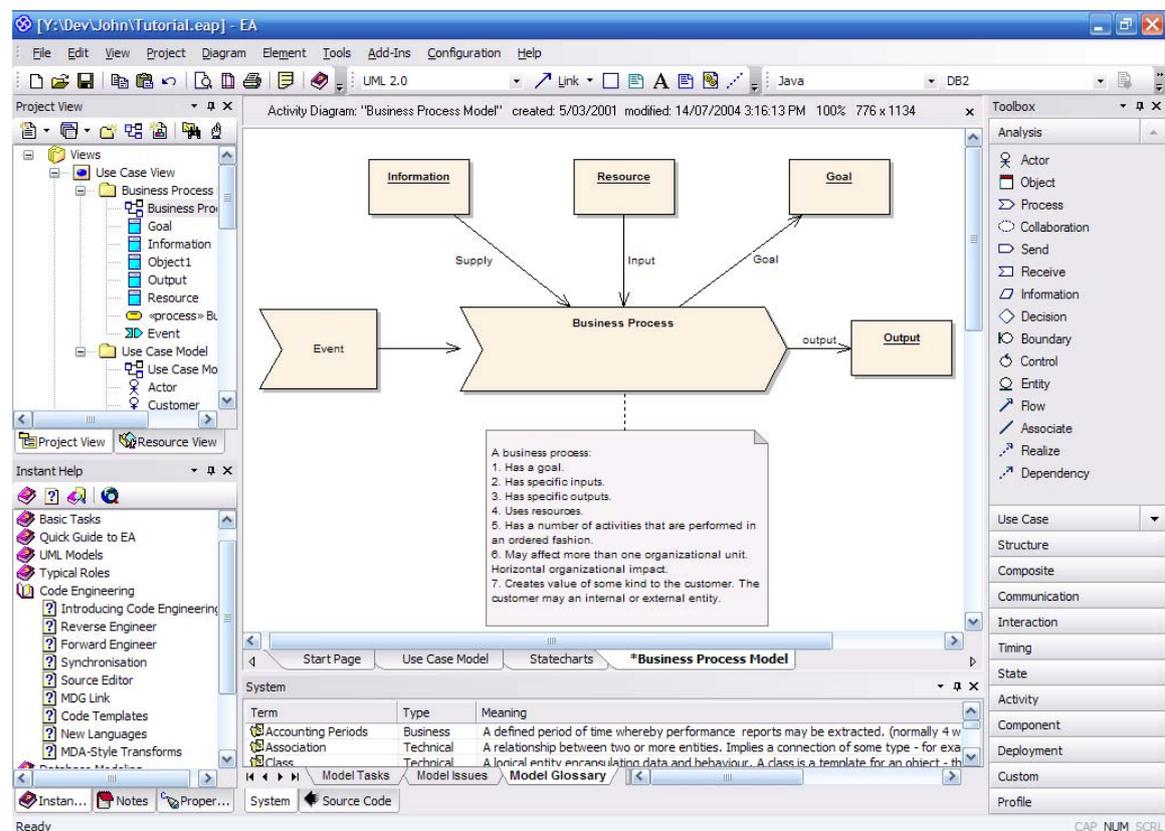


Figure 3.3: Business Process Modeling

Business Process Modeling is the discipline of defining and outlining business practices, processes, information flows, data stores and systems. BPM often involves using a notation such as UML to capture graphical representations of the major

processes, flows and stores. Utilizing this function of Enterprise Architect, we are able to build our eTOM Business Process Framework and personalize the processes according to different scenarios.

The Business Process Modeling Notation (BPMN) is a standard for business process modeling, and provides a graphical notation for specifying business processes in a Business Process Diagram (BPD), based on a flowcharting technique very similar to activity diagrams from Unified Modeling Language (UML). The objective of BPMN is to support business process management for both technical users and business users by providing a notation that is intuitive to business users yet able to represent complex process semantics. The BPMN notation is specifically targeted at the business modeling community and has a relatively direct mapping to UML through BPMN Profiles integrated with the Enterprise Architect installer. Through use of these profiles, Enterprise Architect enables you to develop BPMN diagrams quickly and simply. The BPMN facilities are provided in the form of:

- A BPMN diagram type, accessed through the New Diagram dialog
- BPMN pages in the Enterprise Architect UML Toolbox
- BPMN element and relationship entries in the UML Toolbox Shortcut Menu and Quick Linker

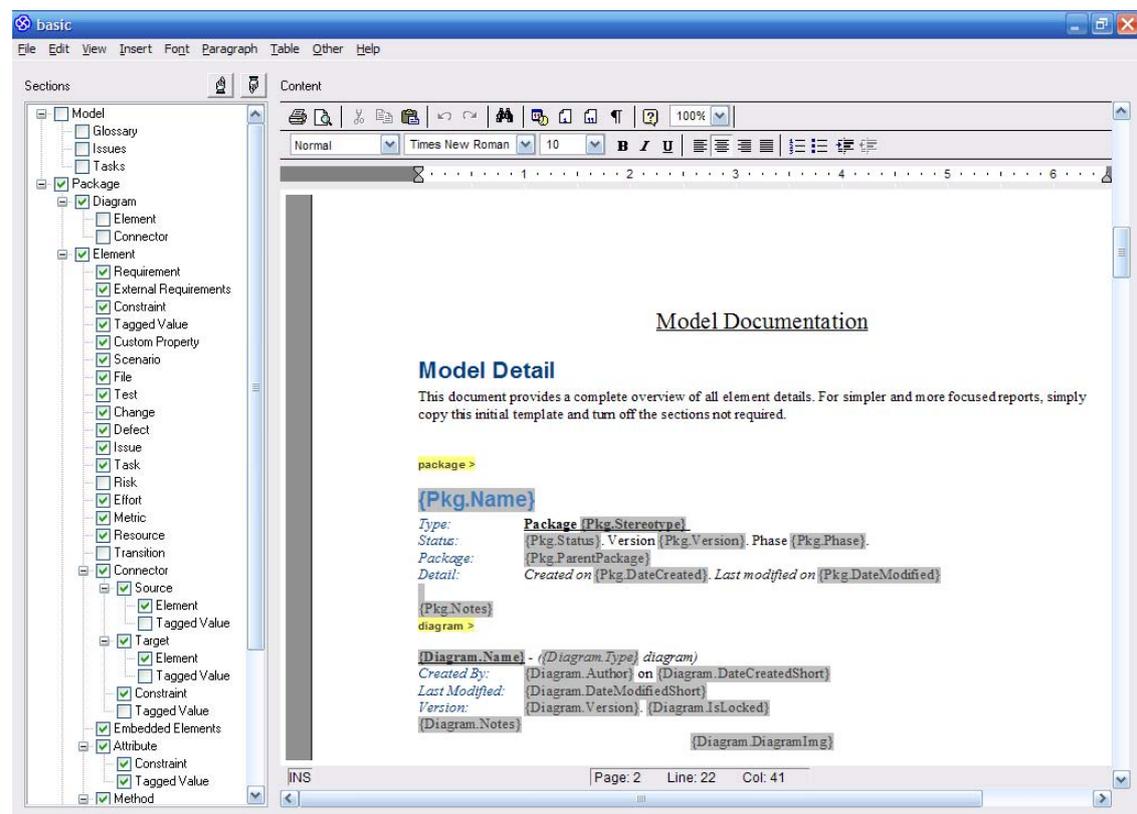


Figure 3.4: RTF template editor

After the investigation on Enterprise Architect license scheme, we achieve the Table 3.1 as below to show the price especially for Academic License:

Academic License	Price: Standard / Floating
Enterprise Architect Ultimate Edition	US \$349 / US \$424
Enterprise Architect Systems Engineering Edition	US \$299 / US \$399
Enterprise Architect Business & Software Engineering Edition	US \$299 / US \$399
Enterprise Architect Corporate Edition	US \$119 / US \$168
Enterprise Architect Professional Edition	US \$105
Enterprise Architect Desktop Edition	US \$65

Table 3.1: Price scheme for academic license

According to the above functionality, we can conclude that EA is an appropriate tool supporting modeling and design based on the eTOM framework. Nevertheless, it's more sophisticated and superfluous according to the objective of our project.

3.4 MG-SOFT

MG-SOFT MIB Browser with MIB Compiler is a toolkit intended to design and test SNMP-based management tools. Particularly, it allows building management information bases (MIB) compliant with the different SNMP standards and to browse through their respective implementations.

Although the use of a tool intended for low level network management may appear inappropriate to describe high level business processes, it is not less true that a SNMP MIB is a hierarchical data structure as the eTOM framework is also a hierarchical processes structure. In that sense, we understood that tools to build MIBs and browse MIBs could also be used to represent processes.

As the Figure 3.5 shows, MG-SOFT [12] has a user-friendly interface, through which, we are able to instantiate the eTOM framework.

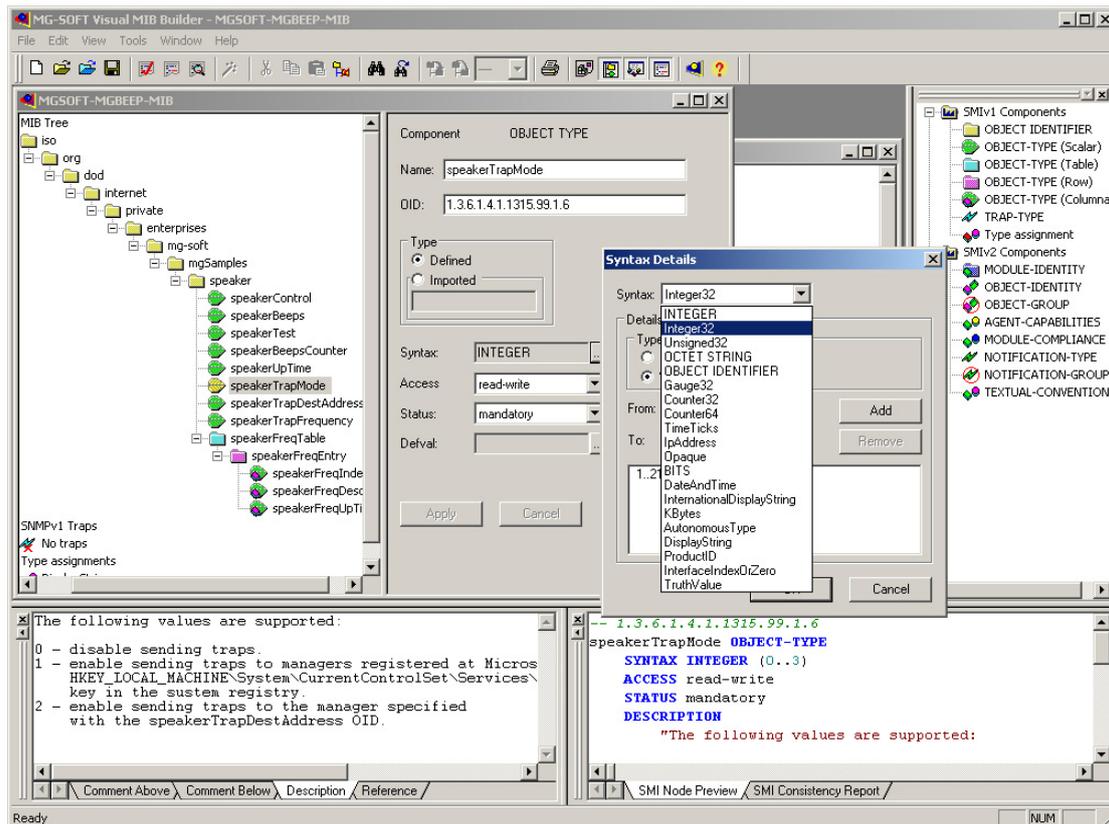


Figure 3.5: MG-SOFT visual MIB builder (Main window)

Making full use of this point mentioned above, we are able to build a roadmap with different hierarchy and objects based on eTOM framework. In order to have a clear view of the entire eTOM framework, as for the supporting research phase of the project, we decided to build part of the eTOM framework by means of the MG-Soft MIB Builder. Through this, we would be able to move around with navigation like the MG-Soft MIB Browser.

First of all, the MIB Tree is built according to the eTOM framework which includes the three parts as Operations (OPS), Strategy, Infrastructure & Product (SIP) and Enterprise Management (EM). Then, both the OPS and SIP parts have vertical and horizontal sections which are cross laid in the eTOM framework Level 1. Finally, the objects represented with the icon of a leaf play an important role in the business process detail description. Figure 3.6 shows how the tree-like structure built with MG-SOFT tools is able to provide the functionality of browsing and navigation. It enables us to deal with the eTOM framework at different levels to cover the appropriate business process. In this figure, we will instantiate the whole eTOM framework in Level 1.

MG-SOFT Visual MIB Builder for Windows, Standard Edition for single user license costs about 1500 US dollars. In this project, we make full use of the existing supporting tools to assist to understand and navigate the framework.



Figure 3.6: Hierarchy diagram by MG-SOFT

3.5 ArcheTOM

ArcheTOM productivity software is a tool specialized in eTOM Business Process Framework issued by ArchiTelco and TM Forum. ArchiTelco stands for “Telco Architecture”. It was created in January 2003 as an open association of Telecoms industry experts. ArchiTelco [13] is constantly involved in activities carried out by various industry and participates in numerous ongoing projects related to the definition of ICT standards, methodologies and architecture models, such as those published by the TM Forum, the Open Group, the IT Service Management Forum (ITSMF), European Telecommunications Standards Institute (ETSI), the Software Engineering Institute (SEI), the IT Governance Institute (ITGI) and so on.

As for the tool, ArcheTOM provides an information repository that follows the structure of the eTOM Business Process Framework. It provides a user-friendly, ergonomic and simple graphical user interface (GUI) which allows designing and developing business process architecture across 8 different process decomposition levels. ArcheTOM provides a facility to integrate heterogeneous data formats into each and all of its defined process elements.

ArcheTOM is a productivity tool which contributes to the interpretation and implementation of different scenarios based on eTOM framework. As the Figure 3.7 shows as following, ArcheTOM provides the overall view of the Framework with the main parts in eTOM framework: SIP, OPS and EM. In addition, it also illustrates actors as Customer, Supplier/Partner, Shareholders, Employees and other Stakeholders.

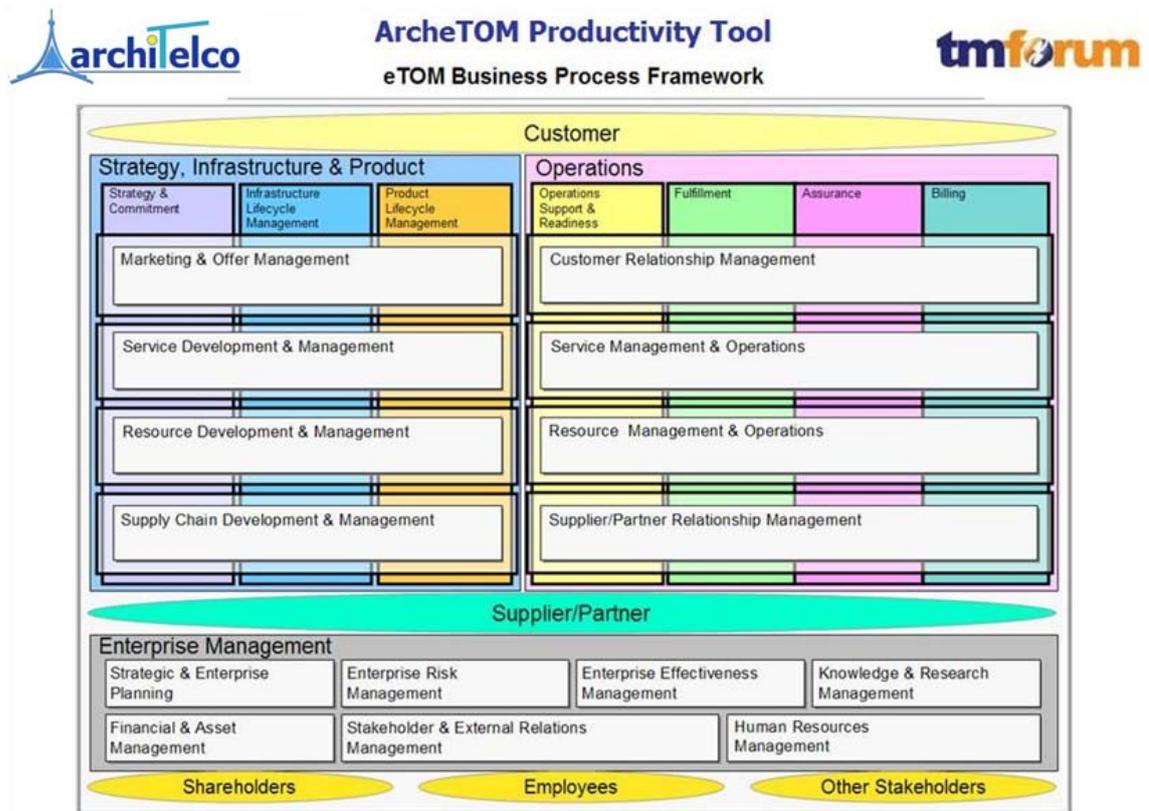


Figure 3.7: Overview diagram of ArcheTOM

In the form of an overview diagram, in Figure 3.7, it indicates that ArcheTOM supports the eTOM Business Process Framework.

Inside ArcheTOM, there are mainly 4 labels in the toolbar which enables different functionalities showing over the framework of following figures. Thus, in order to discover more significance of this tool, we devote into the details as following.

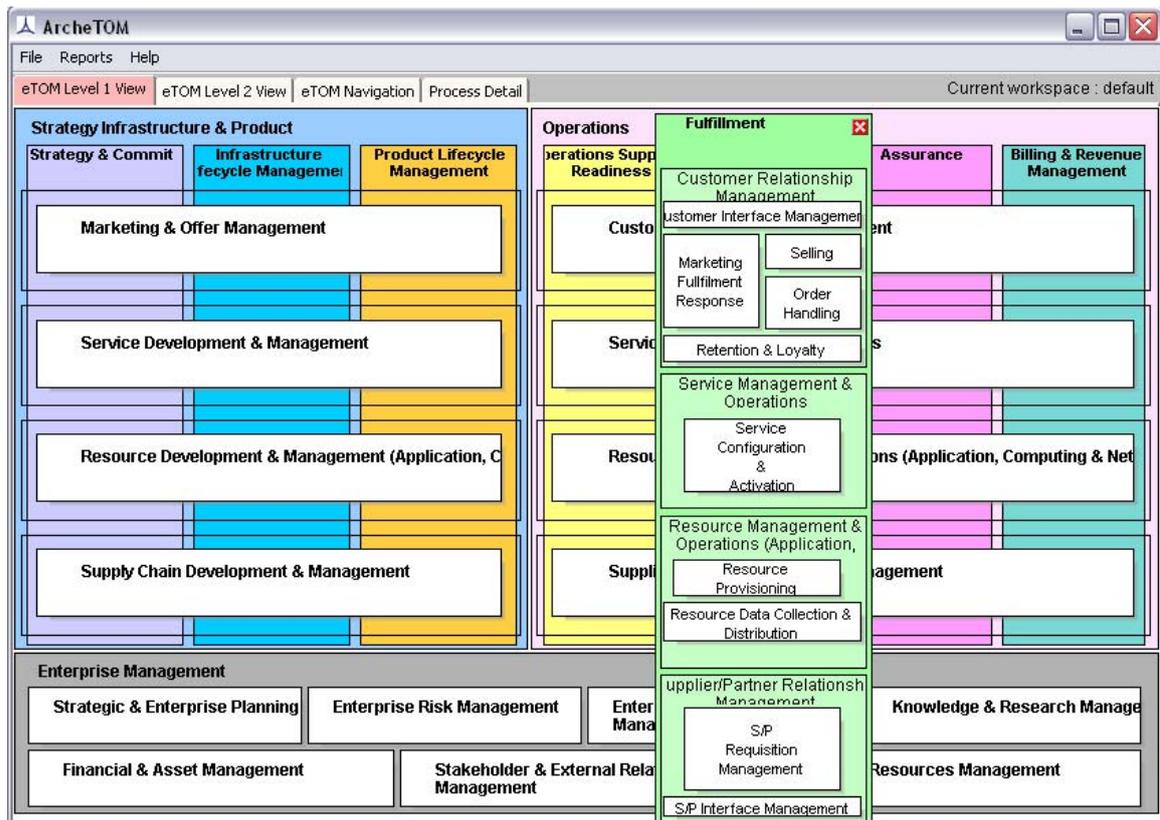


Figure 3.8: eTOM Level 1 view of ArcheTOM

As for the first label, eTOM Level 1 view provides a diagram of eTOM framework in Level 1 which includes all the three areas: Strategy Infrastructure & Product (SIP), Operations (OPS) and Enterprise Management (EM). Inside each area, we have a clear view of different sections, both horizontal and vertical process groupings. Besides there is an extra function below this label, to zoom into one process groupings to have a detail look at the specific horizontal or vertical grouping into Level 2, as the Figure 3.8 shows. With this, we are able to have a general notion about the whole framework and main processes. It provides a clear architecture which facilitates the ongoing of our project.

To penetrate into the framework, Figure 3.9 illustrates the eTOM framework in Level 2 with all processes contained. With the second label, eTOM Level 2 view, we have an easier approach to have an overview with the detail of all the process groupings. It enables us to clarify the relationship and its adscription. This is in need, during the design and implementation of specific scenarios, to assist.

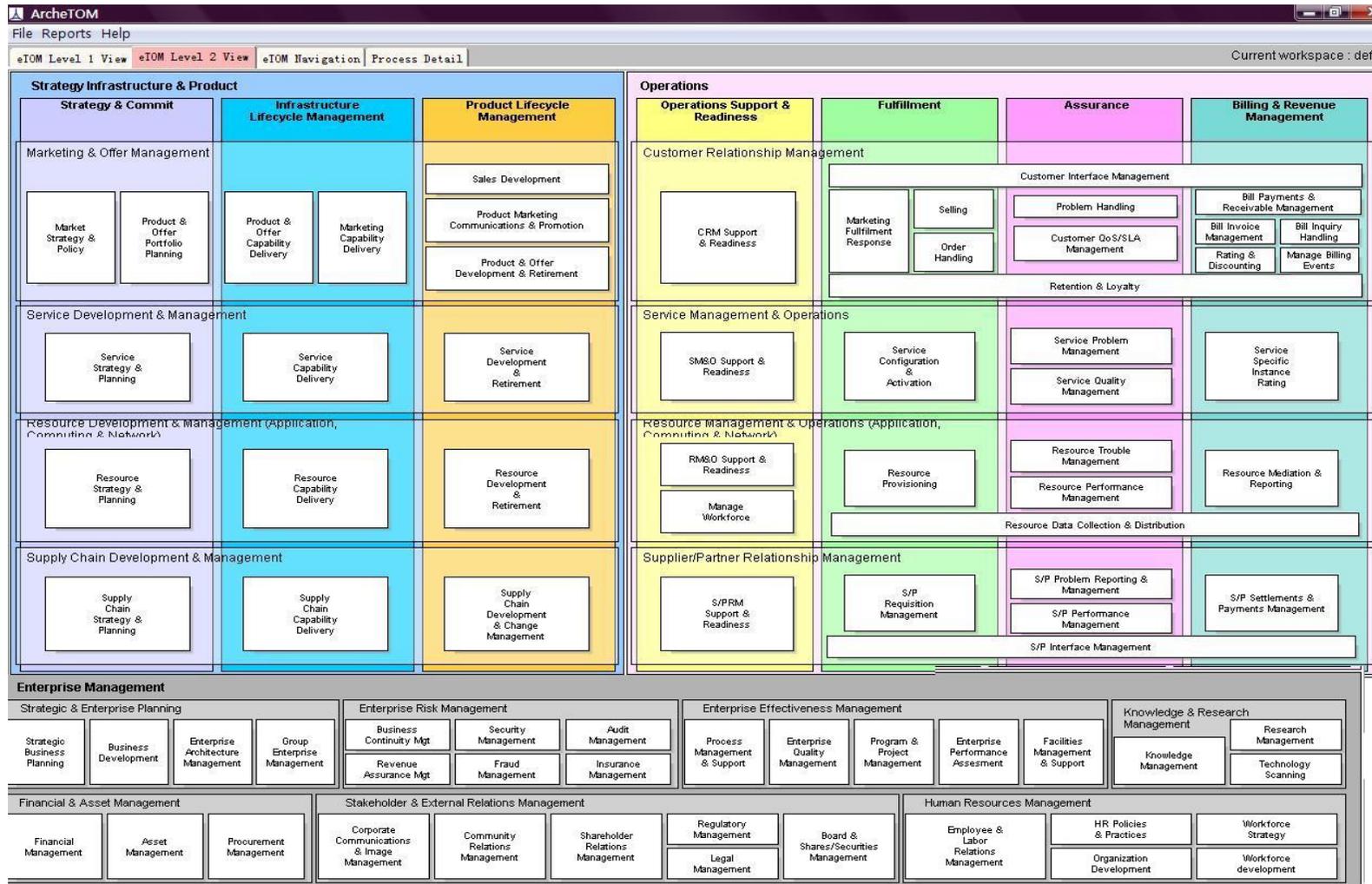


Figure 3.9: eTOM Level 2 view of ArcheTOM

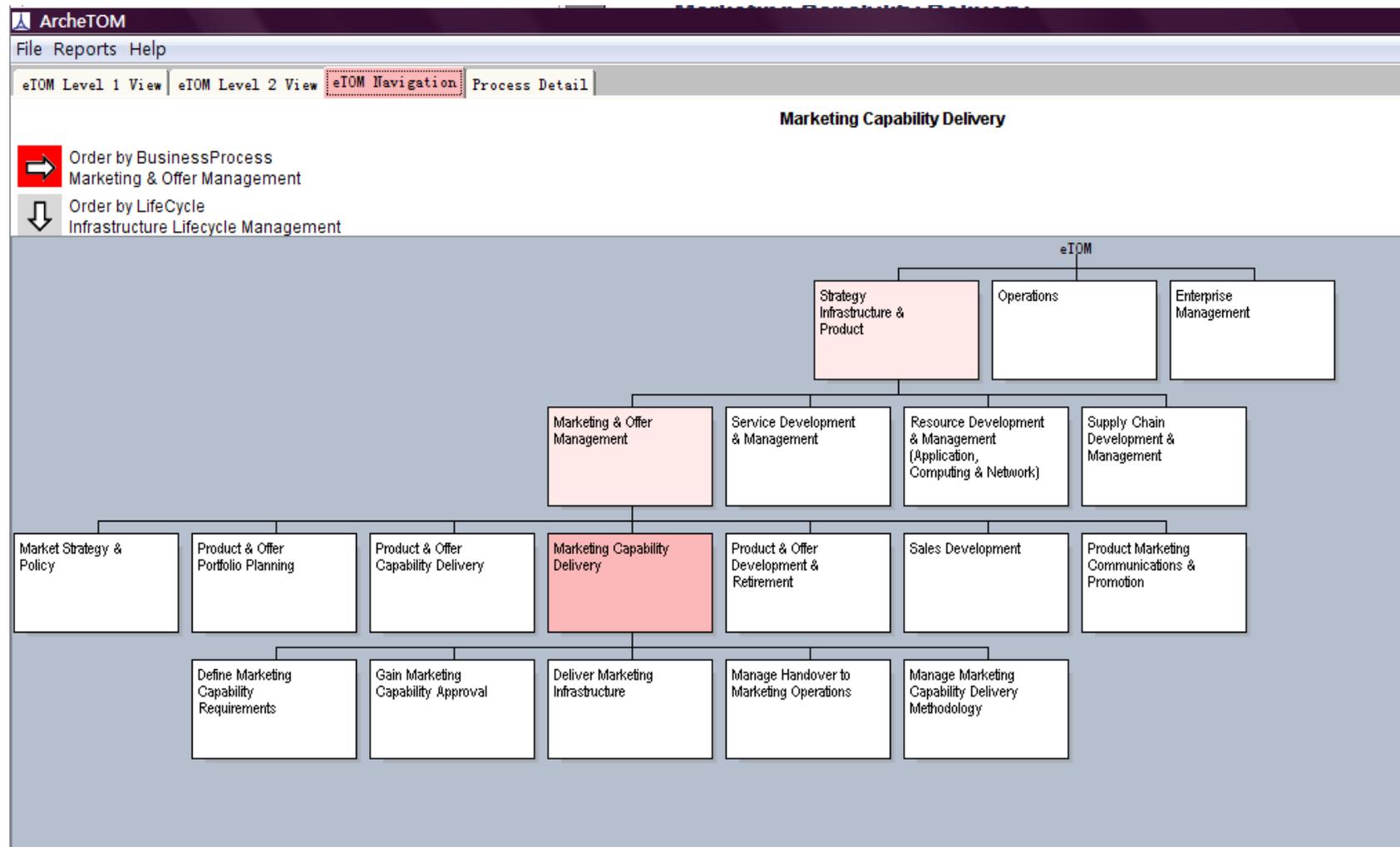


Figure 3.10: eTOM navigation view of ArcheTOM

As the Figure 3.10 shows, the third label, eTOM navigation, provides a tree-like diagram enables us to modify and delete existing processes, and add a new sub process. Through this, we can simplify the framework and decompose the essential processes into deeper level in the context of the scenarios with the necessary processes and sub processes. In this way, the supporting tool can contribute in both the scenario design and implement.

By choosing one specific process in the hierarchical diagram, to click the fourth label, we can get the definition and detailed description on the other page. In addition, there are much more information that is not defined yet on the left scalable list showing in the Figure 3.11. Using this, we can instantiate the description and define other parameters due to the specific situation of our scenarios.

The screenshot displays the ArcheTOM application window. The title bar reads 'ArcheTOM'. Below it is a menu bar with 'File', 'Reports', and 'Help'. A tab bar shows 'eTOM Level 1 View', 'eTOM Level 2 View', 'eTOM Navigation', and 'Process Detail' (which is active). The main content area is split into two panes. The left pane is a tree view showing the structure of 'Marketing Capability Delivery' with various sub-items like 'Definition', 'Detailed Description', 'Purpose', etc. The right pane displays the detailed information for the selected 'Definition' item.

Marketing Capability Delivery

Process Identifier: SIP 1.2

Definition
Manage the delivery and build of new or changed market capabilities or customer-related capabilities.

Detailed Description
Based on the market strategy for the enterprise, the Marketing Capability Delivery processes manage the delivery and build of new or changed market capabilities (e.g. on-line channels and sales channels) or customer-related capabilities (e.g. ability to identify, save, manipulate and retrieve and apply new types of knowledge about customers). These capabilities are created and delivered in line with the Market Strategy, for example, one strategy may be to create more on-line channels to allow for customer self-service.

Figure 3.11: eTOM process detail of ArcheTOM

Moreover, with the report option, it is able to generate an excel document to describe all the processes existed in the framework with descriptions and hierarchy. Especially after the selection and decomposition of processes, we are able to report a document with a list of the result. It will be taken into practice in the chapter 4 for our scenarios and the detail navigation diagram will be shown in the Appendix.

Due to the clear advantages exhibited by ArcheTOM in front of the MG-SOFT tools we decided to adopt it for further development of this project.

3.6 Visio

Visio is a user friendly tool to create diagrams; hence it can be used by everyone. We do not need to know software programming in order to use Visio. Using Visio, an electrician can create Electrical Diagrams; a student can create a flowchart to understand the process flow; sales persons can create charts and graphs; engineers can create Mechanical Engineering diagrams, managers can create organizational charts and software programmers can create UML diagrams and user interface prototypes. Some of the different kinds of diagrams that you can create using Visio are:

- Flowcharts
- Block Diagrams
- Business Process Diagrams
- Charts and Graphs
- Database Models
- Data Flow Diagrams
- Electrical Diagrams
- Mechanical Engineering Diagrams
- Systems and Network Architecture Diagrams
- Organizational Charts
- Gantt Charts
- User Interface Prototypes
- Sitemaps for Websites
- UML Diagrams, etc.

In our case, we need to illustrate the scenario implementation as a part of the project with flowcharts. Since the ArcheTOM doesn't provide this functionality and Visio is a user-friendly tool, we adopt this one as a complement of ArcheTOM for designing the flows of selected end-to-end processes as will be shown in Chapter 4.

4 Business processes deployment in a practical scenario

4.1 Scenario and use cases

This project is devoting in creating a new content provider company with business processes aligned with eTOM. The content provider company was named as MEDIA, an SME (Short-Medium Enterprise) that owns different types of multimedia content. This content includes video and audio which is enabled to offer to its customers. The services are orientated to people living in a given geographical area which are interested in the content. As for the network, they are also equipped with the appropriate access device of their own.

The offer of MEDIA is available through a catalog visible as an Internet portal. Furthermore, the content is stored in different types of media. Selective subscription has the access to different types of content as well as different types of QoS. The QoS standard was divided into gold, silver and bronze. It is selected by the customer at subscription time. As for the billing scheme, it charges not only the fixed rate for service subscription type, but also pays per view.

Instead of buying their own servers and carrying out the corresponding operation, MEDIA has signed an agreement with CLOUD, another company that materializes the concept of “cloud computing”. In this particular case, CLOUD is offering to host the content of MEDIA in appropriate servers, making them accessible through the Internet with a given end-to-end latency.

Acting as a provider, CLOUD is supporting an overlay network. When a request is received, it is redirected to the most appropriate server which stores the content ordered by the subscriber. In the mean time, CLOUD has access to the Internet through an Internet service provider, shown as the Figure 4.1 below.

Moreover, in order to make an easy access to its potential customers, MEDIA has decided to deploy its own access network to the Internet. This network will consist of a mix of WiMAX and WiFi technology conveniently deployed in the area of coverage. Interconnection of the wireless network and the fixed network is through an Internet service provider mentioned above.

MEDIA will install the OSS in a central location which supports the business process of the company. This OSS includes the business processes that are the subject of this thesis.

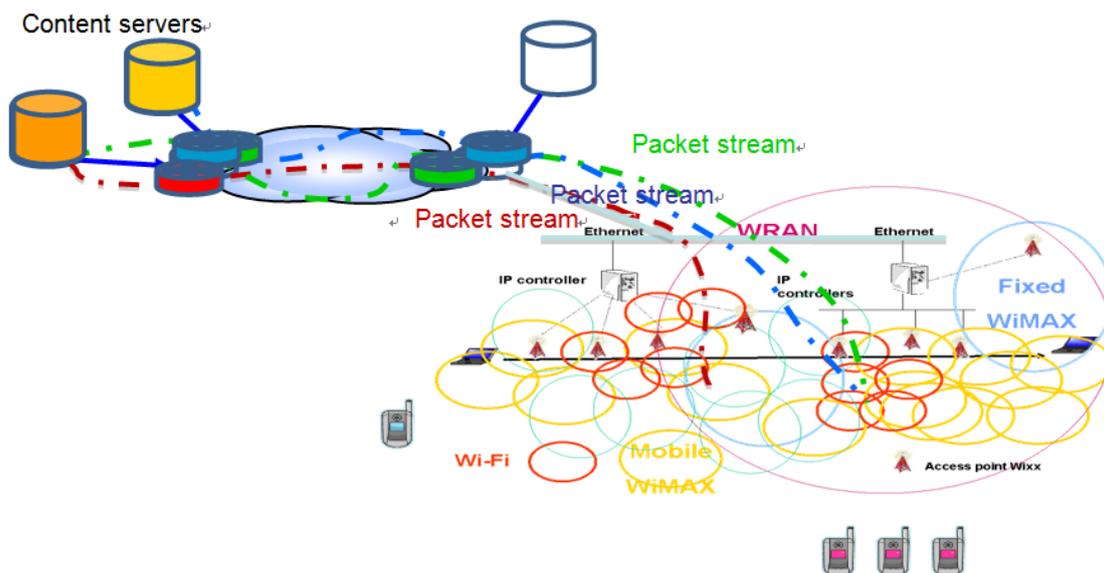


Figure 4.1: Hardware deployments in use cases

4.1.1 Actors identification

Figure 4.2 depicts the sets of relationship groupings involved in a value network in the ICT industry. The value network must operate with the efficiency of a self-contained enterprise, which requires managing the network on a process rather than an organizational basis. The model explicitly shows the use of the eTOM Business Process Framework by the service provider at its core. It is only shown here to simplify the figure and its presence is not intended to imply that its use by the Service Provider is prescribed, just that the service provider would probably benefit from its use. Likewise, it is not intended to preclude the use of eTOM by the other entities shown within the value network. These entities may or may not make use of the eTOM business process.

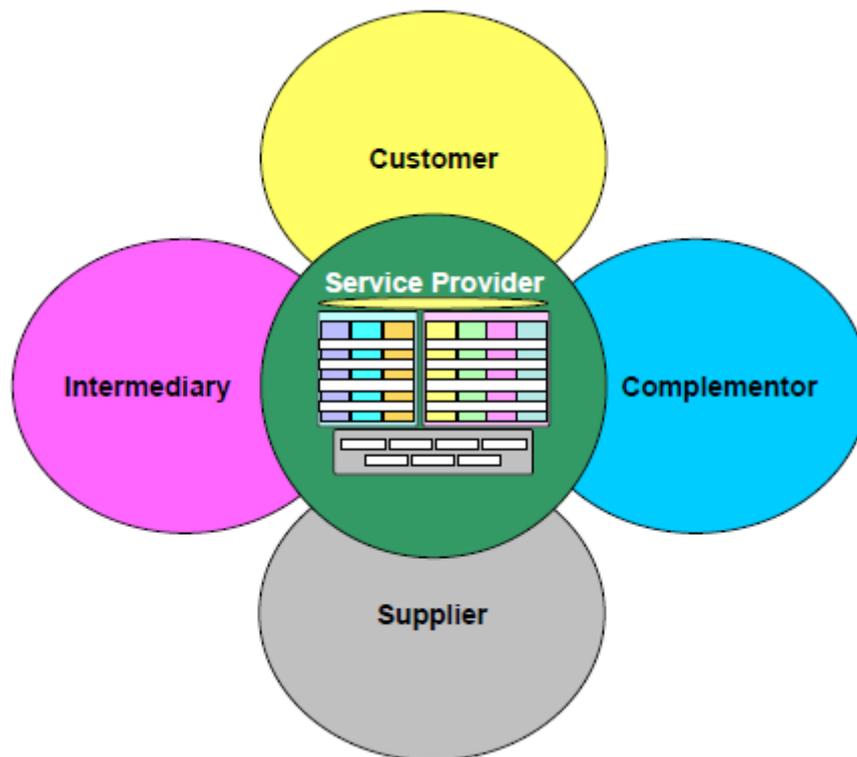


Figure 4.2: Roles of entities in value network

The roles of the entities in the value network shown in Figure 4.2 are described below:

- Customer

The customer may represent an end customer who is responsible for ordering, using and paying for service products where the product provided by the value network is consumed, or a wholesale customer. In our scenario, the customer of MEDIA is the end customer, the subscribers who make use of the content service and subscribe to pay for the content service.

- Service Provider

The service provider supplies the customers with services and support who is responsible for the contract and billing as well. It acts on behalf of the value network it represents in relationships with Intermediaries as well as with the customer. In our scenario, the service provider is the enterprise MEDIA who provide the content service to the subscribers. It plays a role to interact with customers including subscribing, problem solving, billing and so on.

- Complementary Provider

The complementary provider is in a partnership with the service provider to extend the product provided by the service provider and offers additional capability, making interactions with the service provider more attractive and convenient for the customer.

In our scenarios, there is no complementary provider who adds more services provided to customers, only MEDIA works as a service provider itself.

- Intermediary

The Intermediary supplies a service for a fee. At a time of Internet globalization an Intermediary can play an important role as it can promote market transparency by overcoming the geographic constraints that used to limit knowledge about the products available [6]. Functional intermediaries provide a specific function, such as selling, electronic payment or authentication. In our scenarios, to simplify, there is no intermediary.

- Supplier

The supplier interacts with the service provider in providing hardware, software, solution and services which are assembled by the service provider in order to deliver its solutions or services to the customer [6]. In our scenarios the supplier is CLOUD, the overly network owner who supports the network for the service provider MEDIA to run its business. In addition, the Internet access provider adopts the role to provide Internet connectivity to MEDIA. Therefore, it is a supplier as well.

Generally, an enterprise can play different parts in different value networks. A service provider serves its customer whereas it can also be a customer of the other service provider or complementary provider at the same time. In current telecommunication market, the roles keep changing and updating. There are no fixed rules to follow but all depends on the situation and specific scenarios. According to the role analysis based on the scenarios, we conclude that:

- ◆ Service Provider: MEDIA (the Enterprise)
- ◆ Customer: Subscriber (Subscribe services)
- ◆ Supplier: CLOUD (overlay network) and Internet Provider (Internet access)

4.1.2 Use case 1-Service subscription

One of the most basic end-to-end processes a service provider must support is to ensure the appropriate response to a potential customer service request. A subscription process defines who has access to selected information. Whether we are developing a newsletter, deliver regular e-mail-based or telephone communications, to internal or external subscribers, we will need a process to ensure that the right people are accessing only the information intended for them. Let's imagine an individual who never had any relationship with MEDIA. This means that the company has no records about the identity or the profile of that person. Our user is roughly aware of the MEDIA services through advertisements he got through his mail. He knows the URL and contact of the company and he expects that through a relatively simple interaction process he will end with the payment of his subscription and he will be ready to view his first movie.

Summarizing, the use case is triggered by an unknown user and ends with a formal subscription to one particular service of the MEDIA portfolio.

4.1.3 Use case 2-Problem complain

Going back to the user mentioned in Use Case 1, now already a customer of MEDIA, assume that he has been enjoying satisfactorily of different content programs when suddenly, viewing the retransmission of a match of his football team he observes an abnormal deterioration of the quality of the image. He starts again the program, thinking that perhaps is due a transitory network problem, but arriving at the same scenes the quality worsens again. At that moment, the customer decides to contact MEDIA expecting a quick and efficient solution to this problem. The mechanism to communicate problems observed in the service is by filling a form that is provided in the web site. He fills and sends the form and waits for the answer of the company via e-mail.

Summarizing, this use case is triggered by the user at the moment of detecting a problem and will be ended by the service provider contacting the user that the problem is solved or giving him alternative options or compensations if necessary.

4.2 Solution design approach

With the background introduced before, we devote into the solution of the scenario. Our focus will be the two described uses cases. In other words, our business process deployment methodology will be driven to support the above mentioned use cases in the context of the previously defined scenario.

The design and deployment of the business processes of a company is not easy. To make it more affordable, we have established a deployment program that ranks the business processes in three priorities. With priority number 1 we consider the processes that have to be ready at the company startup. With priority number 2 we include the processes that will be implemented in a subsequent phase. Finally, with priority number 3 we consider other processes whose implementation will be reviewed according to the business evolution. In the case of MEDIA, it is a starting company in a small scale and we only take into account the business processes needed in a time frame up to 3 or 6 months. Therefore, it is not because the processes without taken into account are meaningless or unimportant, it only means we are able to deal with it and launch them sooner or later. The eTOM framework includes an Enterprise Management process area so that all service provider processes are included. Service providers consistently employ enterprise or corporate level processes to manage and support their businesses. Due to the small scale of Media, we prefer to consider it later as the company growing bigger.

Firstly, we select the process according to the current situation of MEDIA, from upper level to lower levels until Level 3. In Level 1, we abandon the Strategy, Infrastructure & Product (SIP) and Enterprise Management (EM) sections to cope with the specific

case of MEDIA. The reasons to adopt this decision are various. The Strategy, Infrastructure & Product process area provides the focus within the enterprise for generating specific business strategy and gaining buy-in within the business. At the same time, the Enterprise Management contains elements that relate to both policy setting and support of the enterprise. They are both relatively overweighed for a small starting company as Media. Therefore, they will not catch too much attention in the scenario design.

As for the Level 2, we focus on the Operations excluding Operations Support & Readiness (OSR). In fact, this later area includes those processes needed to ensure that customer operations processes can respond with what the customer requires, in a timeframe and cost the customer requires, including delighting the customer with delivery and support. In this project, support processes are not so urgent and necessary for our current small company. Then, we try to master all the functionality in the FAB part and select the processes concerned to instantiate the description of each process according to the situation of our small scale company.

On the other hand, the eTOM is a decomposition model from a notional Level 0 through to Level 3. In order to keep the eTOM to a level which is generally useful it is not intended to decompose the eTOM to further levels beyond Level 3. It is asserted that the further a decomposition is taken, the more difficult it is to prove the uniqueness of lower level processes. The mechanism of decomposition can be extended as required. In this project we have decided to set the end-point at Level 4 because we have sufficient detail to use within our business in this project. Since MEDIA is a starting SME, the processes selected which are decomposed until Level 4 are adequate.

Last but not least, the eTOM framework includes a considerable amount of process flow modeling to support and apply the process decompositions. The control flow defines the logic of business processes i.e. the enterprise behavior in terms of a sequence or order in which enterprise activities must be performed to achieve business objectives. According to the sequences of the processes, we arrange the business process as a flow diagram to demonstrate the scenario use cases.

4.3 Detailed design

In eTOM framework, a top-down approach was adopted. This enabled the definition of the Business Process Framework at the Enterprise level in a series of Level 1 process groupings. These Level 1 processes are split into Vertical and Horizontal groupings, with the dependant Level 2 processes positioned within the Vertical and the Horizontal grouping appropriate to the process concerned. As described in the process methodology in Chapter 4, we will implement the scenarios in the following steps due to the specific case of MEDIA.

4.3.1 Process instantiation

After analysis and evaluation for the first step of scenario implementation, we chose FAB Vertical groupings crossed with 4 other Horizontal groupings as the focus in Level 1. Based on the situation of MEDIA, the instantiation with description in Level 1 is described as below:

- **Fulfillment:**

Description: This process is responsible for providing customers with their requested products in a timely and correct manner.

Instantiation: It is responsible for MEDIA to provide subscribers a set of pre-established content services with different QoS performance levels (bronze, silver, and gold) which depends on their subscription in a timely and correct manner.

- **Assurance:**

Description: This process is responsible for the execution of proactive and reactive maintenance activities to ensure that services provided to customers are continuously available and to SLA or QoS performance levels.

Instantiation: It is responsible for the execution of proactive and reactive maintenance activities in MEDIA with its wireless network and relevant hardware and software as well such as the wireless routers and the operating systems to ensure the content service provided to subscribers are continuously available and to QoS performance levels (bronze, silver, and gold).

- **Billing & Revenue Management:**

Description: this process is responsible for the collection of appropriate usage records, determining charging and billing information, production of timely and accurate bills, for providing pre-bill use information and billing to customers, for processing their payments, and performing payment collections. In addition, it handles customer inquiries about bills, provides billing inquiry status and is responsible for resolving billing problems to the customer's satisfaction in a timely manner. This process grouping also supports prepayment for services.

Instantiation: It is responsible for MEDIA to provide timely and accurate bills, for providing pre-bill use information and billing to customer according to the QoS subscribed and in a pay per view basis, for processing their payments, and performing payment collection.

- **Customer Relationship Management (CRM):**

Description: CRM process grouping considers the fundamental knowledge of customers needs and includes all functionalities necessary for the acquisition, enhancement and retention of a relationship with a customer.

Instantiation: It is responsible for the fundamental knowledge of subscribers needs and includes all functionalities necessary for the acquisition, enhancement and retention of a relationship with a subscriber.

- **Service Management & Operations (SM&O):**

Description: This horizontal functional process grouping focuses on the knowledge of services (Access, Connectivity, Content, etc.) and includes all functionalities necessary for the management and operations of communications and information services required by or proposed to customers.

Instantiation: It is responsible for the knowledge of content services and includes all functionalities necessary for the management and operations of content services required by or proposed to subscriber.

- **Resource Management & Operations (RM&O):**

Description: Maintains knowledge of resources (application, computing and network infrastructures) and is responsible for managing all these resources (e.g. networks, IT systems, servers, routers, etc.) utilized to deliver and support services required by or proposed to customers.

Instantiation: It is responsible for MEDIA to maintain knowledge of the wireless network infrastructures and manage all wireless routers, content and operating systems etc. utilized to deliver and support the content services required by or proposed to subscribers.

- **Supplier/Partner Relationship Management (S/PRM):**

Description: This horizontal functional process grouping supports the core operational processes, both the customer instance processes of Fulfillment, Assurance and Billing & Revenue Management and the functional operations processes. Supplier/Partner Relationship Management (S/PRM) processes align closely with a supplier's or partner's Customer Relationship Management processes.

Instantiation: It is responsible to issue purchase orders and track them through to delivery, mediation of purchase orders as required conforming to external processes, handling problems, validating billing and authorizing payment, as well as quality management of CLOUD and the Internet provider. It is important to note that when MEDIA sells content to CLOUD or the internet provider, this is done through the enterprise CRM processes, which act on behalf of CLOUD or the internet provider or MEDIA in such cases. Supplier/Partner processes only cover the buying of CLOUD or the internet provider supplied products by Media [6].

4.3.2 Process priority classification

First of all, in Level 1, Strategy, Infrastructure & Product (SIP) and Enterprise Management (EM) parts are not taken into account. It is not because they are not important processes; we would like to consider it later. Because, as for a SME company like MEDIA, the SIP part is too overweighed and the EM part is not so urgent and important, perhaps we will be able to lunch them one year later. Therefore, the main area is (Fulfillment, Assurance and Billing& Revenue Management) FAB part inside the framework. Thus, in order to simply the map, according to the current

situation and schedule of MEDIA, we advise to divide all the relevant processes into 3 priorities.

As the Table A.1 shows in the Appendix A, we include all the processes inside eTOM framework from Level 1 to Level 3 which is generated by the ArcheTOM. We divide it into A, B, C three areas as A. Strategy, Infrastructure & Product (SIP), B. Operations (OPS) and C. Enterprise Management (EM). Inside each of the area mentioned above, there are a large amount of processes numbered from SIP 1.0 to SIP 4.0, from OPS 1.0 to OPS 4.0 and from EM 1.0 to EM 7.0. Thus, the number can indicate the not only the relationship but also the hierarchy of the processes in all levels.

Fist of all, the third priority represents the processes with less urgency and we can put it aside at the beginning. After MEDIA is on its track, we can take these processes into account later. Due to the situation of MEDIA, the processes in Level 3 inside the SIP and EM areas are not so significant for the first phase to run the business. Therefore, we exclude them and the rest of the processes in OPS area shown in Appendix A in bold are with the second priority, while the rest of the processes are with third priority.

Refer to as the first priority we select it from the OPS area to ensure MEDIA to run the business smoothly in the first phase up to 3 or 6 months. There are the processes in need immediately. Here we list and instantiate the first priority processes in Level 3 according to the current situation of MEDIA:

OPS 1.0 - Customer Relationship Management

OPS 1.2.6 - Develop Sales Proposal

MEDIA has to develop a sales proposal to respond to the subscriber's requirements on the content provided.

OPS 1.3.2 - Track Leads

Track leads help to pinpoint the best sources, maintain lead quality, analyze marketing performance, manage future sales and manage and modify marketing plans.

OPS 1.4.1 - Determine Preorder Feasibility

Before activating the services, MEDIA needs to ensure the feasibility of providing and supporting the product – content service to the subscriber.

OPS 1.4.2 - Authorize Credit

Due to the billing method, MEIDIA needs to assess a subscriber's credit worthiness, the availability to pay online with their credit cards.

OPS 1.4.3 - Receive PO & Issue Orders

MEDIA will receive a content service order through internet and issue it to provide the service.

OPS 1.4.4 - Track & Manage Customer Order Handling

MEDIA needs to ensure subscriber provisioning activities are assigned, managed and tracked efficiently.

OPS 1.4.5 - Complete Customer Order

MEDIA needs to manage subscriber information and interactions after associated content service orders have been finalized and during the order completion phase.

OPS 1.4.6 - Issue Customer Orders

MEDIA has to issue correct and complete subscriber orders.

OPS 1.4.7 - Report Customer Order Handling

Monitoring the status of subscriber orders, it provides notifications of any changes and management reports.

OPS 1.4.8 - Close Customer Order

After subscriber provisioning activities have been completed, MEDIA need to close a subscriber order.

OPS 1.5.1 - Isolate Customer Problem

When there is problem complained by the subscriber, MEDIA need to identify the root cause of the subscriber problem.

OPS 1.5.2 - Report Customer Problem

Monitoring the status of subscriber problem reports, it provides notifications of any changes and management reports.

OPS 1.5.3 - Track & Manage Customer Problem

MEDIA needs to ensure that recovery activities are assigned, coordinated and tracked efficiently, and that escalation is invoked as required for any open subscriber problem reports in jeopardy.

OPS 1.5.4 - Close Customer Problem Report

MEDIA needs to ensure that a problem affecting the subscriber is solved.

OPS 1.5.5 - Create Customer Problem Report

MEDIA needs to create a new subscriber problem report.

OPS 1.5.6 - Correct & Recover Customer Problem

MEDIA had to restore the service to a normal operational state as efficiently as possible.

OPS 1.6.2 - Manage QoS/SLA Violation

MEDIA need to ensure that the subscriber and the relevant internal processes are informed of service quality degradations and violations and that action is undertaken to resolve the degradation or violation.

OPS 1.7.1 - Manage Contact

We need to manage all contacts/requests between potential subscribers and MEDIA.

OPS 1.7.2 - Manage Request (Including Self Service)

MEDIA needs to manage all requests (inbound and outbound) made by potential subscribers.

OPS 1.7.3 - Analyze & Report on Customer

MEDIA has to perform all necessary analysis on closed content service requests and generate related reports.

OPS 1.7.4 - Mediate & Orchestrate Customer Interactions

MEDIA needs to ensure that transaction message structure and interactions conform to agreed, externally defined standards used by MEDIA and its subscribers.

OPS 1.9.1 - Manage Customer Billing

MEDIA needs to ensure effective management of the subscriber's billing account as it relates to the content service purchased throughout the appropriate billing cycle.

OPS 1.11.5 - Report Customer Bill Inquiry

MEDIA has to report on the subscriber's bill inquiry.

OPS 2.0 - Service Management & Operations

OPS 2.2.2 - Allocate Specific Service Parameters to Services

When new services need to be launched, MEDIA needs to issue service identifiers for new services.

OPS 2.2.4 - Implement, Configure & Activate Service

MEDIA implements, configures and activates the specific content services allocated against an issued service order.

OPS 2.2.7 - Issue Service Orders

MEDIA needs to issue correct and complete service orders

OPS 2.2.10 - Recover Service

When the content services are no longer required by subscribers, MEDIA has to recover it.

OPS 2.3.1 - Create Service Trouble Report

MEDIA needs to create a new service trouble report when there is problem during providing the content services.

OPS 2.3.2 - Diagnose Service Problem

MEDIA had to identify the root cause of the specific service problem.

OPS 2.3.3 - Correct & Resolve Service Problem

When there is a problem, MEDIA needs to restore the service to a normal operational state as efficiently as possible.

OPS 2.3.4 - Track & Manage Service Problem

MEDIA needs to ensure that testing, repair and restoration activities are assigned, coordinated and tracked efficiently, and that escalation is invoked as required for any open service trouble reports in jeopardy.

OPS 2.3.5 - Report Service Problem

Monitoring the status of service trouble reports, MEDIA provides notifications of any changes and management reports.

OPS 2.3.6 - Close Service Trouble Report

MEDIA should close a service trouble report when the service problem has been resolved.

OPS 2.3.7 - Survey & Analyze Service Problem

MEDIA needs to monitor service alarm event notifications and manage service alarm event records in real-time.

OPS 3.0 - Resource Management & Operations (Application, Computing & Network)

OPS 3.2.1 - Allocate & Install Resource

MEDIA has to allocate specific resources required to support a specific content service.

OPS 3.2.2 - Configure & Activate Resource

MEDIA needs to configure and activate the specific resources allocated against an issued resource order.

OPS 3.2.3 - Test Resource

MEDIA needs to test specific resources to ensure they are operating within normal parameters

OPS 3.4.1 - Monitor Resource Performance

Monitoring received resource performance information MEDIA needs to undertake first-in detection.

OPS 3.4.3 - Control Resource Performance

In order to optimize the resource performance MEDIA should apply controls to resources.

OPS 3.7.2 - Assign Work Order

It is responsible for assigning manual activities to assignable staff within MEDIA.

OPS 3.7.5 - Administer Workforce

MEDIA needs to perform the necessary activities to assure that the assignable workforce is efficiently utilized.

OPS 4.0 - Supplier/Partner Relationship Management

OPS 4.2.1 - Select Supplier /Partner

It's necessary for MEDIA to identify the most appropriate supplier/partner or suppliers/partners amongst those with whom a supply arrangement exists.

OPS 4.2.2 - Determine S/P Pre-Requisition Feasibility

MEDIA also needs to determine the ability of suppliers/partners to deliver the specific resources, services within the specified requirements

OPS 4.2.4 - Receive & Accept S/P Requisition

MEDIA needs to record delivery of S/P requisitions, and arrange for any acceptance testing or commissioning required.

OPS 4.2.5 - Initiate S/P Requisition Order

MEDIA has to generate a correctly formatted and specified S/P requisition order, and issue this to the selected supplier/partner.

OPS 4.4.1 - Monitor & Control S/P Service Performance

MEDIA needs to collect and analyze performance of content services delivered by suppliers and partners.

OPS 4.5.2 - Receive & Assess Invoice

It compares invoices against usage records and offsets, and manages the interactions between the supplier/partner and MEDIA to confirm usage records and resolve account differences.

OPS 4.5.3 - Negotiate & Approve Invoice

It manages the interactions between the supplier/partner and MEDIA, in relation to enquiries about the billing account, handling disputes and any subsequent negotiations.

OPS 4.6.1 - Manage S/P Requests (including Self Service)

MEDIA has to accept requests and enable the supplier / partner to obtain the desired information from MEDIA, or identify and activate the appropriate process area to accomplish the request.

4.3.3 Process decomposition

Through hierarchical decomposition, complex entities can be structured and understood by means of the formalization of their components. Hierarchical decomposition enables detail to be defined in a structured way and also allows the

framework to be adopted at varying levels and for different processes [14]. Figure 4.3 is an example of the partial decomposition¹ of a given process at Level 0 into sub processes up to Level 4.

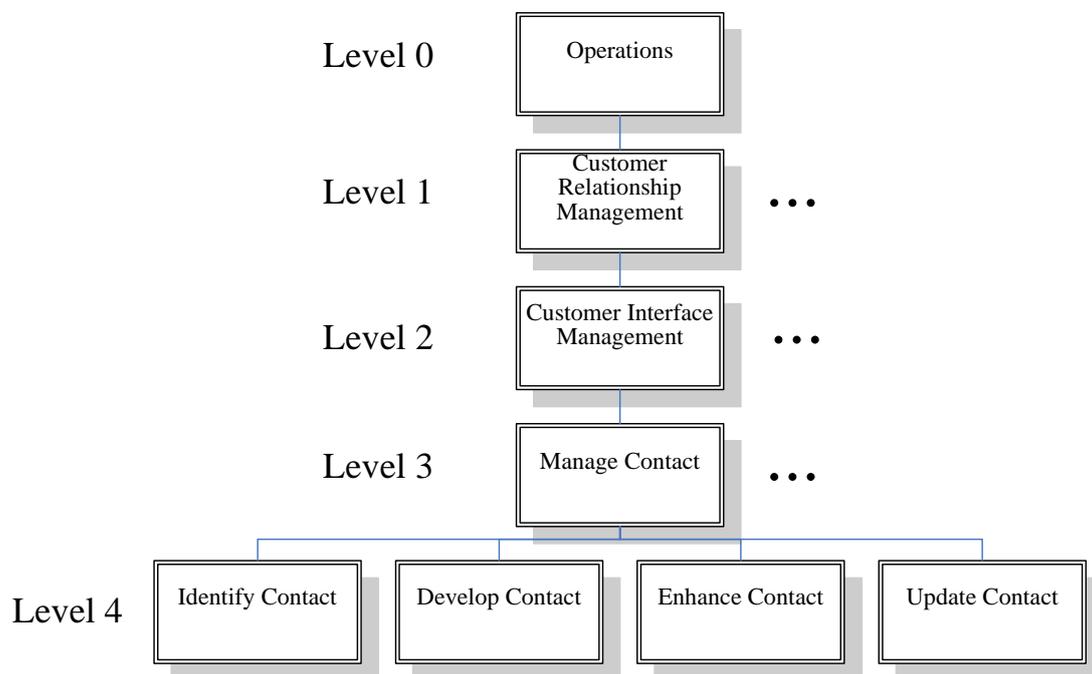


Figure 4.3: Partial decomposition from Level 0 to Level 4

Adopting ArcheTOM, described as a supporting tool in Chapter 3, we are able to reach the hierarchical decomposition from the Level 3 into Level 4 by adding sub nodes on the tree-like architecture. Since the eTOM framework only provides the processes until Level 3, there is a space for us to create the Level 4 processes in a more specific and concrete manner. To identify Level 4 processes we have adopted the latest drafts of the TMF working groups inside the document of detailed description of Level 3 processes. According to the requirement of our scenarios, we focus on the specific processes in Level 2 for decomposition: Customer Interface Management, Order Handling, Problem Handling and Service Problem Management.

As for the Use Case 1 dealing with customers' subscription, the Customer Interface Management and Order Handling processes are appropriated to implement it.

The other use case, about the management of user's complains, is able to be accomplished with Problem Handling and Service Problem Management. All the decompositions are showed with the framework navigation in ArcheTOM which is incorporated into the Appendix A. The diagrams illustrate the hierarchical architecture for decomposition. As the Table 4.1 shows below, to specify the scenarios separately, there is text edition to demonstrate the hierarchical decomposition until Level 4:

¹ At each level we only show one component of the decomposition

ArchiTelco Business Model			
<i>Level</i>	<i>Level</i>	<i>Level</i>	<i>Level</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
Use case 1			
OPS 1.0 - Customer Relationship Management			
OPS 1.2 - Selling			
OPS 1.2.2 - Qualify Opportunity			
OPS 1.2.4 - Acquire Customer Data			
OPS 1.2.6 - Develop Sales Proposal			
OPS 1.4 - Order Handling			
OPS 1.4.1 - Determine Preorder Feasibility			
OPS 1.4.1.1 - Determine Product Availability			
OPS 1.4.1.2 - Determine Product Supportability			
OPS 1.4.1.3 - Determine CRM Processes Supportability			
OPS 1.4.2 - Authorize Credit			
OPS 1.4.2.1 - Initiate Customer Credit Checks			
OPS 1.4.2.2 - Authorize Credit and Credit Terms			
OPS 1.4.3 - Receive PO & Issue Orders			
OPS 1.4.3.1 - Receive Purchase Order			
OPS 1.4.3.2 - Issue Customer Order			
OPS 1.4.4 - Track & Manage Customer Order Handling			
OPS 1.4.4.1 - Schedule Customer Provisioning Related Activities			
OPS 1.4.4.2 - Assign Customer Provisioning Related Activities			
OPS 1.4.4.3 - Coordinate Customer Provisioning Related Activities			
OPS 1.4.4.4 - Generate Perspective Service Order			
OPS 1.4.4.5 - Escalate Status of Customer Order			
OPS 1.4.4.6 - Undertake Tracking of Execution Process			
OPS 1.4.4.7 - Add Additional Information to Existing Customer Order			
OPS 1.4.4.8 - Modify Information in Existing Customer Order			
OPS 1.4.4.9 - Modify Customer Order Status			
OPS 1.4.4.10 - Cancel Customer Order			
OPS 1.4.4.11 - Monitor Jeopardy status of Customer Order			
OPS 1.4.4.12 - Escalate Customer Orders			
OPS 1.4.4.13 - Indicate Completion of Customer Order			
OPS 1.7 - Customer Interface Management			
OPS 1.7.1 - Manage Contact			
OPS 1.7.1.1 - Identify Contact			
OPS 1.7.1.2 - Develop Contact			
OPS 1.7.1.3 - Enhance Contact			
OPS 1.7.1.4 - Update Contact			
OPS 1.7.2 - Manage Request (Including Self Service)			
OPS 1.7.2.1 - Identify Request			

			OPS 1.7.2.2 - Approve Request
			OPS 1.7.2.3 - Activate Request
			OPS 1.7.2.4 - Monitor Request
			OPS 1.7.2.5 - Close Request
		OPS 1.7.3 - Analyze & Report on Customer	
			OPS 1.7.3.1 - Collect Customer Data
			OPS 1.7.3.2 - Evaluate Customer Data
			OPS 1.7.3.3 - Report Customer Data
		OPS 1.7.4 - Mediate & Orchestrate Customer Interactions	
			OPS 1.7.4.1 - Identify Data Format
			OPS 1.7.4.2 - Convert Data Format
Use case 2			
OPS 1.0 - Customer Relationship Management			
		OPS 1.5 - Problem Handling	
		OPS 1.5.1 - Isolate Customer Problem	
			OPS 1.5.1.1 - Verify Correctness of Product Using
			OPS 1.5.1.5 - Perform Diagnostics
		OPS 1.5.2 - Report Customer Problem	
			OPS 1.5.2.1 - Monitor Status of Customer Problem Report
			OPS 1.5.2.2 - Provide Notifications of Changes
			OPS 1.5.2.3 - Provide Management Report
		OPS 1.5.3 - Track & Manage Customer Problem	
			OPS 1.5.3.1 - Schedule Recovery Activities
			OPS 1.5.3.2 - Assign Recovery Activities
			OPS 1.5.3.3 - Track Recovery Activities
			OPS 1.5.3.4 - Repair Activities Delegated to Other Processes
			OPS 1.5.3.5 - Restore Activities Delegated to Other Processes
			OPS 1.5.3.6 - Generate Service Trouble Report Creation Request
			OPS 1.5.3.7 - Undertake Tracking of Execution Progress
			OPS 1.5.3.8 - Modifying Information in Existing Customer Problem Report
			OPS 1.5.3.9 - Modify Customer Problem Report Status
			OPS 1.5.3.10 - Cancel Customer Problem Report
			OPS 1.5.3.11 - Monitor Jeopardy Status of Open Customer Problem Report
			OPS 1.5.3.12 - Escalate customer Problem Report
		OPS 1.5.4 - Close Customer Problem Report	
			OPS 1.5.4.1 - Monitor Status of Open Customer Problem Report
			OPS 1.5.4.2 - Recognize Customer Problem Report Ready to Close
		OPS 1.5.5 - Create Customer Problem Report	
			OPS 1.5.5.1 - Capture Customer Information
			OPS 1.5.5.2 - Detect Service Failure or Degradation
			OPS 1.5.5.3 - Create Report

		OPS 1.5.6 - Correct & Recover Customer Problem
		OPS 1.5.6.1 - Interact Educationally with Customer
		OPS 1.5.6.2 - Re-assess Customers Needs
		OPS 1.5.6.3 - Withdraw Purchased Product Offering
		OPS 1.5.6.4 - Upgrade Purchased Product Offering
		OPS 1.5.6.5 - Renew Purchased Product Offering
		OPS 1.5.6.6 - Undertake Request for Activities
		OPS 1.5.6.7 - Identify Restorative Activities
		OPS 1.6 - Customer QoS/SLA Management
		OPS 1.6.1 - Assess Customer QoS/SLA Performance
		OPS 1.6.2 - Manage QoS/SLA Violation
		OPS 1.6.3 - Report Customer QoS Performance
		OPS 1.6.4 - Create Customer QoS Performance Degradation Report
		OPS 1.6.5 - Track & Manage Customer QoS Performance Resolution
		OPS 1.6.6 - Close Customer QoS Performance Degradation Report
		OPS 2.0 - Service Management & Operations
		OPS 2.3 - Service Problem Management
		OPS 2.3.1 - Create Service Trouble Report
		OPS 2.3.1.1 - Analyze Service Alarm Event Notification
		OPS 2.3.1.2 - Create New Service Alarm Event Record
		OPS 2.3.2 - Diagnose Service Problem
		OPS 2.3.2.1 - Verify Service Configuration
		OPS 2.3.2.2 - Run Test
		OPS 2.3.2.3 - Start Audits
		OPS 2.3.2.3 - Stop Audits
		OPS 2.3.2.5 - Schedule Routine Test
		OPS 2.3.3 - Correct & Resolve Service Problem
		OPS 2.3.3.1 - Interact With Customer
		OPS 2.3.3.2 - Recognize Problem and Alert Authority
		OPS 2.3.3.3 - Share Feedback
		OPS 2.3.3.4 - Pick Up the Best Resolution
		OPS 2.3.3.5 - Identify the Customer with Problem Unable to Solve
		OPS 2.3.3.6 - Implement the Resolution
		OPS 2.3.3.7 - Keep Customer Fully Informed
		OPS 2.3.3.8 - Check Customer Satisfaction
		OPS 2.3.4 - Track & Manage Service Problem
		OPS 2.3.4.1 - Initiate First-in Testing
		OPS 2.3.4.2 - Add Additional Information to Open Service Trouble Report
		OPS 2.3.4.3 - Schedule Repair and Restoration Activities
		OPS 2.3.4.4 - Assign Repair and Restoration Activities
		OPS 2.3.4.5 - Coordinate Repair and Restoration Activities
		OPS 2.3.4.6 - Generate Respective Resource Trouble Report Creation

			Request
			OPS 2.3.4.7 - Initiate Final Testing
			OPS 2.3.4.8 - Undertake Necessary Tracking
			OPS 2.3.4.9 - Modify Information in Existing Service Trouble Report
			OPS 2.3.4.10 - Modify Service Trouble Report Status
			OPS 2.3.4.11 - Cancel Service Trouble Report
			OPS 2.3.4.12 - Monitor Jeopardy Status of Open Service Trouble Report
			OPS 2.3.4.13 - Escalate Service Trouble Reports
		OPS 2.3.5 - Report Service Problem	
			OPS 2.3.5.1 - Monitor Status of Service Trouble Report
			OPS 2.3.5.2 - Manage Notifications
			OPS 2.3.5.3 - Provide Management Report
		OPS 2.3.6 - Close Service Trouble Report	
			OPS 2.3.6.1 - Monitor Status of Open Service Trouble Report
			OPS 2.3.6.2 - Recognize Service Trouble Report Readiness
		OPS 2.3.7 - Survey & Analyze Service Problem	
			OPS 2.3.7.1 - Detect Service Alarm Event Notifications
			OPS 2.3.7.2 - Cancel Service Alarm Event Notifications
			OPS 2.3.7.3 - Initiate Service Alarm Event Record
			OPS 2.3.7.4 - Manage Service Alarm Event Record
			OPS 2.3.7.5 - Perform Service Alarm Event Notification Localization Analysis
			OPS 2.3.7.6 - Correlate Service Alarm Event Record
			OPS 2.3.7.7 - Filter Service Alarm Event Record
			OPS 2.3.7.8 - Report Service Alarm Event Record Status Change
			OPS 2.3.7.9 - Manage Service Alarm Event Record Jeopardy Condition

Table 4.1: First priority processes of two use cases

4.3.4 Process flow diagram

Process decompositions have provided an essential insight into the process definition and content. To understand further how the processes act, process flows can be developed to examine how some or all of the processes support some larger view across the enterprise [15]. They can have any scope that is considered meaningful and helpful to analyze. In this project we aim at describing the end to end process flows to represent the selected scenario and its two use cases [16].

The process flow approach has these general characteristics:

- It analyzes a typical scenario.
- It provides insight into the behavior and interaction amongst processes.
- It chooses to model the flow at an appropriate level of process detail.

- It can use process decompositions to enhance detail.

Due to the Level 4 processes distributed in its Level 3 processes are relatively in sequence. Therefore, we do not describe more details of Level 4 processes in the following diagram.

Use case 1:

Brief description:

The customer is using the URL and contact of MEDIA to subscribe for a set of content services supplied by MEDIA.

Pre-conditions:

The subscriber has a credit card.

The subscriber logged in successfully

Post-conditions:

The online subscription procedure terminated normally.

The subscription succeeded. [17]

Relevant processes in eTOM framework:

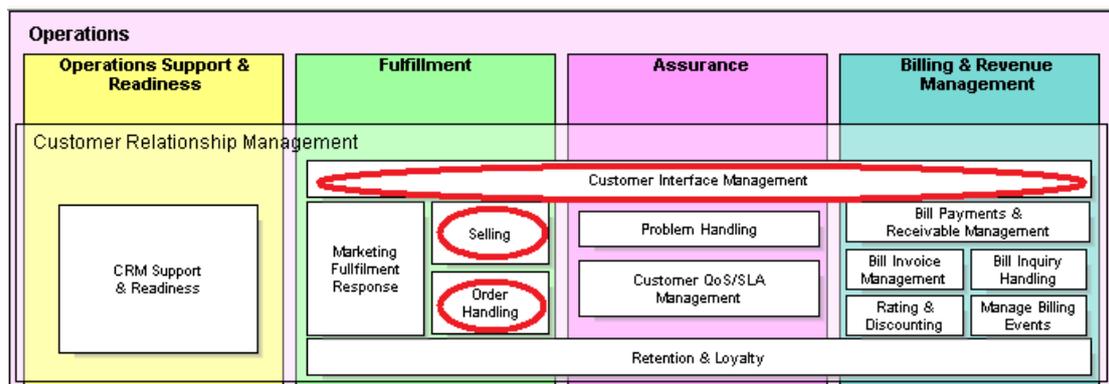


Figure 4.4: Relevant Level 2 processes of use case 1

Diagram:

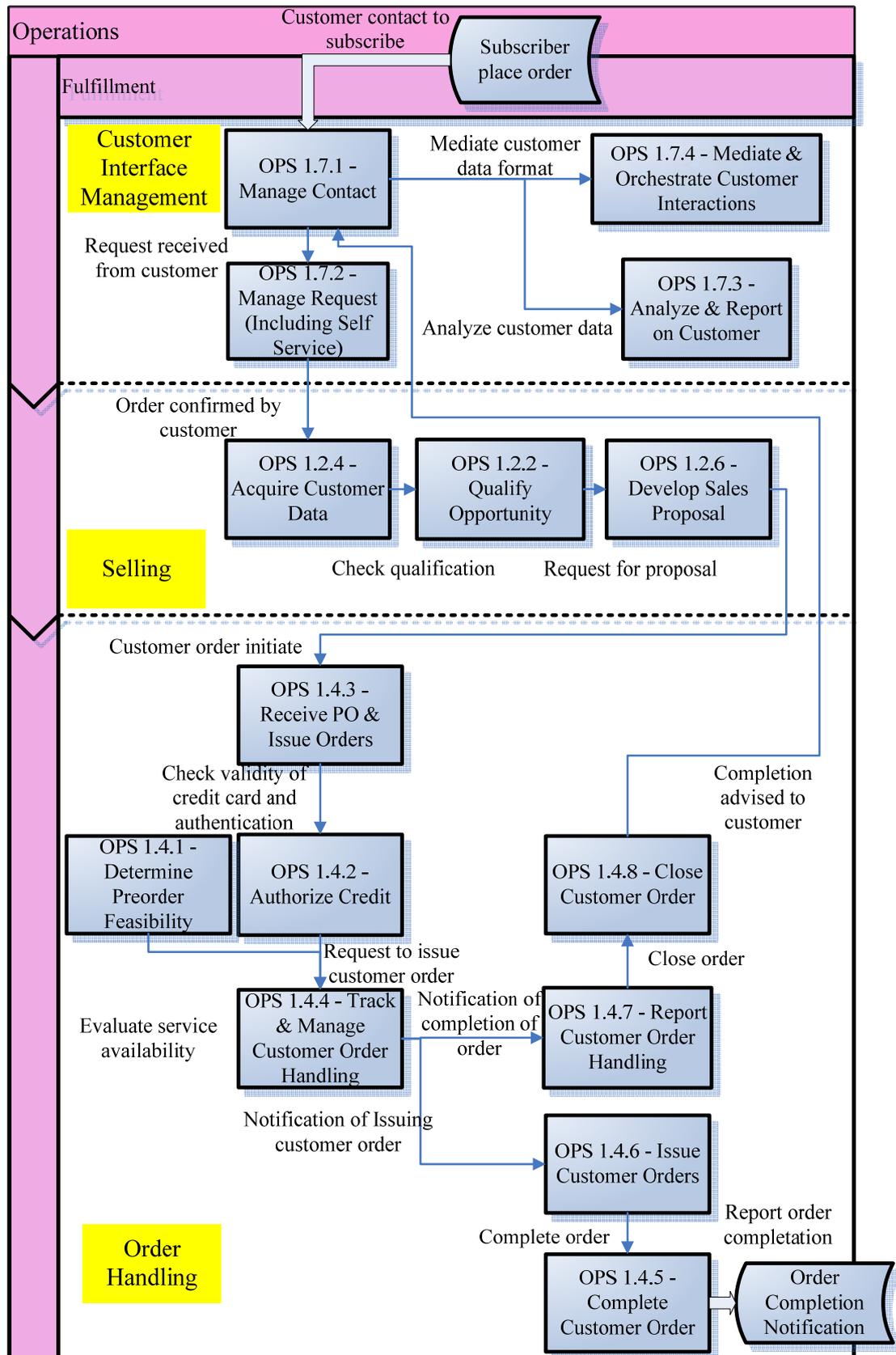


Diagram 4.1: Process flow diagram of use case 1

Use case 2:

Brief description:

Subscriber reports problems during services provided and MEDIA need to take measures to solve the problem.

Pre-conditions:

The subscriber reports a problem.

The subscriber identity is valid.

Post-conditions:

The problem is solved or the customer is informed that the problem results from improper use of the customer [18].

Relevant Processes in eTOM framework:

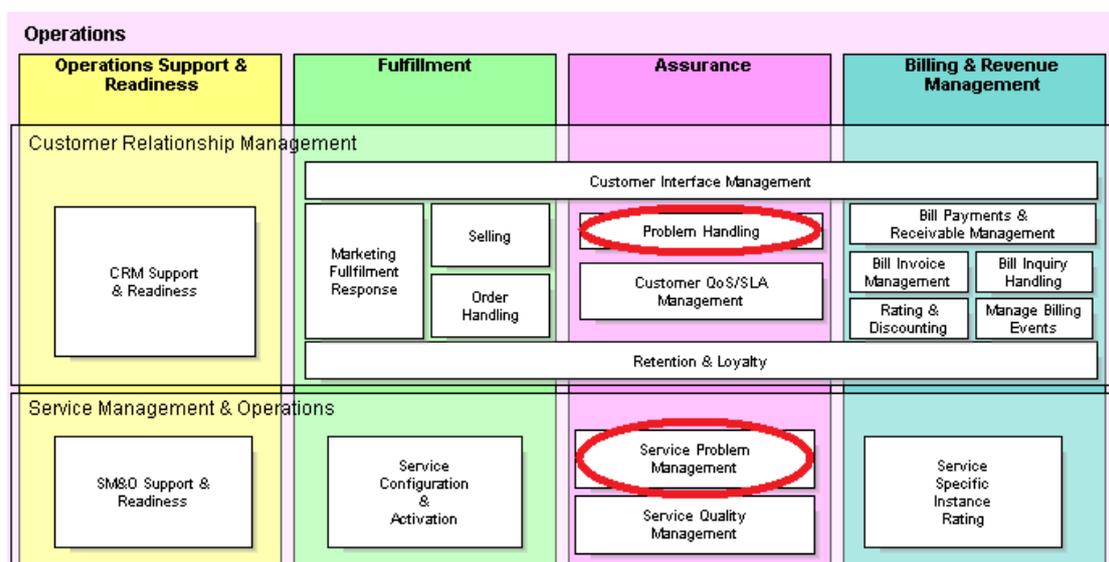


Figure 4.5: Relevant Level 2 processes of use case 2

Diagram [19]:

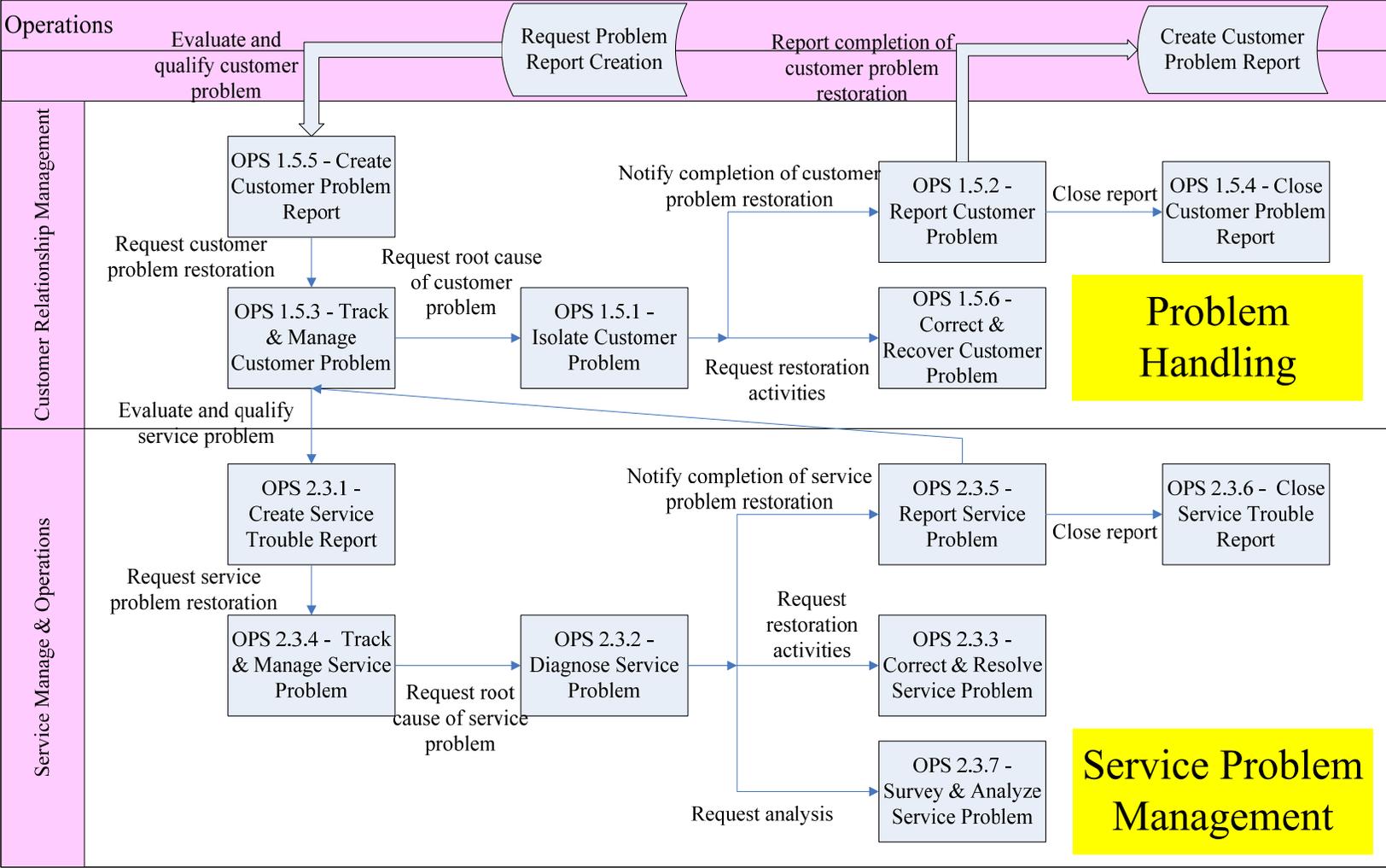


Diagram 4.2: Process flow diagram of use case 2

5 Conclusion

The TMF claims that eTOM is a common structure to define and share business processes within the telecommunications industry. Being a relevant part of the NGOSS architecture, it appears as a quite huge set of documents containing definitions of processes at different hierarchical levels, as well as best practice rules on how to use them. Implicitly or explicitly, eTOM assumes that service providers, manufacturers and other stakeholders run their companies with their own business processes architecture. That proprietary architectures are undoubtedly incompatible, both in terms of the syntaxes and the semantics of the entities (business processes) they deal with. Thus a complex scenario is depicted if these companies have to interact to reach their own goals. Therefore, the adoption of a common structure like eTOM would be beneficial for everybody and the TMF tries to ease this adoption in terms of rules and guidance contained in the set of documents that constitute the standard.

The motivation of this thesis was to understand and size the difficulties that a potential adopter of eTOM can find. For that reason we established the particular objectives of the thesis as:

- Know the challenges a given service provider has to face in order to provide services to their customers.
- Know how to express the needs of the service provider in terms of eTOM artefacts.
- Understand, in summary, the role of eTOM in the context of the NGOSS framework and the benefits brought by its potential use by service providers.

Likewise we adopted a methodology to tackle the problem consisting in a thorough study of the set of documents where eTOM is grounded, a search of the current commercial development and support tools and the specification of a scenario with the intention to apply eTOM to the contexts there defined.

Once the project has been finished we claim that the objectives have been fully reached. In fact this thesis begins with the introduction of NGOSS and e-TOM framework to provide a general background in this area. As part of increasing its focus on service management, TM Forum worked with service providers to gather their business requirements into a Business Process Model that evolved into the original Telecom Operations Map (TOM). A view of business processes across a whole enterprise is provided in this thesis, with new ways of handling commercial interactions between, and within, organizations.

It gives a direction in deploying cases in e-TOM framework by introducing the supporting tools for business process specification. It brings diverse ideas in utilizing the tools to assist the scenario design and implementation in the context of NGOSS.

From the ad hoc business process design tools to data structuring tools, it presents diverse possibilities to adopt the best choice for your own case due to the functionality and the price issue as well.

Recent work has extended the core e-TOM with detailed process decompositions and flows in high-priority areas. These are being rolled out as addenda to the basic business process framework. Through analyzing the scenarios, we obtain the knowledge of the challenges and efforts that the service provider need to confront. And by design and implementing, we experienced the whole procedure from the broad sense to specific details within e-TOM framework. It also highlight the benefits brought by e-TOM through the scenario implementation, thus objectives of this thesis are reached.

5.1 Thesis achievement

From the study of the eTOM set of documents we highlight that the latest specifications of eTOM corresponds to release number 8 (October 2008) of which the latest version is 0.10 (June 2009). This release is constituted by eleven documents and a release note that can be grouped in three categories as follows.

- Normative properly said. This group contains the description of the framework. GB921P *An eTOM primer* [17] is an introduction to the eTOM concepts and intended usage. It was helpful at the startup phase of this project. GB921 *Concepts and Principles* [6] is the main eTOM document. It constitutes the formal specification of the model. GB921D *Process Decompositions and Descriptions* [14] contains the detailed description of the eTOM hierarchy up to Level 3 processes. This is the main information source and has been thoroughly utilized in this project. GB921B [20] presents e-business as the interaction among business partners by means of information technologies. In other words it models the interactions between a service provider and its external world. The focus is in the inter-enterprise processes (business-to-business -B2B-). Specific processes are defined to support these interactions. Finally, GB921C [21] presents a B2B Business Operations Map (BOM) for levels 0, 1 and 2 and gives guidance for levels 3 and 4. It is highly related to the content of GB921B [20].
- Guidance documents. This set of documents is mainly addressed to users support. GB921U *User Guidelines for eTOM* [7] is intended to guide the users on how to apply eTOM to particular cases. Nevertheless the document covers only very peculiar aspects and in general doesn't fulfill the expectation of its title. GB921G *Guide to Applying the Business Process Framework* [16] is like GB921U [7] specially addressed to users. In this case the focus is on how to keep the business processes of a company aligned with eTOM. GB921F *Process Flow Examples* [15] illustrates the concept of end-to-end flow in some particular cases, namely service delivery and billing. GB921R *NGOSS Real World use Cases* [22] provides examples of use of eTOM in its broader context of NGOSS.

- Mapping to other framework documents. GB921T *eTOM to M3400 Mapping Application Note* [23] focus on the linkage between eTOM and TMN. Finally, GB921V [24] provides linkage between eTOM and ITIL

In front of all these documents the memory of this project is a valuable complement for those starting in the adoption of the framework. In fact, we provide a digest of eTOM making emphasis on the aspects that we believe will be more decisive at the modeling epoch. In this perspective our work complements the introductory documents of the official release. In addition, we offer a survey on most relevant design tools, which is out of scope of the TMF documents, because we believe that as much as the concepts themselves, selection of the right tools and the difficulties that their use may entail are of singular importance. Finally, and perhaps the most important, we offer a complete design process to a realistic use case under a different perspective of what is used to be in the TMF documents. In fact we present the case of the settlement of a company which is wishing to adopt the framework instead of the already existing company with their own business processes that is trying to align to eTOM. This is the main contribution of this thesis.

From the search of supporting tools we conclude that *Casewise Corporate Modeler Suite* is the most advanced ad-hoc design tool existing in the market. It is constituted by a set of independent elements allowing for drawings to specify processes and system behaviors - E2E flows - starting from a palette that includes all the eTOM currently defined processes. This is the basic tool to create user defined models. In addition, it provides tools for browsing through all the existing objects in a given model, to discover relationships among them. Special mention is the simulator of process flows that facilitates the detection of misbehaviors or to ascertain if a given performance objective can be fulfilled.

Due to time constraints and license getting issues we were not able to use the Casewise tools in this project. Instead we adopted ArcheTom as process specification tool and Visio as the end-to-end flows drawing tool. ArcheTom embeds the whole eTOM hierarchy up to Level 3 processes included. Processes can be modified and even extended to any other level. For each process, the user is allowed to use a template to fully specify the process. A pictorial representation showing the parent child relationships is permanently updated. Results of the design process can be partially exported to Excel sheets. We have to conclude that ArcheTom is an easy to use and a good alternative to more sophisticated tools especially in early phases of a project, when there is not yet a firm decision to adopt the business framework. For sure ArcheTom in combination with Visio has been more than enough to fulfill our project objectives. Its most apparent weakness is the lack of creating and simulating flows.

From the point of view of the specification of a practical scenario to apply eTOM we conceived the simplest scenario. The idea behind was to think in a service provider with a simple service portfolio, a reduced base of customers and a small owned managed network. In addition, we assumed that we were at the beginning of the

company creation so that no restriction could affect the decision of the process specification steps.

From the specification of the business processes applicable to the selected scenario we can highlight several facts. First of all, the importance to properly select a deployment structured in different implementation priorities. Otherwise, the effort is tremendous and the risk of adopting wrong decisions higher. In that line we considered as first priority processes a subset of the Fulfillment and Assurance areas, because without those processes is really apparent that the service provider can't start its business. More specifically we developed Order Handling and Problem Solving. For these groups of processes we adopted the framework up to Level 3 according to the current set of TMF documents and decomposed the Level 3 processes into Level 4 according to particular needs of our sample service provider company. At this point it is worthy to say that, due to the size of the company and its product portfolio, we don't consider to go further decomposing Level 4 processes into Level 5 ones. Having a too much fine grained decomposition would create more management complexity that would not be compensated by any additional clarification. For this reason our particular choice in this case is to stop the specification process at Level 4.

Another fact to highlight is about the specification methodology of the Level 4 processes. We took as a reference existing ongoing TMF work on processes decomposition at level 4 and for each of these candidate processes we decided whether it was or not appropriate to instantiate it for our service provider. The starting point to take the decision was the definition of these provisional works and our own conception about our target service provider. Here we have to say that even at Level 4 the processes that TMF is working on are rather generic and sometimes difficult to understand from the accompanying documentation. On the other hand, our own understanding of the business needs of the service provider company was quite elementary and therefore these were not aiding too much to interpret the above mentioned generic processes. For future work we propose to dig more in the area of the real business needs of a company and not only base the decision on the definition of generic processes. This business needs could be collected by means of questionnaires designed for that purpose.

5.2 Future work

Looking to the immediate future, work has to be a seamless continuation of what has been settled. As we said, current work is limited to a few Level 2 Operations processes. Therefore, still in this functional area it is necessary to pay attention to Billing & Revenue Assurance. Once this has been completed, the next natural step would be a quantitative description of each process. In fact, our current specification work ended with the textual description of the processes. Parameters like inputs, outputs, triggering events, ending events, execution costs, frequency, KPI should be determined for each process. In addition to the Operations area, it would be necessary to look at the SIP and the EM areas as well. In respect to SIP, the product area seems

to be the most prone to development in the context of our SME company. For instance, the marketing of services could be one of the first processes to be developed. As far the EM area is concerned we should take advantage of the creation of the new company to align its methods to the framework.

Once the first deployment phase is completed, our work as company consultants would be to keep track of the results of the implementations based on our advice. Special attention would deserve the comparison of the observed dynamic behavior of selected E2E flows with what could be foreseen by means of simulations. In order to do this it would be necessary to design a measurement program inline with the day to day activity of the company. The agreement between observed KPI and simulation results would confirm the initial design. Otherwise, appropriate corrective actions would be undertaken.

To sum up, we have accomplished a detailed project presentation and succeeded in introducing and implementing the practical approach to operation of telecommunication services driven by eTOM framework which reached the main objectives of this thesis. What's more, it also suggests the possible areas for future research to focus on.

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Appendix A

This appendix contains the processes needed in the thesis and the decomposition diagrams.

A.1 Business Processes

We list the processes from Level 1 to Level 4 (partially) in Fulfilling, Assurance and Billing (FAB) area inside eTOM framework:

<i>ArchiTelco Business Model</i>		
<i>Level 1</i>	<i>Level2</i>	<i>Level 3</i>
A. Strategy Infrastructure & Product		
SIP 1.0 - Marketing & Offer Management		
	SIP 1.1 - Market Strategy & Policy	
		SIP 1.1.1 - Gather & Analyze Market Information
		SIP 1.1.2 - Establish Market Strategy
		SIP 1.1.3 - Establish Market Segments
		SIP 1.1.4 - Link Market Segments & Products
		SIP 1.1.5 - Gain Commitment to Marketing Strategy
	SIP 1.2 - Product & Offer Portfolio Planning	
		SIP 1.2.1 - Gather & Analyze Product Information
		SIP 1.2.2 - Establish Product Portfolio Strategy
		SIP 1.2.3 - Produce Product Portfolio Business Plans
		SIP 1.2.4 - Gain Commitment To Product Business Plans
	SIP 1.3 - Product & Offer Capability Delivery	
		SIP 1.3.1 - Define Product Capability Requirements
		SIP 1.3.2 - Capture Product Capability Shortfalls
		SIP 1.3.3 - Approve Product Business Case
		SIP 1.3.4 - Deliver Product Capability
		SIP 1.3.5 - Manage Handover to Product Operations
		SIP 1.3.6 - Manage Product Capability Delivery Methodology
	SIP 1.4 - Marketing Capability Delivery	
		SIP 1.4.1 - Define Marketing Capability Requirements
		SIP 1.4.2 - Gain Marketing Capability Approval
		SIP 1.4.3 - Deliver Marketing Infrastructure
		SIP 1.4.4 - Manage Handover to Marketing Operations
		SIP 1.4.5 - Manage Marketing Capability Delivery Methodology
	SIP 1.5 - Sales Development	
		SIP 1.5.1 - Monitor Sales & Channel Best Practice

	SIP 1.5.2 - Develop Sales & Channel Proposals
	SIP 1.5.3 - Develop New Sales Channels & Processes
	SIP 1.6 - Product Marketing Communications & Promotion
	SIP 1.6.1 - Define Product Marketing Promotion Strategy
	SIP 1.6.2 - Develop Product & Campaign Message
	SIP 1.6.3 - Select Message & Campaign Channels
	SIP 1.6.4 - Develop Promotional Collateral
	SIP 1.6.5 - Manage Message and Campaign Delivery
	SIP 1.6.6 - Monitor Message & Campaign Effectiveness
	SIP 1.7 - Product & Offer Development & Retirement
	SIP 1.7.1 - Gather & Analyze New Product Ideas
	SIP 1.7.2 - Assess Performance of Existing Products
	SIP 1.7.3 - Develop New Product Business Proposal
	SIP 1.7.4 - Develop Product Commercialization Strategy
	SIP 1.7.5 - Develop Detailed Product Specifications
	SIP 1.7.6 - Manage Product Development
	SIP 1.7.7 - Launch New Products
	SIP 1.7.8 - Manage Product Exit
	SIP 2.0 - Service Development & Management
	SIP 2.1 - Service Strategy & Planning
	SIP 2.1.1 - Gather & Analyze Service Information
	SIP 2.1.2 - Manage Service Research
	SIP 2.1.3 - Establish Service Strategy & Goals
	SIP 2.1.4 - Define Service Support Strategies
	SIP 2.1.5 - Produce Service Business Plans
	SIP 2.1.6 - Develop Service Partnership Requirements
	SIP 2.1.7 - Gain Enterprise Commitment to Service Strategies
	SIP 2.2 - Service Capability Delivery
	SIP 2.2.1 - Map & Analyze Service Requirements
	SIP 2.2.2 - Capture Service Capability Shortfalls
	SIP 2.2.3 - Gain Service Capability Investment Approval
	SIP 2.2.4 - Design Service Capabilities
	SIP 2.2.5 - Enable Service Support & Operations
	SIP 2.2.6 - Manage Service Capability Delivery
	SIP 2.2.7 - Manage Handover to Service Operations
	SIP 2.3 - Service Development & Retirement
	SIP 2.3.1 - Gather & Analyze New Service Ideas
	SIP 2.3.2 - Assess Performance of Existing Services
	SIP 2.3.3 - Develop New Service Business Proposal
	SIP 2.3.4 - Develop Detailed Service Specifications
	SIP 2.3.5 - Manage Service Development
	SIP 2.3.6 - Manage Service Deployment
	SIP 2.3.7 - Manage Service Exit

SIP 3.0 - Resource Development & Management (Application, Computing & Network)		
	SIP 3.1 - Resource Strategy & Planning	
		SIP 3.1.1 - Gather & Analyze Resource Information
		SIP 3.1.2 - Manage Resource Research
		SIP 3.1.3 - Establish Resource Strategy & Architecture
		SIP 3.1.4 - Define Resource Support Strategies
		SIP 3.1.5 - Produce Resource Business Plans
		SIP 3.1.6 - Develop Resource Partnership Requirements
		SIP 3.1.7 - Gain Enterprise Commitment to Resource Plans
	SIP 3.2 - Resource Capability Delivery	
		SIP 3.2.1 - Map & Analyze Resource Requirements
		SIP 3.2.2 - Capture Resource Capability Shortfalls
		SIP 3.2.3 - Gain Resource Capability Investment Approval
		SIP 3.2.4 - Design Resource Capabilities
		SIP 3.2.5 - Enable Resource Support & Operations
		SIP 3.2.6 - Manage Resource Capability Delivery
		SIP 3.2.7 - Manage Handover to Resource Operations
	SIP 3.3 - Resource Development & Retirement	
		SIP 3.3.1 - Gather & Analyze New Resource Ideas
		SIP 3.3.2 - Assess Performance of Existing Resources
		SIP 3.3.3 - Develop New Resource Business Proposal
		SIP 3.3.4 - Develop Detailed Resource Specifications
		SIP 3.3.5 - Manage Resource Development
		SIP 3.3.6 - Manage Resource Deployment
		SIP 3.3.7 - Manage Resource Exit
SIP 4.0 - Supply Chain Development & Management		
	SIP 4.1 - Supply Chain Strategy & Planning	
		SIP 4.1.1 - Gather & Analyze Supply Chain Information
		SIP 4.1.2 - Establish Supply Chain Strategy & Goals
		SIP 4.1.3 - Define Supply Chain Support Strategies
		SIP 4.1.4 - Produce Supply Chain Business Plans
		SIP 4.1.5 - Gain Enterprise Commitment to Supply Chain Plans
	SIP 4.2 - Supply Chain Capability Delivery	
		SIP 4.2.1 - Determine the Sourcing Requirements
		SIP 4.2.2 - Determine Potential Suppliers/Partners
		SIP 4.2.3 - Manage the Tender Process
		SIP 4.2.4 - Gain Tender Decision Approval
		SIP 4.2.5 - Negotiate Commercial Arrangements
		SIP 4.2.6 - Gain Approval for Commercial Arrangements
	SIP 4.3 - Supply Chain Development & Change Management	
		SIP 4.3.1 - Manage Supplier/Partner Engagement
		SIP 4.3.2 - Manage Supply Chain Contract Variation
		SIP 4.3.3 - Manage Supplier/Partner Termination

B. Operations	
OPS 1.0 - Customer Relationship Management	
	OPS 1.1 - CRM Support & Readiness
	OPS 1.1.1 - Support Customer Interface Management
	OPS 1.1.2 - Support Order Handling
	OPS 1.1.3 - Support Problem Handling
	OPS 1.1.4 - Support Billing & Collections
	OPS 1.1.5 - Support Retention & Loyalty
	OPS 1.1.6 - Support Marketing Fulfillment
	OPS 1.1.7 - Support Selling
	OPS 1.1.8 - Support Customer QoS/SLA
	OPS 1.1.9 - Manage Campaign
	OPS 1.1.10 - Manage Customer Inventory
	OPS 1.1.11 - Manage Product Offering Inventory
	OPS 1.1.12 - Manage Sales Inventory
	OPS 1.1.13 - Support Bill Invoice Management
	OPS 1.1.14 - Support Bill Payments & Receivables Management
	OPS 1.1.15 - Support Bill Inquiry Handling
	OPS 1.2 - Selling
	OPS 1.2.1 - Manage Prospect
	OPS 1.2.2 - Qualify Opportunity
	OPS 1.2.3 - Negotiate Sales/Contact
	OPS 1.2.4 - Acquire Customer Data
	OPS 1.2.5 - Cross/Up Selling
	OPS 1.2.6 - Develop Sales Proposal
	OPS 1.2.7 - Manage Sales Accounts
	OPS 1.3 - Marketing Fulfillment Response
	OPS 1.3.1 - Issue and Distribute Marketing Collaterals
	OPS 1.3.2 - Track Leads
	OPS 1.4 - Order Handling
	OPS 1.4.1 - Determine Preorder Feasibility
	OPS 1.4.2 - Authorize Credit
	OPS 1.4.3 - Receive PO & Issue Orders
	OPS 1.4.4 - Track & Manage Customer Order Handling
	OPS 1.4.5 - Complete Customer Order
	OPS 1.4.6 - Issue Customer Orders
	OPS 1.4.7 - Report Customer Order Handling
	OPS 1.4.8 - Close Customer Order
	OPS 1.5 - Problem Handling
	OPS 1.5.1 - Isolate Customer Problem
	OPS 1.5.2 - Report Customer Problem
	OPS 1.5.3 - Track & Manage Customer Problem

		OPS 1.5.4 - Close Customer Problem Report
		OPS 1.5.5 - Create Customer Problem Report
		OPS 1.5.6 - Correct & Recover Customer Problem
		OPS 1.6 - Customer QoS/SLA Management
		OPS 1.6.1 - Assess Customer QoS/SLA Performance
		OPS 1.6.2 - Manage QoS/SLA Violation
		OPS 1.6.3 - Report Customer QoS Performance
		OPS 1.6.4 - Create Customer QoS Performance Degradation Report
		OPS 1.6.5 - Track & Manage Customer QoS Performance Resolution
		OPS 1.6.6 - Close Customer QoS Performance Degradation Report
		OPS 1.7 - Customer Interface Management
		OPS 1.7.1 - Manage Contact
		OPS 1.7.2 - Manage Request (Including Self Service)
		OPS 1.7.3 - Analyze & Report on Customer
		OPS 1.7.4 - Mediate & Orchestrate Customer Interactions
		OPS 1.8 - Retention & Loyalty
		OPS 1.8.1 - Establish & Terminate Customer Relationship
		OPS 1.8.2 - Build Customer Insight
		OPS 1.8.3 - Analyze & Manage Customer Risk
		OPS 1.8.4 - Personalize Customer Profile for Retention & Loyalty
		OPS 1.8.5 - Validate Customer Satisfaction
		OPS 1.9 - Bill Payments & Receivable Management
		OPS 1.9.1 - Manage Customer Billing
		OPS 1.9.2 - Manage Customer Payments
		OPS 1.9.3 - Manage Customer Debt Collection
		OPS 1.10 - Bill Invoice Management
		OPS 1.10.1 - Apply Pricing, Discounting, Adjustments & Rebates
		OPS 1.10.2 - Create Customer Bill Invoice
		OPS 1.10.3 - Produce & Distribute Bill
		OPS 1.11 - Bill Inquiry Handling
		OPS 1.11.1 - Create Customer Bill Inquiry Report
		OPS 1.11.2 - Assess Customer Bill Inquiry Report
		OPS 1.11.3 - Authorize Customer Bill Invoice Adjustment
		OPS 1.11.4 - Track & Manage Customer Bill Inquiry Resolution
		OPS 1.11.5 - Report Customer Bill Inquiry
		OPS 1.11.6 - Close Customer Bill Inquiry Report
		OPS 1.12 - Rating & Discounting
		OPS 1.12.1 - Perform Rating
		OPS 1.12.2 - Apply Rate Level Discounts
		OPS 1.13 - Manage Billing Events

		OPS 1.13.1 - Enrich Billing Events
		OPS 1.13.2 - Guide Billing Events
		OPS 1.13.3 - Mediate Billing Events
		OPS 1.13.4 - Report Billing Event Records
OPS 2.0 - Service Management & Operations		
		OPS 2.1 - SM&O Support & Readiness
		OPS 2.1.1 - Manage Service Inventory
		OPS 2.1.2 - Enable Service Configuration & Activation
		OPS 2.1.3 - Support Service Problem Management
		OPS 2.1.4 - Enable Service Quality Management
		OPS 2.1.5 - Support Service & Specific Instance Rating
		OPS 2.2 - Service Configuration & Activation
		OPS 2.2.1 - Design Solution
		OPS 2.2.2 - Allocate Specific Service Parameters to Services
		OPS 2.2.3 - Track & Manage Service Provisioning
		OPS 2.2.4 - Implement, Configure & Activate Service
		OPS 2.2.5 - Test Service End-to-End
		OPS 2.2.6 - Activate Service
		OPS 2.2.7 - Issue Service Orders
		OPS 2.2.8 - Report Service Provisioning
		OPS 2.2.9 - Close Service Order
		OPS 2.2.10 - Recover Service
		OPS 2.3 - Service Problem Management
		OPS 2.3.1 - Create Service Trouble Report
		OPS 2.3.2 - Diagnose Service Problem
		OPS 2.3.3 - Correct & Resolve Service Problem
		OPS 2.3.4 - Track & Manage Service Problem
		OPS 2.3.5 - Report Service Problem
		OPS 2.3.6 - Close Service Trouble Report
		OPS 2.3.7 - Survey & Analyze Service Problem
		OPS 2.4 - Service Quality Management
		OPS 2.4.1 - Monitor Service Quality
		OPS 2.4.2 - Analyze Service Quality
		OPS 2.4.3 - Improve Service Quality
		OPS 2.4.4 - Report Service Quality Performance
		OPS 2.4.5 - Create Service Performance Degradation Report
		OPS 2.4.6 - Track & Manage Service Quality Performance Resolution
		OPS 2.4.7 - Close Service Performance Degradation Report
		OPS 2.5 - Service Specific Instance Rating
		OPS 2.5.1 - Mediate Service Usage Records
		OPS 2.5.2 - Not Available Process
		OPS 2.5.3 - Report Service Usage Records

		OPS 2.5.4 - Guide Resource Usage Records
OPS 3.0 - Resource Management & Operations (Application, Computing & Network)		
		OPS 3.1 - RM&O Support & Readiness
		OPS 3.1.1 - Enable Resource Provisioning
		OPS 3.1.2 - Enable Resource Performance Management
		OPS 3.1.3 - Support Resource Trouble Management
		OPS 3.1.4 - Enable Resource Data Collection & Distribution
		OPS 3.1.5 - Manage Resource Inventory
		OPS 3.1.6 - Not Available
		OPS 3.1.7 - Manage Logistics
		OPS 3.2 - Resource Provisioning
		OPS 3.2.1 - Allocate & Install Resource
		OPS 3.2.2 - Configure & Activate Resource
		OPS 3.2.3 - Test Resource
		OPS 3.2.4 - Collect, Update & Report Resource Configuration Data
		OPS 3.2.5 - Track & Manage Resource Provisioning
		OPS 3.2.6 - Report Resource Provisioning
		OPS 3.2.7 - Close Resource Order
		OPS 3.2.8 - Issue Resource Orders
		OPS 3.2.9 - Recover Resource
		OPS 3.3 - Resource Trouble Management
		OPS 3.3.1 - Survey & Analyze Resource Trouble
		OPS 3.3.2 - Localize Resource Trouble
		OPS 3.3.3 - Correct & Resolve Resource Trouble
		OPS 3.3.4 - Track & Manage Resource Trouble
		OPS 3.3.5 - Report Resource Trouble
		OPS 3.3.6 - Close Resource Trouble Report
		OPS 3.3.7 - Create Resource Trouble Report
		OPS 3.4 - Resource Performance Management
		OPS 3.4.1 - Monitor Resource Performance
		OPS 3.4.2 - Analyze Resource Performance
		OPS 3.4.3 - Control Resource Performance
		OPS 3.4.4 - Report Resource Performance
		OPS 3.4.5 - Create Resource Performance Degradation Report
		OPS 3.4.6 - Track & Manage Resource Performance Resolution
		OPS 3.4.7 - Close Resource Performance Degradation Report
		OPS 3.5 - Resource Data Collection & Distribution
		OPS 3.5.1 - Collect Management Information & Data
		OPS 3.5.2 - Process Management Information & Data
		OPS 3.5.3 - Distribute Management Information & Data
		OPS 3.5.4 - Audit Data Collection & Distribution
		OPS 3.6 - Resource Mediation & Reporting

		OPS 3.6.1 - Mediate Resource Usage Records
		OPS 3.6.2 - Report Resource Usage Records
	OPS 3.7 - Manage Workforce	
		OPS 3.7.1 - Manage Appointment Schedule
		OPS 3.7.2 - Assign Work Order
		OPS 3.7.3 - Track & Manage Work Order
		OPS 3.7.4 - Plan and Forecast Workforce
		OPS 3.7.5 - Administer Workforce
		OPS 3.7.6 - Report Manage Workforce
		OPS 3.7.7 - Close Work Order
		OPS 3.7.8 - Issue Work Order
	OPS 4.0 - Supplier/Partner Relationship Management	
	OPS 4.1 - S/PRM Support & Readiness	
		OPS 4.1.1 - Support S/P Requisition Management
		OPS 4.1.2 - Support S/P Problem Reporting & Management
		OPS 4.1.3 - Support S/P Performance Management
		OPS 4.1.4 - Support S/P Settlements & Payment Management
		OPS 4.1.5 - Support S/P Interface Management
		OPS 4.1.6 - Manage Supplier/Partner Inventory
	OPS 4.2 - S/P Requisition Management	
		OPS 4.2.1 - Select Supplier /Partner
		OPS 4.2.2 - Determine S/P Pre-Requisition Feasibility
		OPS 4.2.3 - Track & Manage S/P Requisition
		OPS 4.2.4 - Receive & Accept S/P Requisition
		OPS 4.2.5 - Initiate S/P Requisition Order
		OPS 4.2.6 - Report S/P Requisition
		OPS 4.2.7 - Close S/P Requisition Order
	OPS 4.3 - S/P Problem Reporting & Management	
		OPS 4.3.1 - Initiate S/P Problem Report
		OPS 4.3.2 - Receive S/P Problem Report
		OPS 4.3.3 - Track & Manage S/P Problem Resolution
		OPS 4.3.4 - Report S/P Problem Resolution
		OPS 4.3.5 - Close S/P Problem Report
	OPS 4.4 - S/P Performance Management	
		OPS 4.4.1 - Monitor & Control S/P Service Performance
		OPS 4.4.2 - Track & Manage S/P Performance Resolution
		OPS 4.4.3 - Report S/P Performance
		OPS 4.4.4 - Close S/P Performance Degradation Report
		OPS 4.4.5 - Initiate S/P Performance Degradation Report
	OPS 4.5 - S/P Settlements & Payments Management	
		OPS 4.5.1 - Manage Account
		OPS 4.5.2 - Receive & Assess Invoice
		OPS 4.5.3 - Negotiate & Approve Invoice

		OPS 4.5.4 - Issue Settlement Notice & Payment
	OPS 4.6 - S/P Interface Management	
		OPS 4.6.1 - Manage S/P Requests (including Self Service)
		OPS 4.6.2 - Analyze & Report S/P Interactions
		OPS 4.6.3 - Mediate & Orchestrate Supplier/Partner Interactions
C. Enterprise Management		
EM 1.0 - Strategic & Enterprise Planning		
	EM 1.1 - Strategic Business Planning	
	EM 1.2 - Business Development	
	EM 1.3 - Enterprise Architecture Management	
	EM 1.4 - Group Enterprise Management	
EM 2.0 - Enterprise Risk Management		
	EM 2.1 - Business Continuity Management	
	EM 2.2 - Security Management	
	EM 2.3 - Fraud Management	
	EM 2.4 - Audit Management	
	EM 2.5 - Insurance Management	
	EM 2.6 - Revenue Assurance Management	
		EM 2.6.1 - Manage Revenue Assurance Policy Framework
		EM 2.6.2 - Manage Revenue Assurance Operations
		EM 2.6.3 - Support Revenue Assurance Operations
EM 3.0 - Enterprise Effectiveness Management		
	EM 3.1 - Process Management & Support	
	EM 3.2 - Enterprise Quality Management	
	EM 3.3 - Program & Project Management	
	EM 3.4 - Enterprise Performance Assessment	
	EM 3.5 - Facilities Management & Support	
EM 4.0 - Knowledge & Research Management		
	EM 4.1 - Knowledge Management	
	EM 4.2 - Research Management	
	EM 4.3 - Technology Scanning	
EM 5.0 - Financial & Asset Management		
	EM 5.1 - Financial Management	
	EM 5.2 - Asset Management	
	EM 5.3 - Procurement Management	
EM 6.0 - Stakeholder & External Relations Management		
	EM 6.1 - Corporate Communications & Image Management	
	EM 6.2 - Community Relations Management	
	EM 6.3 - Shareholder Relations Management	
	EM 6.4 - Regulatory Management	
	EM 6.5 - Legal Management	
	EM 6.6 - Board & Shares/Securities Management	
EM 7.0 - Human Resources Management		

	EM 7.1 - HR Policies & Practices
	EM 7.2 - Organization Development
	EM 7.3 - Workforce Strategy
	EM 7.4 - Workforce development
	EM 7.5 - Employee & Labor Relations Management

Table A.1 Processes from Level 1 to Level 3 in eTOM framework

A.2 Decomposition diagram

Utilizing ArcheTOM, we reach the decomposition diagram into Level 4. The detail is shown as follows:

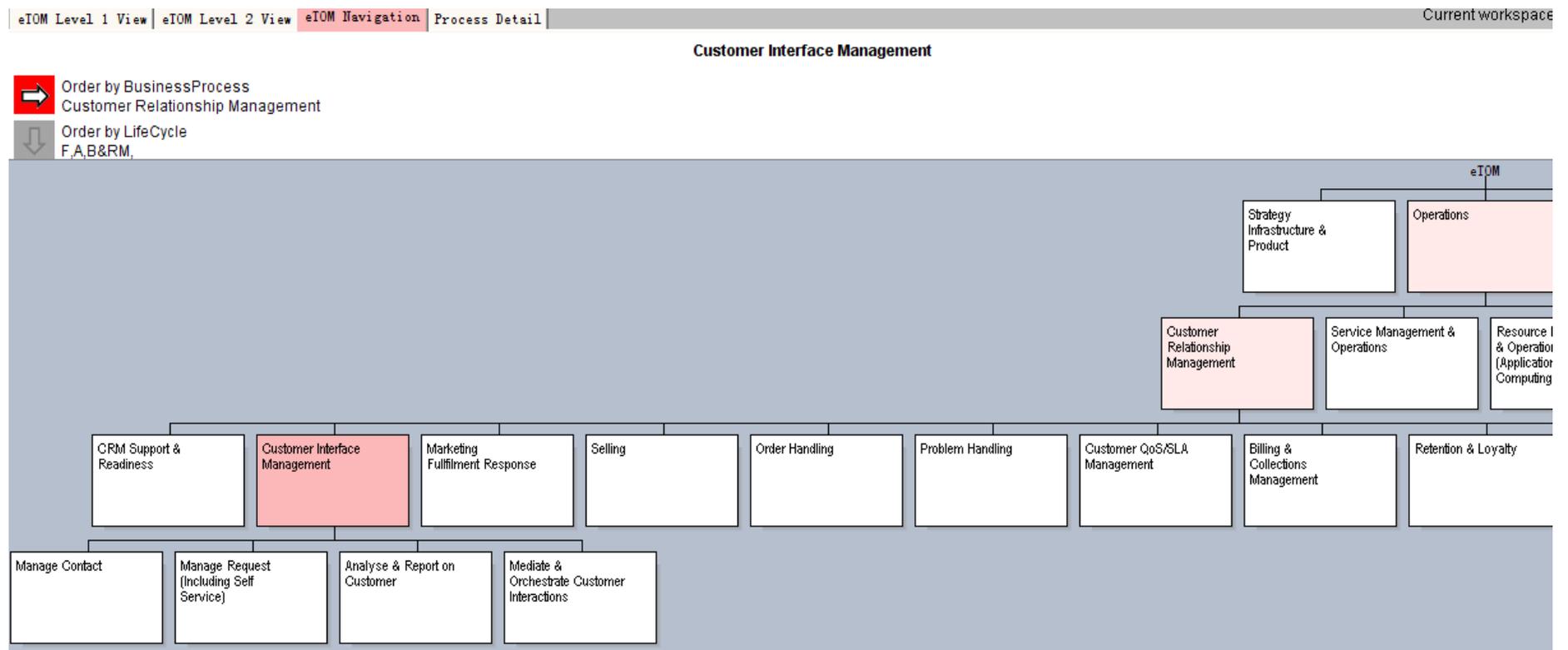


Figure A.1 Customer Interface Management decomposition to Level 3

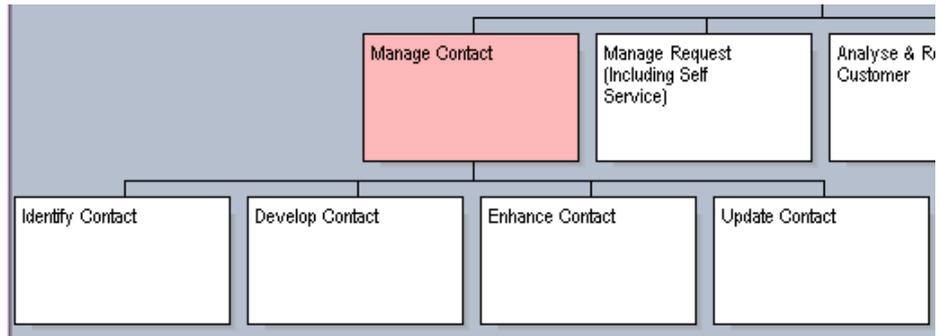


Figure A.2 Manage Contact decomposition to Level 4

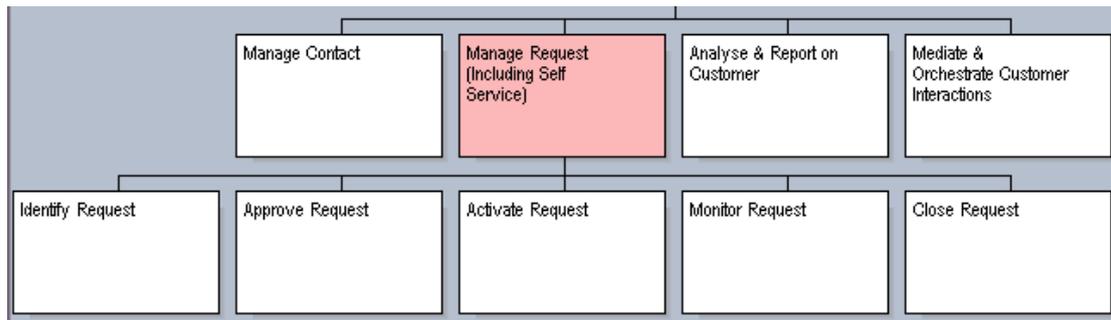


Figure A.3 Management Request decomposition to Level 4

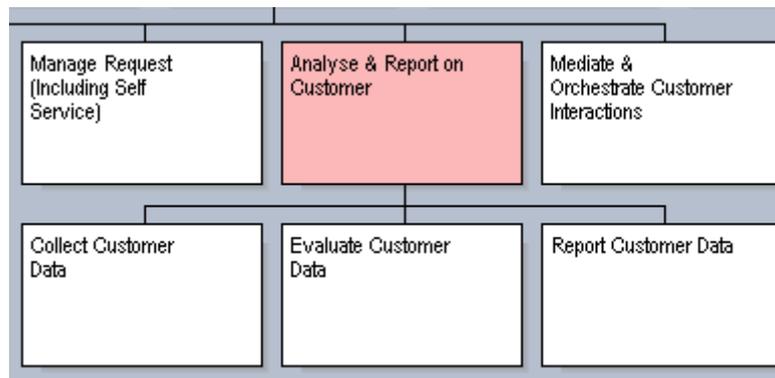


Figure A.4 Analyze & Report on Customer decomposition to Level 4

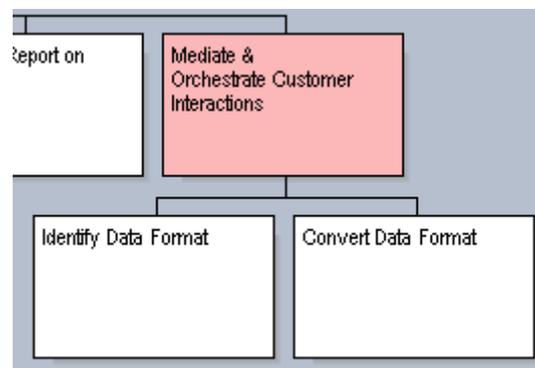


Figure A.5 Mediate & Orchestrate Customer Interaction decomposition to Level 4

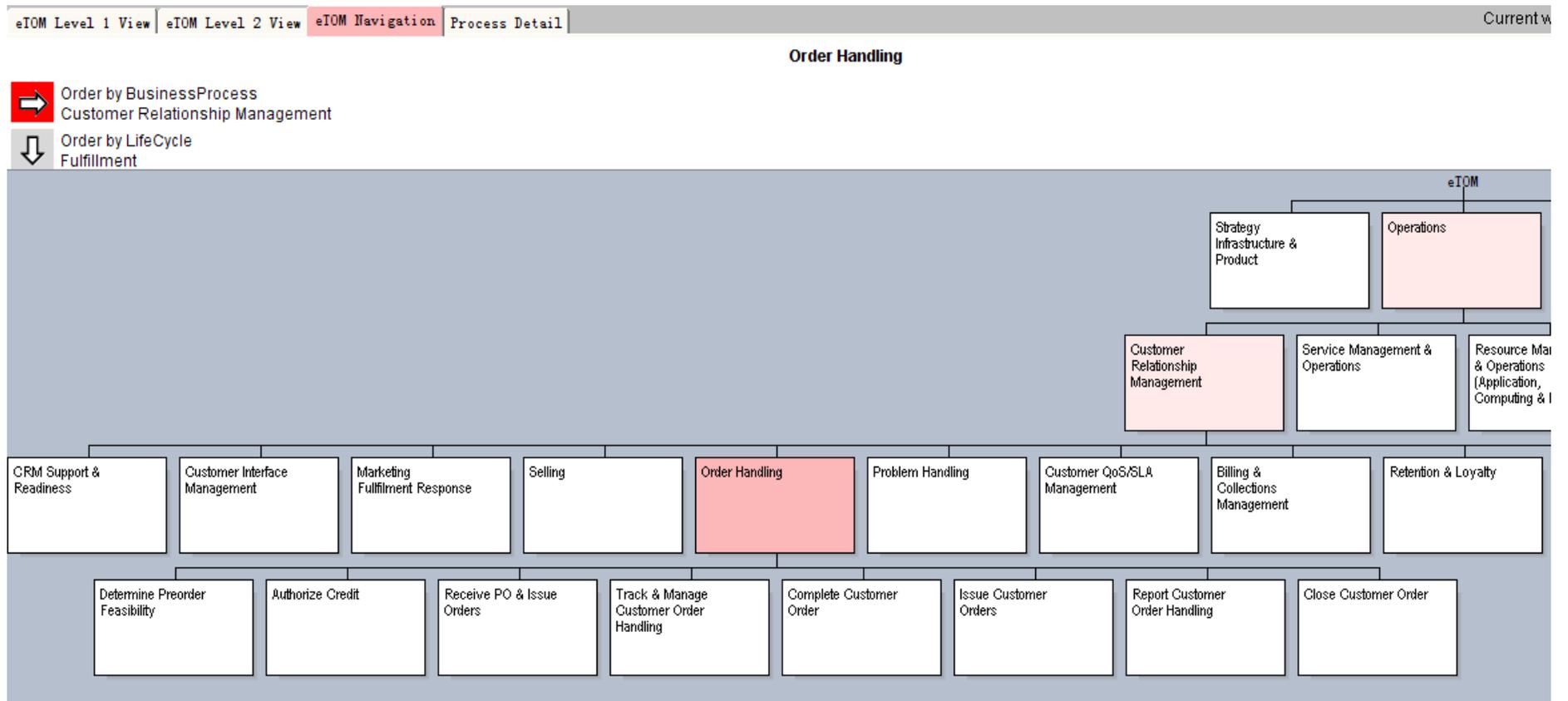


Figure A.6 Order Handling decomposition to Level 3

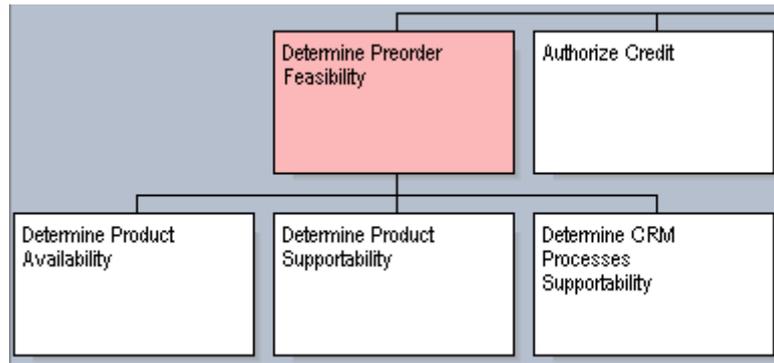


Figure A.7 Determine Preorder Feasibility decomposition to Level 4

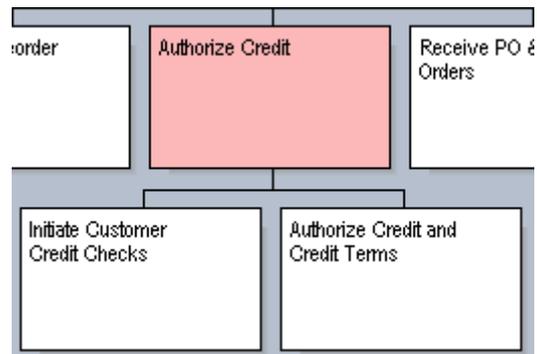


Figure A.8 Authorize Credit decomposition to Level 4

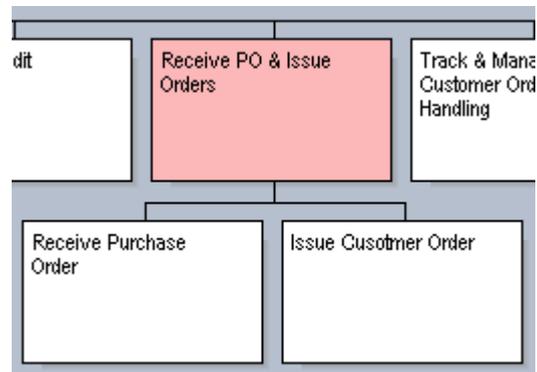


Figure A.9 Receive PO & Issue Orders decomposition to Level 4

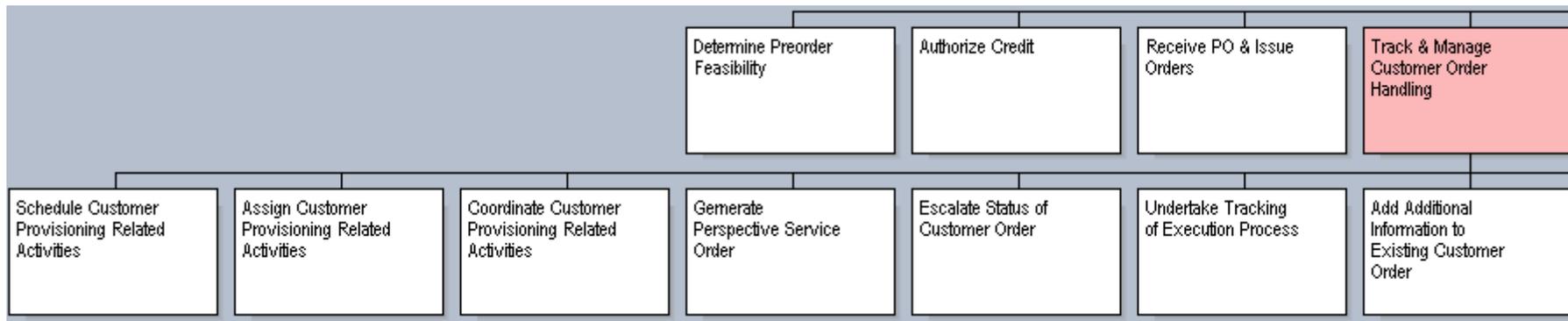


Figure A.10 Track & Manage Customer Order Handling decomposition to Level 4 a

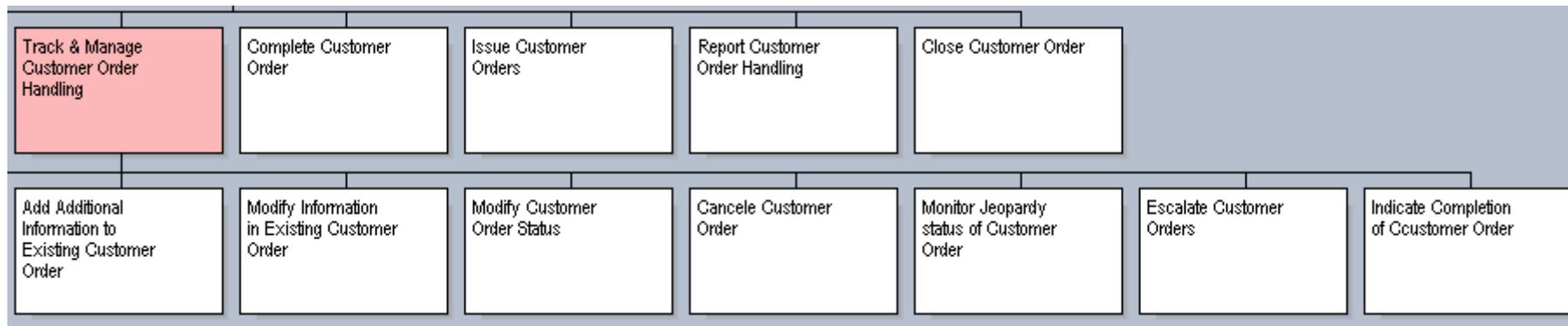


Figure A.11 Track & Manage Customer Order Handling decomposition to Level 4 b

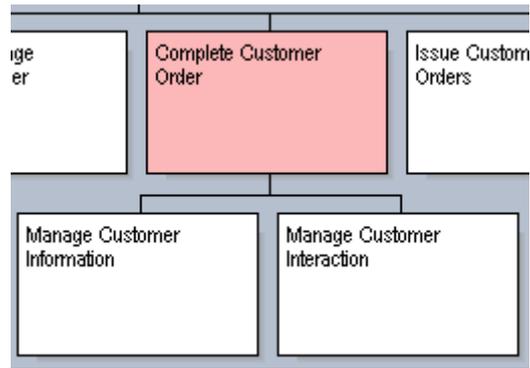


Figure A.12 Complete Customer Order decomposition to Level 4

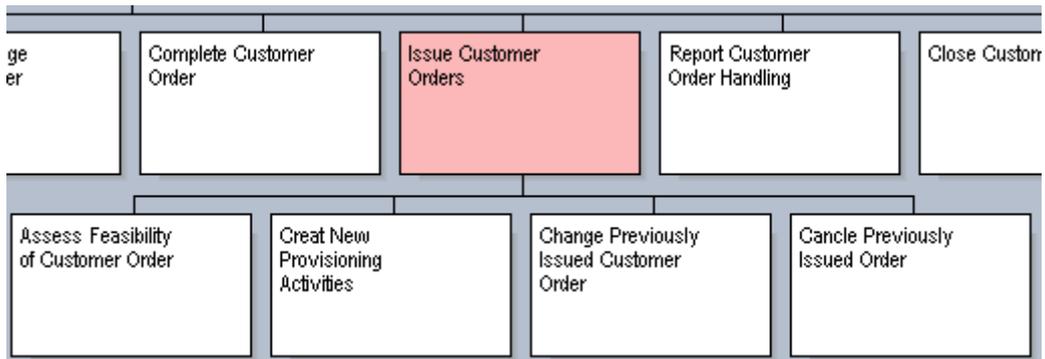


Figure A.13 Issue Customer Order decomposition to Level 4

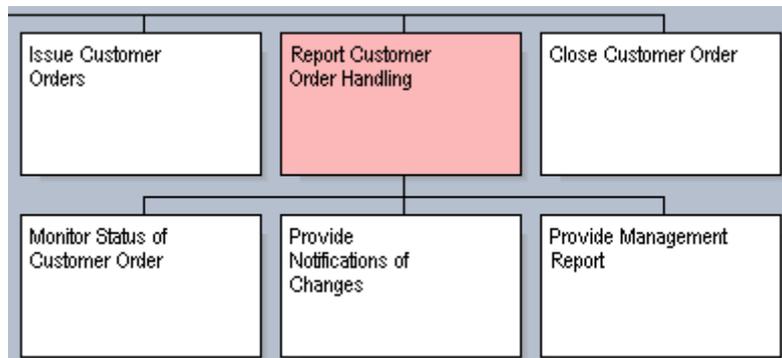


Figure A.14 Report Customer Order Handling decomposition to Level 4

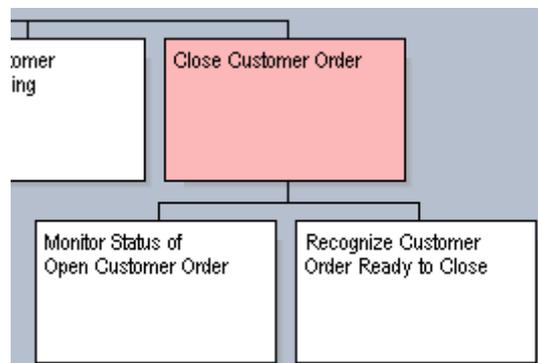


Figure A.15 Close Customer Order decomposition to Level 4

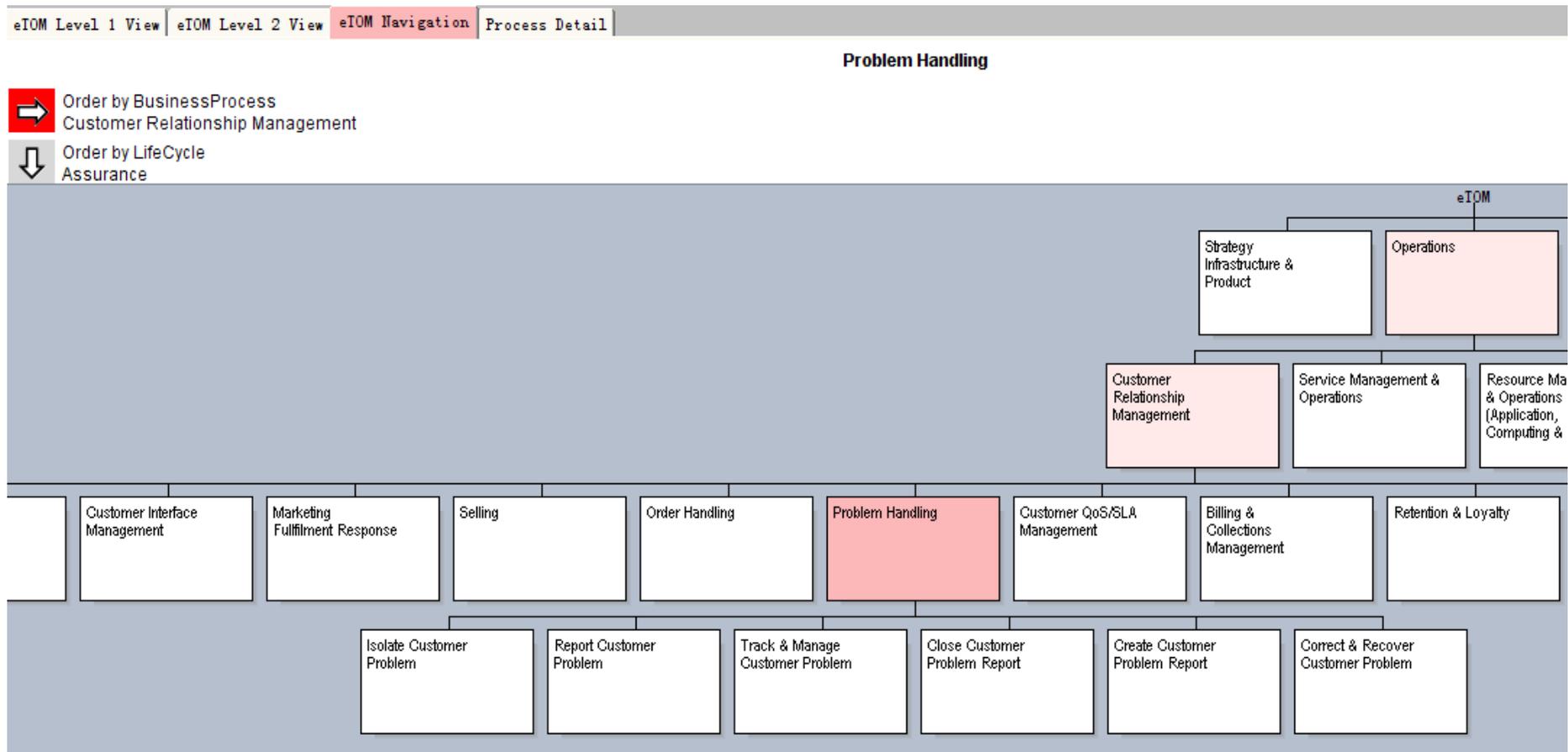


Figure A.16 Problem handling decomposition to Level 3

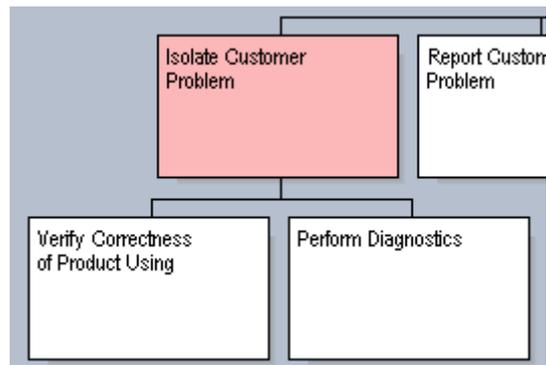


Figure A.17 Isolate Customer Problem decomposition to Level 4

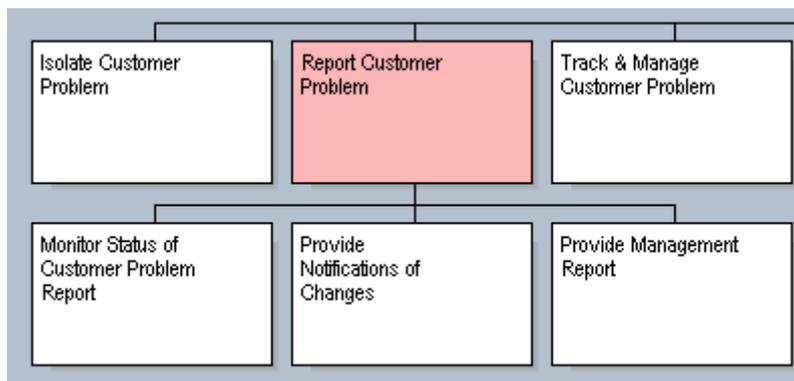


Figure A.18 Report Customer Problem decomposition to Level 4

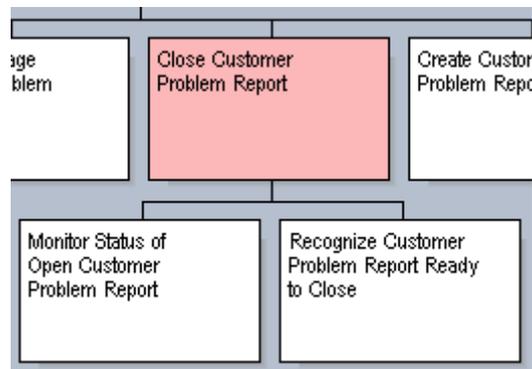


Figure A.19 Close Customer Problem Report decomposition to Level 4

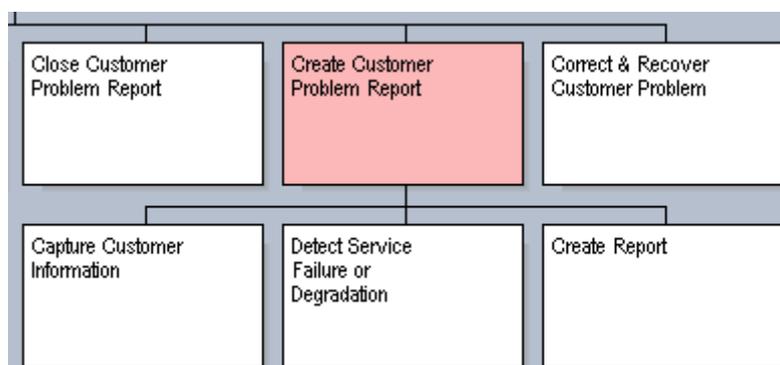


Figure A.20 Create Customer Problem Report decomposition to Level 4

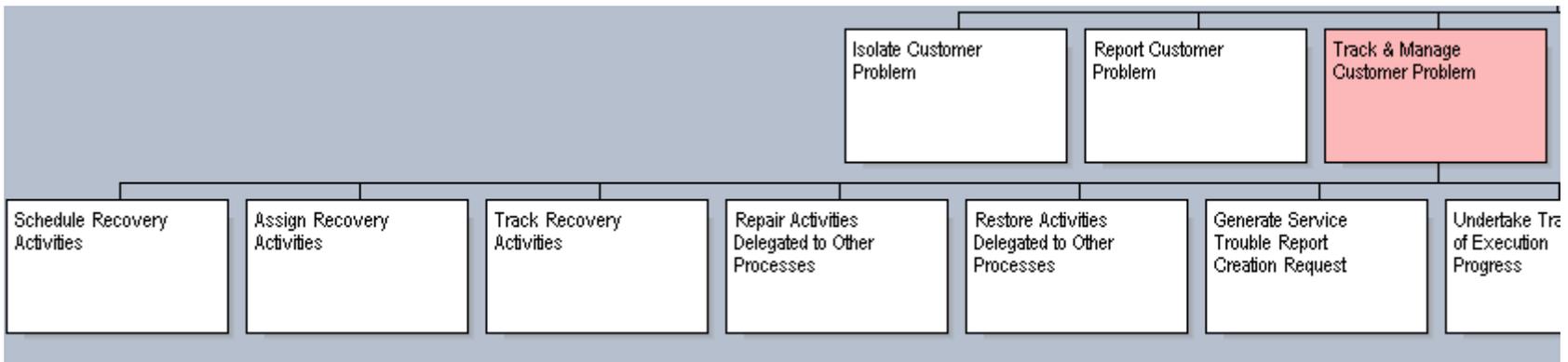


Figure A.21 Track & Manage Customer Problem decomposition to Level 4 a

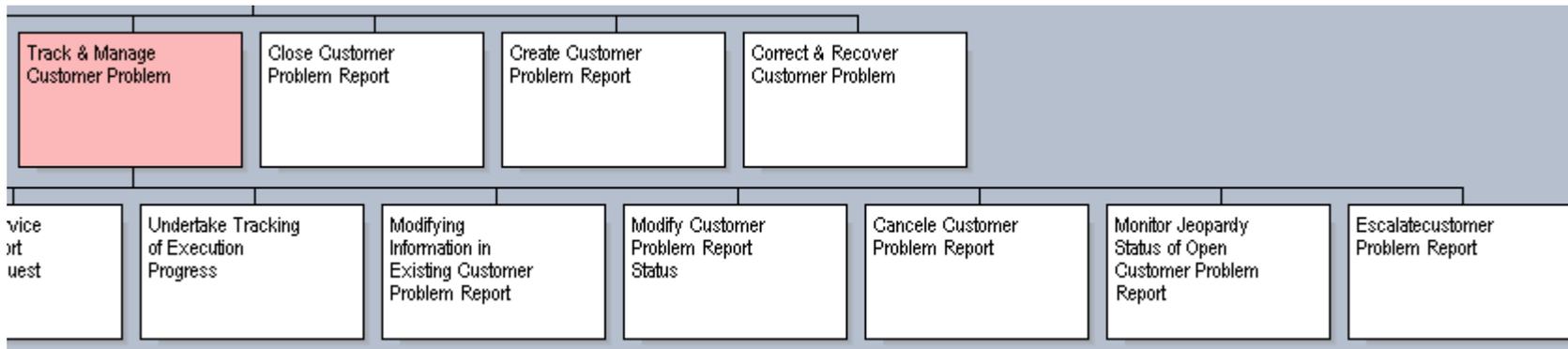


Figure A.22 Track & Manage Customer Problem decomposition to Level 4 b

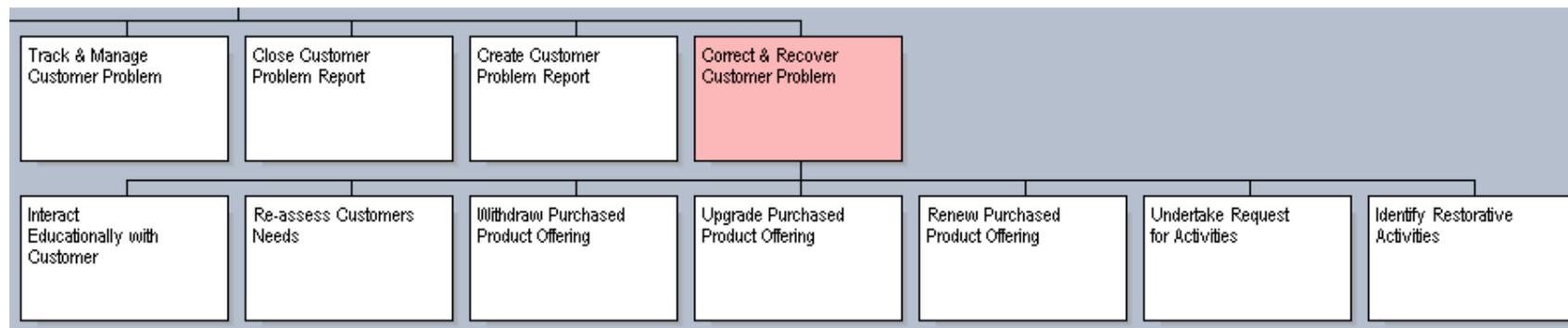


Figure A.23 Correct & Recover Customer Problem decomposition to Level 4

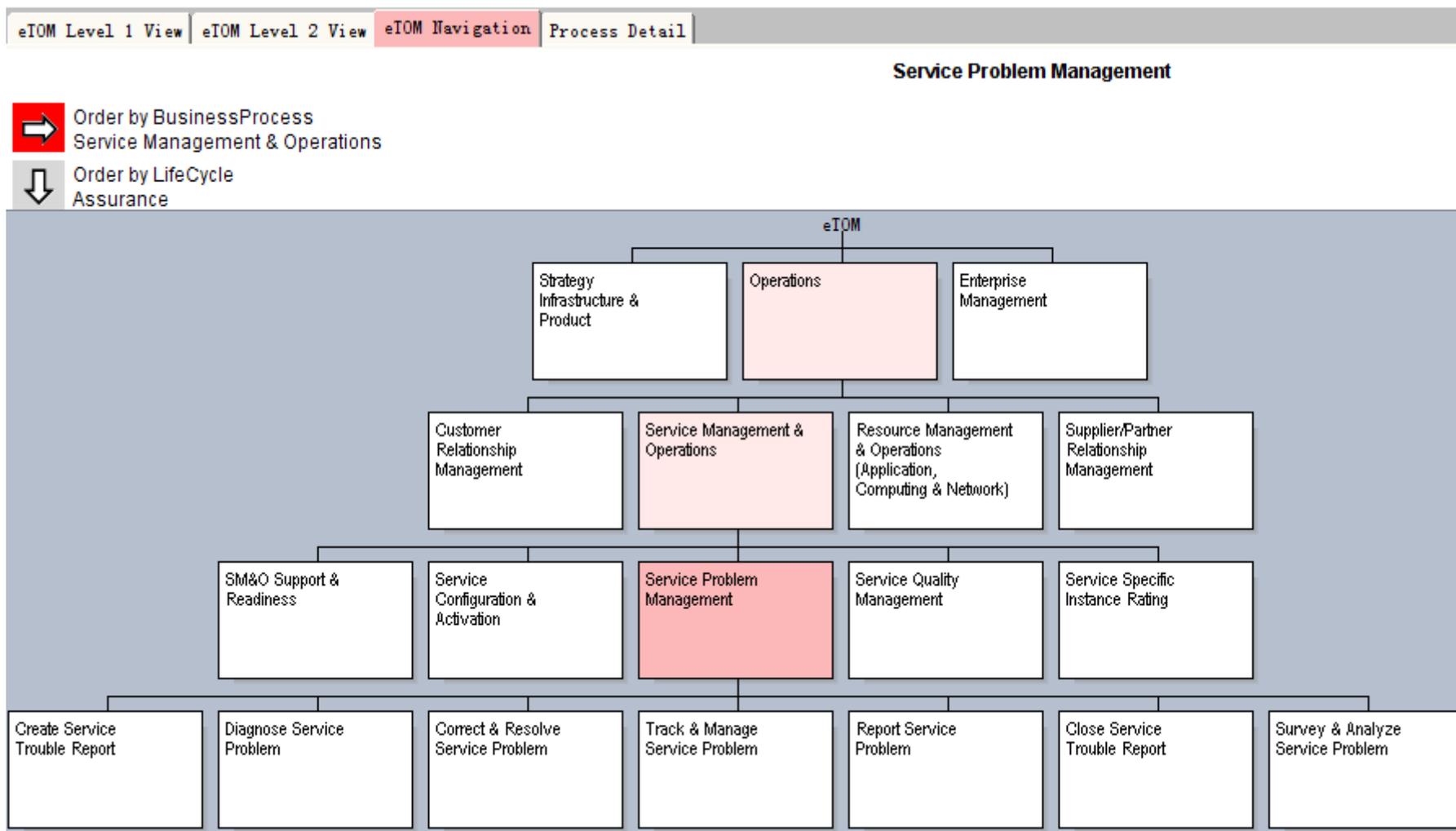


Figure A.24 Service Problem Management decomposition to Level 3

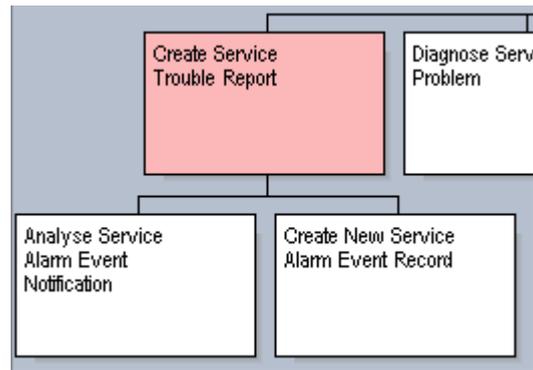


Figure A.25 Create Service Trouble Report decomposition to Level 4

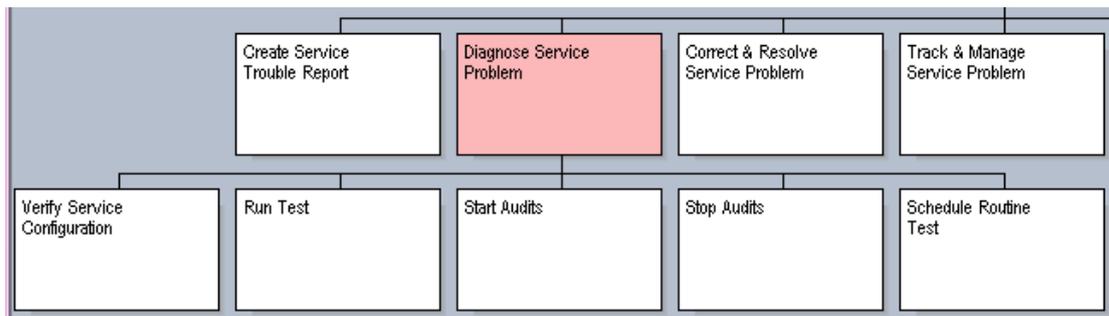


Figure A.26 Diagnose Service Problem decomposition to Level 4

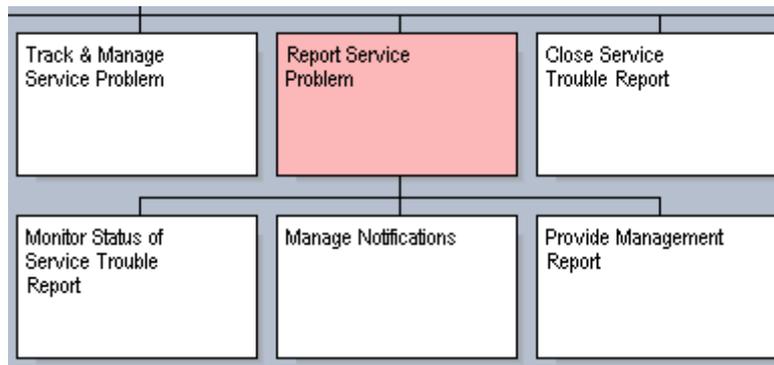


Figure A.27 Report Service Problem decomposition to Level 4

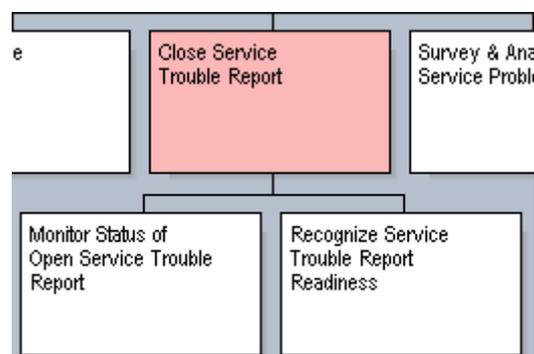


Figure A.28 Close Service Problem decomposition to Level 4

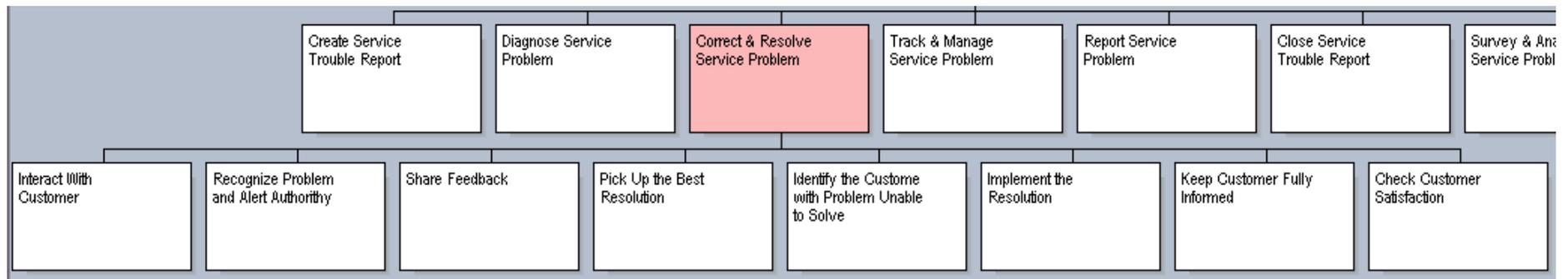


Figure A.29 Correct & Resolve Service Problem decomposition to Level 4

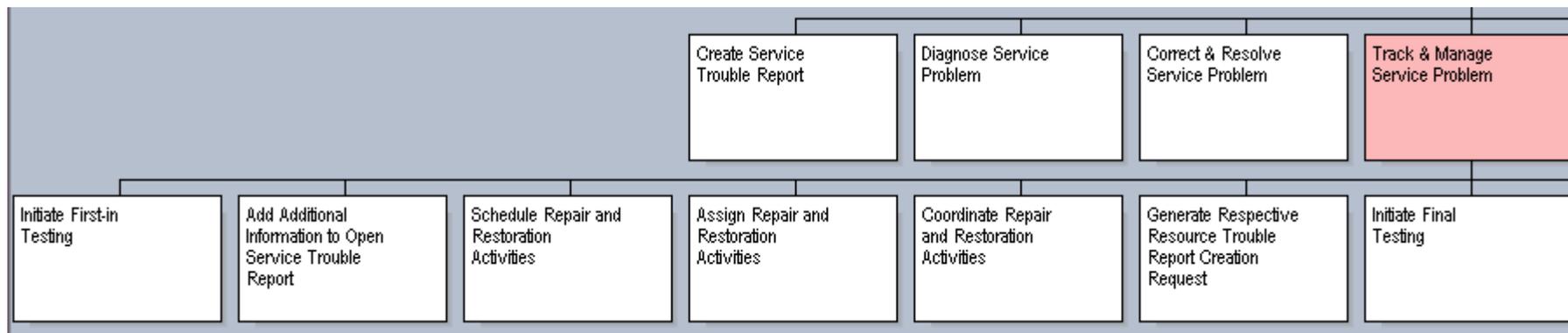


Figure A.30 Track & Manage Service Problem decomposition to Level 4 a

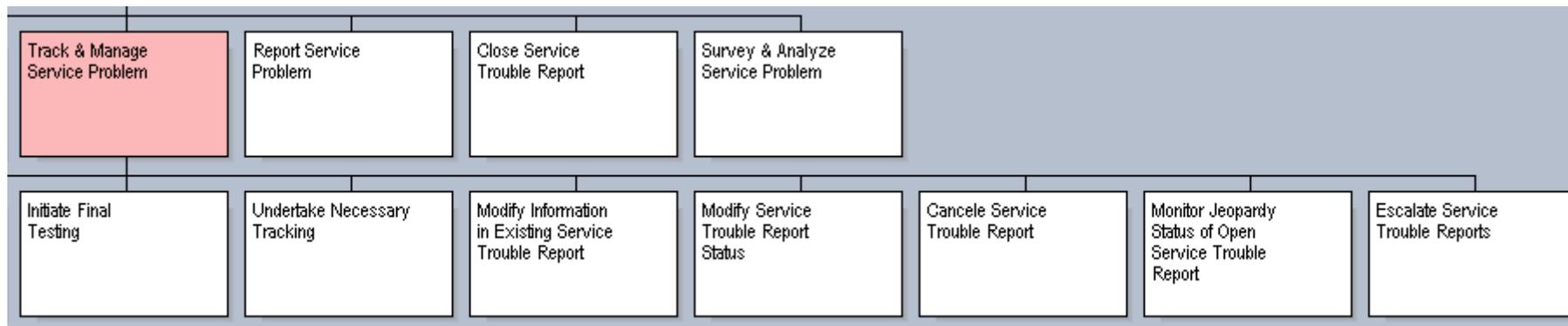


Figure A.31 Track & Manage Service Problem decomposition to Level 4 b

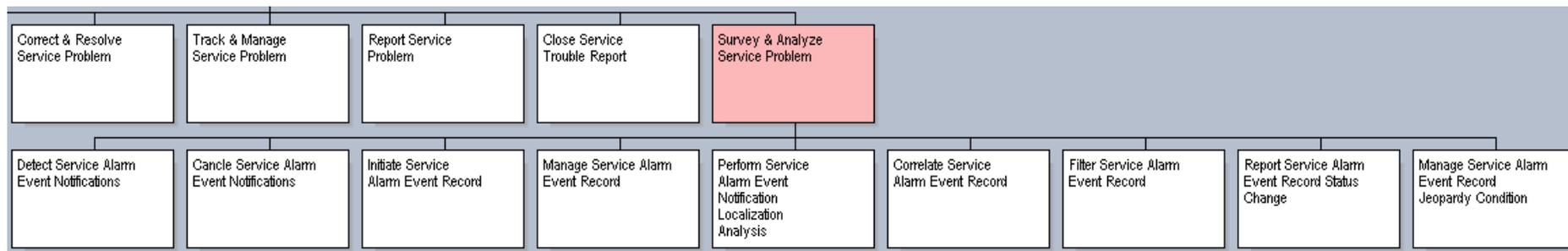


Figure A.32 Survey & Analyze Service Problem decomposition to Level 4

Appendix B

Acronym

ARIS - Architecture of Integrated Information Systems

B2B – Business to Business

BOM – Business Operations Map

BPM - Business Process Management

BPD - Business Process Diagram

BPMN - Business Process Modeling Notation

BSS - Business Support System

CASE - Computer Aided Software Engineering

CRM - Customer Relationship Management

eTOM - enhanced Telecom Operations Map

EM - Enterprise Management

E2E - End to End

ETSI - European Telecommunications Standards Institute

FAB - Fulfillment, Assurance and Billing & Revenue

GUI - Graphical User Interface

ICT - Information and Communications Technology

IT – Information Technology

ITGI - IT Governance Institute

ITIL - Information Technology Infrastructure Library

ITSMF - IT Service Management Forum

ITU-T - International Telecommunication Union - Telecommunication Standardization Sector

KPI - Key Performance Indicator

MIB - Management Information Bases

NGOSS - New Generation Operations Systems and Software

OPS - Operations

OSR - Operations Support & Readiness

OSS - Operations Support System

PO - Purchase Order

POLDAT - Process, Organization, Location, Data, Application, and Technology

QoS - Quality of Service

RM&O - Resource Management & Operations

SEI - Software Engineering Institute

SID - Shared Information & Data Model

SIP - Strategy, Infrastructure and Product

SLA - Service Level Agreement

SME - Short-Medium Enterprise

SM&O - Service Management & Operations

SNMP - Simple Network Management Protocol

SP - Service Provider

S/P - Supplier/Partner

S/PRM - Supplier/Partner Relationship Management

TAM - Telecom Application Map

TM Forum - TeleManagement Forum

TMF - TeleManagement Forum

TMN - Telecommunications Management Network

TNA - Technology Neutral Architecture

TOM - Telecom Operations Map

UML - Unified Modeling Language