Improving E-Business Design through Business Model Analysis

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REPORT SERIES/DSV 10-009
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Dedicated to my
Loving Mother and Father
Abstract

To a rapidly increasing degree, traditional organizational structures evolve in large parts of the world towards online business using modern Information and Communication Technology (ICT) capabilities. For efficient applications of inter-organizational information systems, the alignment between business and ICT is a key factor. In this context, business analysis using business modelling can be regarded as a first step in designing economically sustainable e-business solutions.

This thesis examines how business modeling can be used to improve e-business design. We examine how business stakeholder intentions and different objectives of business collaborations can be used to obtain an explorative business model that can be used as a basis for designing e-business solutions. The thesis proposes a set of artifacts for business modeling and e-service design. In regard to business modeling, we propose methods that consider internal aspects such as strategic intentions of actors and external aspects such as business collaborations among them. Considering stakeholder intentions, we introduce a method to design business models based on goal models. A set of templates for designing goal models and a set of transformation rules to obtain business models based on goal models are proposed. To further improve business models considering business collaborations, we suggest a classification of business transactions that considers underlying business objectives of business collaborations. Utilizing the suggested business transactions, we then propose a method to improve business modeling. Finally, we propose a method for designing e-services using business models. The methods suggested support business modelers as well as process and services designers in executing their tasks effectively. The methods have been assessed through applications in two cases.
Acknowledgements

Firstly, I would like express my gratitude to my academic supervisor Professor Paul Johannesson for his excellent supervision and the knowledge I gained since I started my research activities at the Department of Computer and Systems Sciences (DSV). During the past couple of years, he has been very good in keeping us busy publishing our research activities in reputed scientific forums. Secondly, I would like to thank Dr. Jelena Zdrakovic for overseeing latter part of studies as my co-supervisor. I gained enormous amount of experience by working with her lately in the last couple of years of my PhD studies.

Secondly, I would thank the Swedish Development Cooperation Agency (SIDA) for funding my research activities at DSV. In addition to that, I extend my appreciation to the University of Ruhuna, Sri Lanka for granting me study leave to pursue my higher studies.

Dr. Prasad Jayaweera, of the University of Ruhuna, is appreciated for his valuable help at the beginning to establish the link with my academic supervisor, Paul. Dr. Gihan Wickramanayake of the University of Colombo is also acknowledged for his help at the beginning. My gratitude also goes to Dr. P.A. Jayantha of the University of Ruhuna and Dr. Upali Mampitiya, Academic Dean of the Monash College in Sri Lanka for their great support in encouraging me at all times.

My special thanks go to DSV/SYSLAB research group members Maria Bergholtz, Birger Andersson, and Ananda Edirisuriya for all the knowledge I gained through many fruitful discussions and working as a team. Also I would like to thank all the personnel at DSV for providing a pleasant environment to do my research activities in. Special thanks go to Birgitta Olsson, Sören Gustafsson and Fatima Ferreira at DSV for their support to solve various administrative issues in timely manner.

I also thank my colleague Rasika Dayaratne who is a PhD student at DSV for sharing all the good and bad times together. One of my friends, Nalin Navaratne, is also acknowledged for his support in numerous ways during my studies. My special thanks go to Sanjeewa Pattiwila, of the Sri Lankan Embassy in Sweden for his assistance during my study period in Sweden.

Finally, I would like to thank my parents and two sisters for their love and support. I am also grateful to my loving wife Chandramali for releasing me from all the housework and being so patient. I did not forget you, Visith, my darling son, who never wanted to see me working.
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1 Introduction

Advancements in ICT have contributed to the transformation of daily life in large parts of the world. From a business point of view, it has transformed traditional methods of interaction between business organizations and their customers by providing efficient ways of performing tasks and communicating with each other. As a consequence, geographical boundaries of the world are more and more disappearing and the demand for globalized product and service offerings is increasing. To meet this demand, enterprises are heavily relying on using e-business or e-commerce applications to perform their business activities. E-business is generally referred to in situations where enterprises use ICT to enhance any of their business processes while e-commerce generally refers to the use of ICT to perform business activities in regard to buying and selling products and services between actors by electronic means.

Designing e-business applications consists of various steps. Among them, identification of the required behavior of the application is considered as an important step and is generally known as requirements elicitation. Goal-Oriented Requirements Engineering (GORE) techniques (e.g. goal modeling techniques) and value-oriented requirements engineering techniques (e.g. business modeling techniques) are widely used to elicit and model requirements for e-business applications.

In general, a business model describes actors involved in a business and the things exchanged between them specifying, the who and what of a business. For example, who are the stakeholders of the business? What do they offer to each other? What activities are there to create the things that the business offers? The definitions of a business model span from simple ones to more elaborate ones. For instance, Linder and Cantrell (2000) defined a business model as: “the organization’s core logic for creating value”. Paul Timmers (1998) defined a business model as: “an architecture for the products, services and information flows, including a description of the various business activities and their roles; A description of potential benefits for the various business actors; and A description of the sources of revenues”. Similar to Timmers’ definition above, Weill and Vitale (2001), defined a business model as a description of different roles and the relationships played by different business partners and customers of a firm that also identifies major flows of products, information and minatory resources among the partici-
pants. From these definitions it is clear that in business modeling the major tasks concern the identification of resources and activities that create and transfer these resources between the involved actors. That is, both the internal and external perspectives are considered in business modeling. In the internal perspective the focus is on identifying business processes of an actor that create value. In business modeling these business processes are often called value activities and are defined as activities that are profitable to an actor who performs them (Gordijn, Akkermans, & van Vliet, 2000). The external perspective models activities that exchange the value, created by the internal value creating business processes. These exchange activities are often viewed as inter-organizational events or more precisely, as business collaborations between actors. According to the Open-edi framework (ISO/IEC, 2007), in business modeling, a business collaboration defines the actors, activities for exchanging resources between them and the reciprocal relationships between these activities.

The resources and activities that are included in a business model reflect the intentions of business stakeholders. As such, the motivation for business models can be found in the goals of an organization. From the business modeling point of view, goals provide a basis for linking business strategies to business model components. From a business perspective, a goal can be defined as a desirable state of business that an organization wants to achieve and hence plays an important role in defining business strategies of an enterprise. As such, in business modeling goals can be used to clarify strategies of different stakeholders answering the "why" of the business.

In this thesis, we focus on the business modeling aspect of designing e-business applications. Thereby in the remaining sections of this thesis, we limit our discussions to the business modeling and the business activities represented in the business model level, more precisely, activities with a higher level of abstraction which focus on producing and exchanging resources between partners and customers of an enterprise.

Over recent years, the use of business models has also been investigated as a basis for designing e-services. Understanding the business model of an organization is identified as critical in designing e-services and implementing them in Information Technology (IT) systems (Gordijn, Yu, & van der Raadt, 2006a). Thereby, business models are often considered to identify e-services (Andersson, Johannesson & Zdrakovic, 2008), (Gordijn et al., 2006a). In general, a service is defined as an abstract notion which hides implementation details. They are also accepted among the business community as business activities that yield intangible benefits or outcomes (Baida, Gordijn, Saele, Akkermans, & Morch, 2005). E-service, on the other hand, is defined as the online offering of these traditional services. Various studies have recognized the business functionalities offered by e-services as an important fact (Baida et al., 2005; Cherbakov, Galambos, Harishankar, Kalyana & Rackham, 2005). In business-oriented designing of e-services, two
classes of services, top-level business services and low-level e-services which realize these business services, have been considered. Thereby, it is important that when top-level business services are elicited and subsequently realized them as e-services using such a top-down manner, strategic & economic aims of an enterprise are carefully considered and modeled. However, in business modeling, resource transfers only pertaining to the actual delivery of resources are often considered (Gailly, España, Poels & Pastor, 2008). Despite this situation, it is identified that a business collaboration between actors can span over various phases (ISO/IEC, 2002). When the entire business collaboration life cycle is not considered in designing business models, the obtained set of e-services may not represent all possible outcomes thus leading to the question of the completeness of the resulting e-service portfolio.

In addition to goal and business modeling, process modeling is also accepted as a prominent activity in designing e-business applications (Gordijn et al., 2000). In contrast to a business model, a process model describes how abstract activities described in a business model are realized as system operations. Thereby, in e-business application development, for instance in an e-service design context, it gives detailed information on the configuration of operations by showing control flows, message transfers, etc of elicited business services. Finally, these complex process models are realized as e-services.

To summarize, from the requirements engineering perspective, designing business models can be considered as one of the preliminary steps that identifies required system behavior in an abstract way. As such it is important that a business model is created in such a way that clearly represents the entire collection of business collaborations between actors, and their strategic interests. The consideration of such aspects will help to align business goals and strategies with e-business applications and thereby achieve provisioning of economically sustainable e-business solutions.

1.1 Research problems

In recent years, exploration of business models has become an important step in aligning business strategy with e-business applications. Recent studies in academia and industrial communities emphasize the need to explore business models to achieve strategic alignment between business and IT (Zlatev, van Eck, Wieringa & Gordijn, 2004; High, Kinder & Graham, 2005; Braet & Ballon, 2007; Kartseva, Gordijn & Tan, 2007).

From a business point of view, e-business applications should help achieving strategic interests of business stakeholders. Recent research on business and IT alignment suggests that this can be achieved by considering alignment between different modeling aspects such as goals, business and e-
services (van der Raadt, Gordijn, Yu, 2005; Derzsi & Gordijn, 2006; Zlatev et al., 2004; Pijpers, Gordijn & Akkermans, 2008).

In the goal aspect, the primary concern is designing business models that are aligned to the strategic intentions of business stakeholders. From a business modeling point of view, the formulation of the business goals should be aligned with notions used in business modeling. Thereby, a problem here is how to formulate strategic intentions of business stakeholders in such a way to assist the designing of business models.

The primary concern in business aspect is to explore the value creation process in multi-party business settings. Often exploration of the value creation process starts with the identification of key resource exchanges between actors. However, the actual number of resource exchanges may be dependent on various other factors such as risks, market types, settlement types, etc. (Kartseva et al., 2007; ISO/IEC, 2002). These factors together define how business collaborations between a buyer and seller could take place. As an example, whether a buyer and seller accept the entry terms of the market in advance and then commence the actual resource exchange later on, etc. From a business modeling viewpoint, an important consideration here is to identify a complete set of business transactions using key resource exchanges and underlying business transactions as a point of departure. Additionally, it is argued that business models often visualize activities pertaining to the actual transfer of resources (Gailly et al., 2008). Thereby, a question remains about how to consider different factors affecting business collaborations to determine and design business transactions in such a way that the business model designing process will be better assisted.

Once the explorative business model is designed determining resource transfers and underlying business transactions, e-services can be elicited. From an e-service design perspective, one of the primary concerns is to design economically sustainable set of e-services. However, creating a shared understanding of e-services and analysis of their economic viability and technical feasibility have been identified as key problems in developing innovative e-services (Gordijn, van Eck & Wieringa, 2009). A number of studies have identified the importance of using business models as a point of departure to identify e-services (Raadt et al., 2005; Andersson et al., 2008; Gordijn et al., 2009; Cherbakov et al., 2005). Gordijn et al. (2009) argues that such a business model exploration process should consider intentions of collaborating business organizations as well as consumer needs to identify activities in which the e-services are created and exchanged. From a business modeling point of view a lack of concern about different stages of a business collaboration may lead to losing vital information regarding the exchange of values between collaborating parties. From a e-service modeling perspective, designing e-services from such business models may not define a complete e-service portfolio. Additionally, e-service design projects are involved with many different stakeholders such as business designers, process designers,
and IT-based stakeholders (Gordijn et al., 2009). Thereby, different concerns of these stakeholders should also be addressed by the e-service design process. As such, there is thus a problem of designing economically viable portfolio of e-services.

Considering these aspects of business and service modeling, the basic research question can be formulated as follows:

*How to design business models and e-services whilst taking into account stakeholder intentions and business environments?*

In e-business applications design, intentions stakeholders are used as a means to describe rationale behind their external relationships with other business partners. In systems designing, such intentions are often formulated as goals of individual actors which are further decomposed down to sub-goals and activities in a goal model. Thereby, in the basic research question above, stakeholder intentions represent strategic business goals of actors. In addition to goals which describe actions of an actor towards others, business environment describes actions they perform collectively in a business constellation. As such the focus of business environment in the basic research questions above can be set on the collaboration space where the business collaborations between actors are seen from an independent point of view.

Considering these two aspects in the process of exploring business model support for the provisioning of e-business solutions, we arrive at three specific research questions outlined below.

1. How to design business models considering goal models?
2. How to design business models considering business collaborations?
3. How to design e-services based on business models?

In the first two research questions, we aim to address the matter of designing strategically-aligned business models. Here, we intend to investigate how goals of actors and different stages of a business collaboration can be used to identify resources that these actors intend to offer each other. In the third research question, we intend to address the matter of designing e-services using the business model as a point of departure.

These questions together address different but interrelated aspects of e-business applications development. In particular, the first two research questions concern the business aspect, whereas the last question concerns the information systems aspect of e-business application development. Answering the first two questions will help business modelers to design high-quality business models, which will support process and service designers to build effective e-services.
1.2 Goals of the research

The goals that we aim to achieve in this study can thus be formulated:

1. To develop a method for designing business models based on goal models.
2. To develop a method for designing business models based on business collaboration models.
3. To develop a method for designing e-services based on business models.

The goals above address research questions presented in the previous section. For instance the problem of aligning business strategies and business models in the first research question in Section 1.1 is achieved by developing a method that considers other forms of enterprise models such as goal models.

1.3 Purpose of the research

The purpose of this research can be described as an effort to support business modelers as well as process and services designers by providing them with methods that will help them execute their tasks effectively.

The purpose of the first two goals, that is methods for designing business models, is to help business modelers by providing them with methods for business modeling. These methods should help them to:

a. ground business model design decisions on goals of actors; and
b. ground business model design decisions on different aims of business collaborations.

From a business modeler’s point of view, grounding business model design decisions on goals will provide traceability between goals of actors and business model components. Since goals are easily understandable to business users, a business modeler will find it easy to explain the designed business model and justify design decisions to the business users. Additionally, when different aims of business collaborations are considered in business modeling, it will provide a business modeler with a way of identifying different types of resource offerings and possible relationships between them. This will help business modelers to better represent a business case at hand by identifying any additional actors required to offer a certain resource. Having a complete understanding of how values could be created at different stages of a business collaboration could also help a business modeler to identify a comprehensive set of resources across the entire life-span of the business collaboration and design an explorative business model (i.e. a business model which captures all the vital resource exchanges across the lifespan of a business collaboration).
This traceability from business model components to the goals of actors could also help process modelers to get a better understanding of abstract business activities represented in a business model and to decide the way they should be represented in a process model.

In a competitive market, identifying economic viability of business services is becoming a prerequisite for implementing them as e-services using, for instance Web Services technology. A method for designing e-services based on a business model could help service designers by providing them with a structured way of designing an economically sustainable service portfolio. The method would also enable traceability by founding the e-services on economic value offerings across the lifespan of a business collaboration. As such, a service designer would be able to design a comprehensive set of economically sustainable e-services by thus improving the overall performance of actors involved in the business collaboration.

1.4 Research methodology

A design of a research study begins with choosing a problem to address and a paradigm in which the research is conducted. A paradigm defines philosophical and scientific methodological foundations in which a research process takes place (Morgan, 1983). It provides a platform in which researchers can interpret or explain their research. This platform is often described as a particular view of the “world” or worldview of the researcher (Guba & Lincoln, 1994). In the research work presented in this thesis, we have used the design science, (Hevner, March, Park & Ram, 2004), research approach for building artifacts to address the questions presented in Section 1.1.

Scientific research in the field of IT encompasses both knowledge-producing and knowledge-using activities (March & Smith, 1995). According to Hevner et al. (2004), much of the research in the information systems discipline can be classified into two paradigms: behavioral science and design science where the behavioral science paradigm focuses on the extension of knowledge and the design science paradigm focuses on the extension of human and organizational boundaries by building artifacts. The goal of behavioral science is truth in the sense that it aims at extending and improving our knowledge about existing human and organizational aspects of information systems, including their development, management and use. In contrast, the goal of design science is utility in the sense that it seeks to create innovations, including models and methods, for supporting the development, management and use of information systems.

In contrast to the behavioral science, the technology orientation of the design science paradigm makes its goal to create artifacts that serve human purposes. March and Smith (1995) classify design science research out-
comes into constructs, models, methods, and implementations that can be used to understand and successfully develop information systems in organizations. According to March and Smith, constructs are basic language concepts which conceptualize the problem within the domain. Model describes solution by inter-relating the problem and the various constructs in the solution space. Further, they state that methods describe how various constructs and models are related together to provide a solution and that method provides a stepwise approach to obtain the solution. Finally, instantiation is defined as a realization of the solution. Considering the solutions that we proposed in this thesis, that is methods for designing business models and e-services, it is obvious that philosophical and scientific methodological foundations of our work fall into design science research approach. Our work reused existing knowledge for building artifacts (i.e. methods for designing business models and e-services) which is different from understanding the reality and generalizing it to a theory as in the behavioral science paradigm. For instance, descriptive research methods such as grounded theory (Strauss & Corbin, 1998) primarily focus on analyzing and describing the domain which is quite different to the work that we have presented in this thesis. Another approach that has the ability to be used in the research information systems domain is the action research (Lewin, 1946). According to Avison, Lau, Myers & Nielsen (1999), the action research lacks detailed guidelines in terms of design, process, presentation, and criteria for evaluation for novice researchers to understand and engage emphasis of action research. The focus of action research is primarily on different actions that a researcher performs during the course of research. Choosing it as a research method would shift the focus from artifacts creation to actions of the researcher which was not the real focus of our research.

1.5 Research process

In the work presented in this thesis, we followed the design science approach and therefore design science research cycles guided all our research activities. From the literature (Takeda, Veerkamp, Tomiyama & Yoshikawam, 1990; March & Smith, 1995; Hevner et al., 2004), we can identify that in design science research, activities can be grouped into two basic sets:

a. activities concerning building an artifact; and
b. activities concerning evaluating an artifact.

According to March and Smith (1995) building represents the process of creating an artifact whereas evaluating represents the process of determining how well the artifact performs. Of the phases: awareness, suggestion, development, evaluation and conclusion of the design research cycle in (Takeda et al., 1990), the first three can be categorized into a building step whereas the last two phases can be put into the evaluation step. According to Takeda et
al. (1990) in the awareness, suggestion and development phases, identification of the problem is made, key concepts required to address the problem are determined and candidate designs are made, respectively. In the suggestion phase, we have applied an iterative approach in the sense that artifacts are improved over an iterative design cycle. Therefore in the awareness, suggestion and development phases, a strategic environment which defined the problem space was selected and the problems were identified, major design foundations of the artifact to be built were determined, and methods for designing business models and e-services were developed, respectively. This process is illustrated in Figure 1 below.

Figure 1. Overview of the research process

The Awareness phase in Figure 1, represents the identification of the research Environment and defines the Problem Space. Our research environment consists of different tasks and roles associated with the e-business application development process of business organizations (see Figure 1). Within this environment, we identified the Problem Space as business modeling and e-service design which also articulate our phenomena of interest in the Environment. The Problem Space consists of an important task of modeling business enterprises in the process of e-business applications development. As such, we consider different dimensions such as goal models, business models and service models. Our Phenomena of interest in the Problem Space can be summarized as: the use of goal models to support business modeling, the lifespan of business collaboration and associated resource transfers between involving actors, and the use of business models for e-service design (see Figure 1). These phenomena of interest represent the
**Business needs** (or the problems that needs to be addressed by business) which are addressed by developing the methods for designing business models and e-services, the *Artifacts*, shown in Figure 1.

The knowledge for designing artifacts is collected in the *Suggestion* phase (see Figure 1). The *Knowledge Base* in the figure contains knowledge about the domain of information systems development (Hevner et al., 2004) from which we chose the methodologies, frameworks, and constructs relevant to design the *Artifacts* which provide solutions to the *Business needs* represented in the *Problem space*. Design knowledge collected from the *Knowledge Base* consists of *Foundations* (see Figure 1). *Foundations* define the relevant methods and constructs that provide basic knowledge to design the artifacts. Existing business modeling methods such as e3 value, Resource Events Agents (REA) and Business Modeling Ontology (BMO); goal modeling methods such as Business Motivation Model (BRG, 2007), business process management standards such as ISO 15944-1, 15944-4 in (ISO/IEC, 2004), (ISO/IEC, 2007) and service-oriented concepts such as e-services and model-driven approaches for e-service design such as Model Driven Architecture (MDA) (Kleppe, Warmer & Bast, 2003) were used as foundations for designing artifacts. *Foundations* provide *Key concepts* to design the Artifacts.

Finally, in the *Development* and *Evaluation* phases, *Artifacts* are developed and their contribution to solve the problems identified in the awareness phase assessed. The *Business needs* from the *Problem Space* and the *Key concepts* from *Foundations* are used to develop *Artifacts*: business modeling and e-service design methods, are shown in Figure 1. These artifacts are *Assessed* by using a descriptive evaluation considering a case from the Swedish healthcare sector (REMS) (Henkel, Johannesson, Perjons & Zdravkovic, 2007) and the Massively Multiplayer Online Games (MMOG) business case. These cases were chosen from different business domains and concern multiparty collaborative business environments. As such, they have provided us appropriate testing grounds to evaluate how our artifacts contribute to, model different activities and parties interact, while showing the different value flows across a network of actors, and subsequently design e-services. In particular, the Swedish healthcare sector was deeply investigated under the REMS project (REMS) at our department. Therefore, it was easy for us to get access to expert domain knowledge and elicit business requirements to model the health sector business case. For the MMOG business case, we could gather adequate amount of domain knowledge through literature reviews. In addition to evaluating the business modeling and service design methods using the cases mentioned above, we have compared our artifacts with similar approaches for e-business solution design and have discussed how our methods differ from the existing approaches for business-driven e-service design. Apart from these, individual research findings were presented
in various scientific research forums and were refined based on constructive feedback from the reviewers.

A detailed discussion of the research work, utilizing the framework proposed by Hevner et al. (2004), is presented in Section 8.3.

1.6 Publications

Different research studies included in this thesis are published in various scientific forums. In this section, we provide an overview of the research publications.

1.6.1 Overview of related publications

In this section, we present the overview of publications that are used in the work presented in this thesis. Considering the concepts and methods, and refinement of these concepts and methods within several publications, we have grouped them into several collections. Under each publication collection, we briefly explain the contributions of the papers of the collection and the author’s specific contribution to the publications. Additionally, we also state the contribution of each publication collection to the goals of the thesis.

**Publication Collection 1: Analysis of Business Notions**

**Paper 1**

**Towards a Common Business Ontology**


**Paper 2**

**Towards a Reference Ontology for Business Models**

The above listed publications analyze three well-established business modeling frameworks: REA ontology, BMO, and e³ value ontology.

These publications have three main contributions. First, a model which includes vital constructs covering different business model frameworks is introduced. This includes an analysis of components of a resource transfer: the right transfer, the custody transfer and evidence document transfer and an analysis of events: conversion events and transfer events. Additionally, their contributions also include mappings that are used as a means to relate similar business notions in these different business modeling frameworks.

This publication collection contributes to achieve the first two goals defined in Section 1.2. It identifies different components of a resource transfer that we have used in the methods for designing business models.

The author contributed to all parts of the first two papers. In particular, the author has mainly contributed to the analysis of the components of a resource transfer and analysis of events.

Publication Collection 2: Aligning Goal and Business Models

Paper 3
On the Alignment of Goal Models and Business Models

Paper 4
Using Strategic Goal Analysis for Understanding and Enhancing Value-based Business Models

Paper 5
Enterprise Sustainability through the Alignment of Goal Models and Business Models
These three papers discuss a methodology for designing goal-aligned business models. Starting from an initial simple business scenario, the papers further discuss how to identify additional business model components to design an enhanced business model. They introduce a set of semi-formal design templates for defining goals and means to build a goal model for an enterprise. Furthermore, the method also introduces guidelines for identifying business model elements based on goals and means in the goal model. Aligning goal and business models is carried out in two steps. In step one, the goals of an enterprise and its stakeholders are elicited and means for realizing these goals are identified. Means templates are then used to formulate the course of actions to realize the elicited goals. In the second step, the goal model, designed in the first step, is used as the basis for identifying elements of a business model. A set of guidelines to identify a basic set of business model elements associated with each means template is used in this step to get the goal-aligned business model.

These papers have two main contributions. One of them is a set of design templates to formulate goals and means. The other contribution is a set of transformation rules that defines a basic set of business model components associated with each template. These contributions together provide the basis for achieving the first goal presented in Section 1.2.

In papers three and five, the author was the main contributor for identifying and defining the structure of means templates and defining transformation rules to map means templates to business model elements and developing a goal-aligned business model. In paper number five, the author primarily contributed to defining transformation rules to map means to business model elements. He also contributed to defining means template.

Publication Collection 3: Exploring Business Collaborations

Paper 6
Modeling Business Transactions from the Value and Collaboration Perspective
In papers six and seven, a structured method to design business models is studied. In these papers we investigate the lifespan of business collaborations and different objectives that these collaborations aim to achieve. Based on the findings we propose:

a. a classification of business transactions; and
b. a systematic way to identify potential resource exchanges.

The papers have two main contributions:

a. classification of business collaborations and identification of business transactions; and
b. identification of potential resource exchanges along different phases of a business collaboration.

*The author was the main contributor to these papers.*

**Publication Collection 4: Business Model Support for e-Service Design.**

**Book Chapter**

**Exploring Business Value Models for E-Service Design**


In this book chapter, we propose a MDA-based approach to design e-services which may be implemented using Web services and Web service coordinations. The chapter focuses on an explorative analysis of business models for e-service design. In this approach, we propose to use business models at the Computational Independent Model (CIM) level in the e-service design process. The CIM level business model is then transformed into the Platform Independent Model (PIM) level, by utilizing well-defined mappings.

Major contributions of this chapter include proposing a value based e-service design method, developing the CIM, and defining transformation rules from CIM to PIM.

*The author contributed to all parts of the chapter with the main contribution being in developing value based CIM and the transformation rules from CIM to PIM.*
Figure 2 below illustrates individual support of different publication collections to the thesis goals in Section 1.2.

1.6.2 Other Publications

Below, we list publications that are not included in the work presented in this thesis. In the publications with more than two authors, the author list is sorted in alphabetical order either from the first position or from the third position onwards.


1.7 Disposition

The thesis is structured as follows.

Chapter 2 provides an overview of the background for the research work presented in this thesis. In this chapter, we first provide a general introduction to the field of Requirements Engineering. We then discuss goal modeling in detail and give an overview of goal modeling techniques in the business modeling method presented in Chapter 4. A detailed discussion of the existing business modeling methods followed by an overview of different frameworks for business collaborations modeling is also presented. The chapter also provides a discussion on the notion of service and recent developments in the business-oriented e-services exploration. We conclude the chapter by presenting business scenarios used to elaborate the application of the artifacts developed in this research work.

In Chapter 3, we analyze the business notions resource, resource transfers and conversion activities as a part of addressing research questions two and three regarding business models. We conclude the chapter by identifying different components associated with a resource transfer as a part of addressing research questions two and three.

The solution to the first research question is presented in Chapter 4. In this chapter, we discuss how a goal-aligned business model can be created using a goal model as an input (see Figure 3). We propose a set of templates for formulating means associated with goals in a goal model. Additionally, in this chapter, we provide a set of transformation rules that explain how business model components can be derived from the means templates in a goal model. We conclude the chapter by showing the application of the method to a business scenario presented in Chapter 3.

The second research question is addressed in Chapter 5 and Chapter 6. In Chapter 5, we provide a classification of business transaction types as a part of answering the research question: “how to design business models considering business collaborations” (see Figure 3). We identify four types of business transactions considering the underlying goals of their respective business collaborations. Each of these transactions is explored along Openedi phases of a business collaboration to identify resources and resource transfers associated with them. We use these transaction types and associated information about possible resources and resource transfers to propose a method for designing explorative business models in Chapter 6 (see Figure 3). Here, in addition to the classification of business transactions in Chapter 5, we use the goal-aligned business model in Chapter 4 as an input. A set of guidelines are presented in Chapter 6 to assist the designing of an explorative business model. Chapter 6 is concluded by presenting the application of the method utilizing a business scenario discussed in Chapter 3.

Our solution to the third research question is presented in Chapter 7. Here, we present a model-driven approach for designing e-services (see
We propose to use the business model as the point of departure for identifying an economically sustainable set of e-services. A set of high-level transformation rules are proposed to assist the transformation between business-oriented computational independent models and technology independent system-oriented models (see Figure 3). We also explore the applicability of the method by applying it to the running business scenario used in Chapter 6.

In Chapter 8, we provide concluding remarks by discussing how we have addressed research questions and goals. The chapter also discusses the research process based on guidelines for design science research by Hevner et al. (2004).

**Figure 3. Overview of design artifacts in relation to the goals**
With the competition among business organizations and Internet-based business increasing, there is a demand for innovative ways of precisely modeling businesses and obtaining a complete set of requirements to support the development of e-business applications. Recent developments in the field of requirements engineering especially in the fields of enterprise modeling such as goal, business and service modeling focus on achieving this goal.

In this chapter, we explain the requirements engineering process in Section 2.1. Then, we focus on the different models used in enterprise modeling. Accordingly, in Sections 2.2, 2.3, and 2.4 we give an overview of goal modeling, business modeling and different business collaboration frameworks developed based on business modeling methods. In Section 2.5, we introduce important concepts related to e-service design and give an overview of related work on business-oriented e-service design in Section 2.6. We conclude the chapter by introducing running business scenarios in Section 2.7.

2.1 Requirements engineering

Requirements engineering is an important aspect in the information systems development process. There, it is regarded as the process of determining the stakeholders such as users, customers, suppliers, etc., their business needs and required system behaviors to satisfy these business needs. Requirements are used for a variety of purposes including project scoping, cost estimation, scheduling of activities, designing and testing of software, etc. (McEwen, 2004).

A stable set of requirements is a prerequisite for the development of a quality software system. Poor requirements that are weakly organized, expressed, or even weakly related to stakeholders are causes of failing (Hull, Jackson & Dick, 2004; McEwen, 2004). The success of any information system depends on its acceptance by customers and users as a system that functions up to the standard they expected. As such proper identification of requirements has been recognized as critical for the successful developments of systems.

In general, the requirements engineering process encompasses activities related to four phases: requirements elicitation, requirements negotiation, requirements specification and requirements validation (Pohl, 1996). They
are performed sequentially and are also interlinked. The overall aim of these phases is to discover the critical inputs for the system development process.

The process of building an information system starts with collecting information such as the stakeholders of the system and the required system behaviors in the requirements elicitation phase. Identification of stakeholders, their goals that loosely denotes the objectives the system must meet and tasks that users intend to perform with the system are three important aspects in requirements elicitation (Nuseibeh & Easterbook, 2000). Different types of techniques are used to elicit requirements. They range from traditional techniques such as questionnaires, surveys, interviews to model-driven techniques. These model-driven techniques include goal-based methods, scenario-based methods, etc. (Kavakli & Loucopoulos, 2004). The elicitation of requirements requires a strong understanding of the business environment, including identification of its activities, stakeholders and their needs. It involves a high level of interaction with the system stakeholders and requires understanding of complex social relationships of system stakeholders, the specific roles they play within the functions of the system to be developed. The identification of system boundaries is one of the important aspects of the elicitation phase and this affects identification of user groups, tasks, etc. (Nuseibeh & Easterbook, 2000). They further state that the elicitation process should be capable of identifying a diverse set of needs from different groups of users of the system to be built. The stakeholders may express their needs in a variety of ways. They can express their needs in more general ways in terms of goals they want to achieve (McEwen, 2004). For instance, a stakeholder may need to streamline helpdesk application support to deal with the high amount of help requests received by them over phones. The developer team may then translate this stakeholder need to a distinct system feature. It is also possible for a stakeholder to express their needs in a more specific way by expressing them as required system features (McEwen, 2004). For example, the same stakeholder may express that he requires a Web-based system which enables customers to enter their own support requests. In this case the stakeholder translates his need into a more distinct system feature. Whatever the way stakeholders use to express their needs, the developers should be capable of understanding these needs and correctly interpreting them. The success of this entire process depends on the ability of the system developers to correctly understand the business environment and collect a precise set of requirements from system stakeholders (Loucopoulos & Kavakli, 1995).

The aim in the requirements elicitation phase is to elicit the requirements. As such at the end of it, a large quantity of information regarding the system stakeholders, their business needs and system functions required by them is available. This information has to be carefully analyzed to resolve conflicts among requirements and to agree on a proper set of requirements that precisely represents the business environment, business needs, etc. The analysis
process not only captures a precise set of requirements but also establishes the relationships among them. Different kinds of modeling techniques are employed in this phase to help the analysis process. For instance, enterprise models and goal models are used in this phase to agree on requirements, identify and resolve conflicts and establish relationships among the elicited requirements (Kavakli & Loucopoulos, 2004; Loucopoulos & Kavakli 1995).

In the requirements specification phase, the negotiated requirements are documented in a formal way by specifying, for example, the stakeholders, their roles and business goals to required system functions. This is done by means of systematically relating elicited requirements to system functions. Documentation is done by using, for instance, natural language or formal specification languages. Similar to previous phases, different techniques, for instance, goal-based techniques such as Knowledge Acquisition in Automated Specification (KAOS) and Goal-Based Requirements Analysis Method (GBRAM), are used to relate business level goals to functional and non-functional requirements at the system level (Kavakli & Loucopoulos, 2004). Given the formal nature of requirements specifications, they provide a vital base for validating requirements and for designing the system. IBM (McEwen, 2004) suggests that the requirements can be captured by using three main types of documents: stakeholder needs, software features, and software requirements specification. This, they argue, simplifies the process of requirement reviews and allows for better accountability since it separates different aspects of requirements along different documentations. This provides freedom for different readers to focus on different parts of the system development process. These documents gradually refine stakeholder needs and the required software features in the problem domain to the more specific software requirements in the solution domain.

Finally in the requirements validation phase, measures are taken to ensure that the correct system is developed. Requirements validation generally requires all the actors involved in the system development, to assess requirements specifications and agree on their correctness. This is to ensure that the requirements specifications, which provide the basis for designing a system, accurately specify the actual needs of system users, customers, the current business environment, the future business needs, etc. The validation process usually goes through the models, use cases, prototypes, etc, developed in the specification phase to identify if requirements are weakly or incorrectly interpreted during the elicitation, analysis or modeling. The validation of requirements is extremely important to increase effectiveness during the system development and during its actual use. Incorrect or weakly captured requirements lead to difficulties in the development process and will also fail to meet the actual demands of the business.

The phases discussed above explain the role requirements engineering plays in system development. In-depth understanding of the current business
processes and the future needs is required for the successful development of a quality software system. Identifying and analyzing internal and external requirements of business and its environment, proposing reasonable solutions and also providing means to system maintenance process in the post-development stages is paramount to successful system development. Research activities in requirements engineering is distributed along two main paths (Nuseibeh & Easterbook, 2000). The theoretical path provides the frameworks to guide the collection of requirements and assess the feasibility of them in the early phase of the software development. The practical path, on the other hand, provides the tools to develop the required software solutions. In recent years, much of the research in the field of requirements engineering has focused on goal and value-oriented methods, especially for requirements elicitation, modeling and validation. These approaches utilize goal and business models as a means of representing and visualizing business requirements in the systems development process. For example approaches such as KAOS (Dardenne, Lamsweerde & Fickas, 1993), Tropos (Mylopoulos & Castro, 2000) and i* (Yu, 1995) provide goal-oriented methods for identifying, modeling and analyzing business requirements and approaches such as e3 value, REA provides value-oriented methods for identifying and modeling business environments.

2.2 Goal models

Goal-oriented requirements engineering (GORE) methods have received much attention, particularly, in recent years. They concern adding on features such as motivation and traceability to the systems development process by means of linking general business needs down to more specific system components. In GORE, one of the prime aims is to justify and explain the choice of selected requirements and their relationship to system functions. As such, instead of directly concentrating on what the system needs to do, GORE methods first focus on exploring why a certain system functionality is required and how it can be implemented.

Goals are formulated at different abstraction levels. Goals with a high-level of abstraction, which are often called top goals, concern the long-term strategic interests of an organization and its stakeholders. The scope of these goals often spans over the present environment and the system to be modeled (van Lamsweerde, 2001). Goals are also formulated with low-level abstraction. However, this distinction between high and low level goals is often unclear. Goals are considered as important in the requirements engineering process for various reasons (van Lamsweerde, 2001). As an example, goals provide a means to assess the completeness of requirements specification. Here completeness is assessed in respect to a set of goals by considering whether or not the specification provides all the means to achieve each and
every goal in the set. Additionally, goals also help to avoid irrelevant requirements by assessing whether or not the specification of a requirement is useful to achieve at least one goal. Furthermore, they provide a means to explain technical requirements to the business users by mapping the low-level technical requirements to strategic business goals. The separation of concerns is another important characteristic which goals provide to the requirements engineering process. For instance, with respect to a high-level goal, corresponding low-level technical requirements to achieve it, tend to evolve with time by finding different ways to achieve the goal. Hence, separating volatile technical requirements from strategic goals makes the whole system more flexible and stable in the sense that different refinements can be introduced and linked to a common set of goals rather than changing strategic goals themselves.

Based on how goals contribute to identifying system components, they have been classified along different axes. Goals that lead to functional requirements and goals that lead to non-functional requirements are two main classifications axes proposed in the requirements engineering literature. Goals which lead to the identification of functional requirements are called functional goals or hard goals and goals which lead to non-functional requirements are called non-functional goals or soft goals. The functional goals represent the class of goals that can be established or achieved in a clear-cut sense while non-functional or soft goals represent the goals that concern the business process qualities such as security, accuracy, etc. Further, goals are also classified based on temporal behaviors laid down by them. For instance, four generic types of goals: achieve, cease, maintain and avoid in KAOS (Dardenne et al., 1993), are identified based on the target behavior prescribed by them on the future states of the system.

In addition to the different classification axes discussed above, goals are also characterized by different attributes such as their names and priority order, etc. attached to them (van Lamsweerde, 2001). Further, goals are interrelated to each other through different types of links. For instance, AND/OR refinements to establish a parent-child relationship between goals (Dardenne et al., 1993). These refinement links define that a parent goal can be achieved by achieving all or any of its child goals.

From the requirements engineering point of view, a goal defines a set of desired behaviors of the system under consideration (van Lamsweerde, 2001). From the business point of view a goal defines a desired state that a business organization wants to achieve (Andersson et al., 2008). The first definition seem to be bit more specific and links goals towards a set of states or simply saying, a set of different ways to reach the goal. This kind of systems thinking gives a goal much more weight in the sense that they are lot more implementation-oriented and if the development process fails to achieve it, then the system may not meet the requirements set by the stakeholders. Business goals may be adjusted over time to meet the changing
requirements of business and its environment. Along the development process, system developers elicit these strategic business goals from the business stakeholders and refine them to more specific system-oriented goals and further down to desired system functionalities. Much of the recent work focuses on linking these two views together to have a structured goal-oriented approach in the context of systems development. Kavakli et al. (2004) argue that goal analysis contributes to every phase in the requirement engineering process discussed previously (see Table 1). The table below shows that the goal analysis is used in every sphere in the requirements engineering process and offers benefits in almost every stage in the requirements engineering process. Yet, there is no single approach that describes the overall role of goal analysis in the requirements engineering process (Kavakli & Loucopoulos, 2004).

Table 1. Goal contribution in the requirements engineering process (adapted from Kavakli & Loucopoulos, 2004)

<table>
<thead>
<tr>
<th>RE Activity</th>
<th>Goal Analysis Contribution</th>
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| Requirements elicitation | 1. Understanding the current organizational situation.  
                           | 2. Understanding the need for change.                                                       |
| Requirements negotiation | 3. Providing the deliberation context of the requirements engineering process.               |
| Requirements specification | 4. Relating business goals to functional and non-functional system components.               |
| Requirements validation | 5. Validating system specifications against stakeholders’ goals                              |

The table above shows that, in requirements elicitation, goal models are used as a means of explaining and understanding present and future situations of a business organization. More often, they are used to explain the business strategies of an organization and intentions of participating actors. For instance, goal modeling techniques such as i* (Yu, 1995) and Enterprise Knowledge Development (EKD) (Kavakli & Loucopoulos, 1999) are used in the requirements elicitation phase for modeling the current and expected future of organizations. Equally, in negotiation, specification and validation phases of requirements engineering, goal modeling techniques are used to reason about the need for the changes in the business context, to help identify required system components to implement the changes and to provide a means to conform that identified functionalities are aligned to stakeholder goals. The objectives of the different phases of requirement engineering are
not similar. For instance the earlier phases aim to collect interests of stakeholders, the ways to address or compromise them and so on. In contrast, the latter phases focus on more complete design decisions, consistency between collected requirements, validating them against the stakeholder interests and so on. As such, the techniques used in early and latter phases on the requirements engineering process are different from each other (Yu, 1997).

The goal modeling techniques used in the early phases of requirements engineering focus on aligning business strategy with IT systems. As explained earlier, goal models have been extensively used to model and analyze organizational business strategies in the early phases of business-oriented information systems development. For instance, the \textit{i*} (Yu, 1995) and Business Motivation Model (2007) are two such techniques that focus on modeling business activities, relationships among them and reasoning their behaviors.

Among them, the \textit{i*} (Yu, 1995) approach models goals, tasks, resources of different actors and the dependencies of these elements to the actors in strategic multi-actor collaborative contexts. It is used to build strategic goal models to describe existing business environments in multi-actor collaborative contexts and to resolve conflicts and improve existing business relationships. The \textit{i*} approach consists of two main modeling components, the Strategic Dependency (SD) model and the Strategic Relationship (SR) model. The former is used to describe the various dependencies among the collaborating actors in the modeling context while the latter is used to describe the interests among them. Actor is the central notion of \textit{i*} approach. By modeling their beliefs, abilities commitments and various dependencies among them, the approach explores the avenues to achieve different goals that may be difficult to achieve a single actor alone. Kavakli (2002) argues that the \textit{i*} approach consists of three main steps. Firstly, it focuses on identifying and modeling existing business processes. Secondly, it analyses the model and identifies required changes. Finally, it proposes new processes to make the relevant changes. That is, modeling begins by identifying an as-is business state, strategic dependencies among business actors, goals and tasks. Next, the model developed in the previous step is analyzed to check whether or not the existing processes support achieving actors’ goals and to identify alternative configurations to the dependencies among the actors. Finally, the to-be model is developed by introducing new processes to support achieving unsatisfiable goals identified in the previous step.

In contrast to \textit{i*} methodology, BMM proposed by Business Rules Group (BRG) provides a scheme for business-driven requirements development (BRG, 2007). It helps to articulate factors to motivate business strategies, to define important elements in these strategies and to identify the relationships between them in an organization. The BMM explores the business environment of a single actor and consist of three principal modeling components: \textit{Ends}, \textit{Means} and \textit{Influencers}. 
In BMM, an End defines things that a business seeks to achieve without actually referring to how they will be materialized. Vision, Goal and Objectives are three important elements defined by an End. These elements formulate business intentions at different levels of granularity. Among these elements, the Vision defines a general business intention which describes the future state that the business wishes to achieve, for example: “to be the brand of choice of customers”. Goal on the other hand defines a state or condition that the business wishes to achieve or sustain. In contrast to Vision, which is broad, Goal is focused. A typical goal of an online retailer could be: “to have a large customer base”. However the margin between them may be too narrow so that to distinguish between a vision and a goal, in depth of knowledge of the business context may be required. The third important element in End is Objective. With compared to Vision and Goals, Objectives are time-targeted and measurable, for an example a typical objective of a business could be: “six percent increase of sales within one year”.

Compared to the End, Means represents any capability or an instrument that can be used to achieve Ends. Means can be of two forms; they can be formulated as a Course of Action which describes how goals are realized. For instance, “implement a reward scheme” could be a means to have a large customer base. Directive is the other form of Means and defines conditions that govern a Course of Action. For instance “rewards should be based on number of purchases” may govern the course of action, “implement a reward scheme”. Given the concrete nature of Means, it can be easily argued that they represent leaf nodes of a goal hierarchy.

The other major component in BMM is an Influencer. An Influencer is anything that is capable of producing an impact on achievement of means. An Influencer can either be external or internal factor. For instance, it could be external factors such as environment or government regulations: “customers prefer businesses with reward schemes” could be an environmental influencer to the means stated in the previous section.

According to BMM (BRG, 2007), the components discussed above together explain two things:

a. the things needed to achieve organizational business intentions; and
b. the reasons for the existence of elements in the developed model.

The former deals with identification of Means necessary to achieve desired Ends. The latter identifies the Ends served by Means and Influencers that justify the modeling decisions.

These different goal modeling techniques and schemes provide instruments for identifying existing business strategies and defining new business strategies. Yet, goals and means are difficult to formulate and can span over different abstraction levels. For instance, they could represent value propositions of organizations up to their intentions of general economic sustainability. Since both modeling domains are closely related to each other, formulation of goals for example, using business notions would provide better inte-
gration and understanding of different business strategies and their choices. Additionally, it will also help formulating goals and means in a more structured manner.

In the next section, we discuss different business modeling approaches and their impact and usage in the requirements engineering process.

2.3 Business models

While goal models are regarded as answering the “why” of the business, business models are regarded as explaining the “what” of the business. That is, goal models give an overview of stakeholder intentions and business strategies, whereas business models provide a high level view of activities taking place in and between organizations. In recent years, different channels to interact with customers provided by the online environment have spurred business firms to devise new ways of building and maintaining relationships with customers to sell products and services.

The online business environment has broadened the choices that a firm can make on how to interact with their customers. This has spurred firms to pursue new and innovative ways of structuring their business strategies to establish a better position over their competitors. The term business model has been used quite frequently. Yet, there is no quite complete consensus of how it could be defined. In general a business model is defined as “the way of doing business” or more precisely “a model that depicts core logic behind the business”. Many authors argue that business models try to answer questions like: who are the actors? What do they offer each other? What are the activities that they perform to produce things, exchange them, etc? (Gordijn, 2002; Osterwalder, 2004). Gordijn, Osterwalder & Pigneur (2005) classify the evolution of business models into several phases. They argue that in the first phase of the evolution, the authors such as (Timmers, 1998) and (Rappa, 2001) were focused on defining and classifying business model notions. In the next generation, the authors were more focused on identifying components of a business model but not really on describing and linking them to each other as building blocks. An example could be the work done by Chesbrough and Rosenbloom (2002). The authors such as Weill and Vitale (2001) and Afuah and Tucci (2001) in the third phase focused on detailed descriptions of business models. The points of departure of fourth and fifth phases of business model frameworks such as Gordijn (2002) and Osterwalder (2004) conceptualize the business model components in the form of ontologies and applying them in different disciplines including information systems and management.

One of the first attempts to define a business model includes the work done by Paul Timmers (1998). In his work on business modeling he defines a business model based on what is meant by it. From his definition, we can
identify two viewpoints: an architectural and an informational viewpoint. From the design points of view, a business model is essentially a description of an architecture for the flow of products, services and information which also describes the actors involved and their specific roles. From an information point of view, a business model describes the potential benefits and source of revenues. Timmers identifies 11 e-business models: e-shops; e-procurement; e-mall; e-auctions; virtual communities; collaboration platforms; third-party marketplaces; value-chain integrators; value-chain service providers; information brokerage and trust; and other third-party services. He further classifies these 11 business models according to their degree of innovation and functional integration. The degree of innovation ranges from simple electronic ways of doing traditional business to more innovative e-business activities. The functional integration dimension describes the number of functions performed by a company, for example an e-shop only provides the marketing function of a shop and therefore with less functional integration while a collaborative platform provides an environment for collaboration between trading partners and has high functional integration.

Similar to Timmers, Weill and Vitale (2001) define eight atomic business models where each model describes different ways of doing a business electronically. These models can be combined in multiple ways to represent different kinds of business models. The eight atomic business models defined by Weill and Vitale are: Content Provider; Direct to Customer; Full Service Provider; Intermediary; Shared Infrastructure; Value-net Integrator; Virtual Community; and Whole of Enterprise.

Michael Rappa (2001) presented a more comprehensive list of business models comprising 30 models organized into nine categories: Brokerage; Advertising; Infomediary; Merchant; Manufacturer; Affiliate; Community; Subscription; and Utility. These generic models classify businesses based on the products and services they offer to their environment.

The business model frameworks presented above have a more descriptive nature and propose different kinds of models that one can use to represent different kinds of businesses. They are in a way exploring various kinds of business models existing in the modern world. Other than these, there is another approach to define a business model in a more precise way by identifying different constituent components of it. These latter approaches provide a set of basic constructs and relationships among them in the form of ontologies.

Gordijn (2002) provides a conceptual framework called $e^3$ value ontology that identifies and classifies business terms based on a value-oriented approach. The approach centers between the trade of objects of value among the various business actors. It aims at providing a simple approach for modeling value-oriented network constellations of business organizations.

Business Model Ontology (BMO) by Osterwalder (2004) provides a more comprehensive way for modeling businesses. It identifies various business
concepts classified around four pillars: Product; Customer Interface; Infrastructure Management; and Financial Aspects. Altogether, these pillars aim to define a company’s business, their customers, how they carry out delivering their value proposition, who their business partners are and how they generate revenue. Among the business-modeling approaches we analyzed in our research, BMO has a wider scope than other approaches and has a strategic focus.

The REA ontology proposed by Bill McCarthy (1982) has its origins in accounting and micro-economics and has a strong theoretical background in basic accounting principles. It centers around the concept of economic reciprocity, meaning that every economic event that increments a business’s resources is linked with a decrement economic event. During recent years REA has been extended to use as a foundation for systems development. For instance, it has been used to develop a framework for model-driven development of systems (Hruby, 2006). Additionally, REA has also been used in many e-commerce frameworks. Examples are UN/CEFACT Modeling Methodology (UMM) (UN/CEFACT, 2003) and Open-edi business transaction ontology (OeBT) (ISO/IEC, 2007).

Having discussed different business modeling approaches briefly, we next move to discuss three specific business modeling ontologies in detail. As mentioned earlier, these business modeling approaches have been used in many standardization efforts and used to model real life business cases. In this thesis, they provide the conceptual bases for analyzing components of resource transfer activities associated with business models.

2.3.1 Ontologies for business modeling

It was explained in the previous section that, over recent years, the conceptualizations with regards to business modeling focus on defining concepts and relationships between them in the form of ontology. The term ontology has its roots in philosophy. Lately, it has been used in information science, for knowledge engineering purposes to define models specifying reusable components and the relationships among them. The term ontology in this thesis is used in relation to information science and therefore we follow the definition provided by Thomas Gruber (1993).

Ontology is an explicit specification of a conceptualization, defines Gruber (1993). He further clarifies the conceptualization as an abstract simplified model of the world that we intend to represent. The aim of using ontology in information science is therefore to make a common understanding of the given subject by describing different objects of it and the relationships between them. In the following section, we briefly introduce the types of ontologies in the domain of business modeling.

The ontologies related to business are developed in two branches: one is called enterprise ontologies and focuses on describing concepts related to
organisational activities, structure, etc., of an enterprise (e.g. TOronto Virtual Enterprise (TOVE) project (Fox, 1992)). The other describes the concepts related to business transactions among several actors meaning that it mainly aims to describe the activities of a network of business constellation (e.g. BMO, $e^3$ value). In this thesis we focus on the ontologies that describe the structuring of business activities in a multi-party business environment.

In the domain of e-business there exist a number of ontologies that identify and classify a number of business concepts. Among them the three leading ontologies are:

- Business Model Ontology (BMO);
- $e^3$ value ontology; and
- Resource Events Agents (REA) ontology.

Though they share similarities in the concepts used in each other, they are expressed in different terminologies and from different perspectives. Among them the BMO (Osterwalder, 2004) is wider in scope than the other two. It focuses on resource exchanges between actors as well as internal capabilities and relationships of an actor. The REA (McCarthy, 1982), on the other hand, was originally developed as a basis for accounting information systems and focuses on increment and decrement of resources of an actor. The $e^3$ value (Gordijn, 2002) aims at modeling value webs of cooperating trading partners and also helps the profitability analysis of the modeled business scenarios.

Due to the differences in scope and underlying theoretical bases, these business modeling ontologies use different terminologies to represent similar business knowledge. Deeper analysis of these three ontologies shows that there are considerable overlaps in their but at the same time there are differences between them (Currie, 2004). All three ontologies use the notions, value and resource in the meaning that resource is used to create value.

The notions relevant to resources and resource transfers appear in BMO, REA and $e^3$ value ontologies. In BMO, resource represents tangible resources such as goods, intangible resources such as brand and reputation, and human resource such as skilled labor. An activity in BMO represents internal activities that create resources and external activities that transfer these resources between actors. Concerning the terminologies used to represent resources and resource transfers in REA and $e^3$ value ontologies, the former uses economic resource and economic events whereas the latter uses the term value object and value transfers to represent the same business notions. Though corresponding notions share a certain level of overlap, they are not identical to each other. As an example, a consumer value can be a value object in $e^3$ value but for REA it cannot be. That is the notion of value used by $e^3$ value which has a broader meaning than the notion economic resource in REA. About the terminologies economic events and value transfers, they share a similarity in the sense that both of them are used to represent a transfer of resource from one actor to another. In addition to
these notions, $e^3$ value distinguishes an activity that transfers a resource from an activity that produces a resource by introducing the notion of value activity. REA ontology does not provide a similar notion. In addition to the above, these ontologies define several other notions that are related to modeling important relationships between the notions discussed above. For instance REA uses duality to represent economic reciprocity between economic events whereas $e^3$ value uses the notion of value interfaces to represent the same. Below, we explain different notions used by these three ontologies in detail.

2.3.1.1 The Business Modeling Ontology (BMO)

BMO, proposed by Alexender Osterwalder (2004) aims to provide an approach to build business models by applying more rigorous, accurate and detailed analysis of business activities for an enterprise. Influenced by the Balanced Scorecard approach of Kaplan and Norton (1996) and Markides (1999), it proposes nine interrelated concepts grouped around four pillars.

The Balanced Scorecard approach gives a set of measures that enables top managers to get a comprehensive view to lead their business efficiently. It identifies four perspectives of the business: customer perspective; internal perspective; innovation and learning perspectives; and financial perspective. The customer perspective deals with answering the question: how is a company seen by its customers? In the internal perspective, the company tries to identify what must be done to meet the expectations of its customers. The innovation and learning perspective aims to continue the improvement of their existing processes, as well as abilities to expand them, to introduce new products. Finally, the financial perspective asks the company itself about how it is viewed by its shareholders.

Markides (1999) describes who a company should focus on whom they target as customers, what they should offer to their customers and how they should go about doing this. As also explained by Ostwerwalder (2004), what is missing in this proposal is the financial aspect of a business.

In the following table Osterwalder compares the four pillars of its BMO with a Balanced Scorecard approach and Markides’ work.

*Table 2. Four pillars of BMO with two other approaches (based on Osterwalder, 2004)*

<table>
<thead>
<tr>
<th>Business Model Ontology</th>
<th>Balanced Scorecard</th>
<th>Markides</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Innovation and Learning Perspective</td>
<td>What?</td>
</tr>
<tr>
<td>Customer Interface</td>
<td>Customer Perspective</td>
<td>Who?</td>
</tr>
<tr>
<td>Infrastructure Management</td>
<td>Internal Business Perspective</td>
<td>How?</td>
</tr>
<tr>
<td>Financial Aspects</td>
<td>Financial Perspective</td>
<td></td>
</tr>
</tbody>
</table>
Based on an analysis of existing business model literature, Osterwalder proposes a new approach which is called BMO. The BMO consists of nine elements grouped into four pillars listed above. The following table adapted from (Osterwalder, 2004) summarizes the synthesis of BMO.

Table 3. Principle concepts of BMO (taken from Osterwalder, 2004).

<table>
<thead>
<tr>
<th>Pillar</th>
<th>Building Block of Business Model</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Value Proposition</td>
<td>A Value Proposition is an overall view of a company's bundle of products and services that are of value to the customer.</td>
</tr>
<tr>
<td>Customer Interface</td>
<td>Target Customer</td>
<td>The Target Customer is a segment of customers a company wants to offer value to.</td>
</tr>
<tr>
<td></td>
<td>Distribution Channel</td>
<td>A Distribution Channel is a means of getting in touch with the customer.</td>
</tr>
<tr>
<td></td>
<td>Relationship</td>
<td>The Relationship describes the kind of link a company establishes between itself and the customer.</td>
</tr>
<tr>
<td>Infrastructure Management</td>
<td>Value Configuration</td>
<td>The Value Configuration describes the arrangement of activities and resources that are necessary to create value for the customer.</td>
</tr>
<tr>
<td></td>
<td>Capability</td>
<td>A capability is the ability to execute a repeatable pattern of actions that is necessary in order to create value for the customer.</td>
</tr>
<tr>
<td></td>
<td>Partnership</td>
<td>A Partnership is a voluntarily initiated cooperative agreement between two or more companies in order to create value for the customer.</td>
</tr>
<tr>
<td>Financial Aspects</td>
<td>Cost Structure</td>
<td>The Cost Structure is the representation in money of all the means employed in the business model.</td>
</tr>
<tr>
<td></td>
<td>Revenue Model</td>
<td>The Revenue Model describes the way a company makes money through a variety of revenue flows.</td>
</tr>
</tbody>
</table>

The above table not only summarizes the most commonly appearing building blocks from various other research in the area of business modeling.
but also shows the nine core concepts of the BMO divided into four categories similar to a Balanced Scorecard approach as well as to Markides’ work. In the following section we briefly discuss the concepts of BMO. We limit our focus to the first three pillars listed in the table above.

**Product**
The *Product* pillar gives a high-level view of a company’s business including a bundle of products or services offered to its customers and how it differentiates from its competitors. Basically it is comprised of two components: the Value proposition and the Offering. The *Value Proposition* describes the value offered by a company to its customer segments. It specifies a set of products and services offered and how they are bundled together. It further differentiates the products of a company and the way they are offered from its competitors by pinpointing different features associated with the products, services and the way they are offered.

The *Offering* sub-element decomposes the aggregated view of the company’s *Value Proposition*, into a set of elementary components by illustrating certain characteristics of specific products or services that describe their position in a competitive market. The BMO uses several attributes: *Reasoning; Value Level; Price level;* and *Life Cycle* to describe why customers should be interested in their products. It does this by specifying various aspects of having them and using them, for example, how much effort is needed to obtain these products and the costs related to their maintenance, etc. These attributes further specify how an enterprise differentiates its products and services from its competitors by means of explaining whether they are unique for the enterprise, or they are an improvement over the same competitive products and services offered by others or just the same as the products offered by others. Furthermore these attributes illustrate the position of the prices of the products over their competitors.

**Customer Interface**
The *Customer Interface* describes the customers of a company. It primarily aims to describe the type of customers targeted by a company, how a company reaches its customers to deliver its products and what a company does to attract new customers and retain existing ones. Customer Interface consists of three basic elements: *Target Customer, Distribution Channel* and *Relationship*.

Among them the *Target Customer* element represents the customers that a company targets to sell their products. Segmentation of customers and identification of groups to sell products is important as to maximally utilize resources and increase profits. The *Criterion* sub-element associated with the *Target Customer* element decomposes a company’s customers into different segments using a set of characteristics it has, for example, of being a geographical or socio-demographic nature.
The way that a company delivers its value is described by the Distribution Channel element. It describes how a company delivers its value proposition to the Target Customers, whether it is directly by itself, for instance through sales force or over the Internet or indirectly, for example, through intermediaries. Its purpose is to deliver the right amount of products and services to the right people at the right time. The Distribution Channel is further decomposed down to a sub-element Link that illustrates specific marketing tasks employed by a company to deliver its value proposition to its customers. The Link sub-element potentially describes the parts of a Distribution Channel by looking at them from different aspects, for example, how the usage of the Web impacts on reaching their customers or what specific functions at various stages of the customer buying cycle are fulfilled by channel links. Moreover, the Link sub-element inherits attributes from the Offering sub-element of the Value Proposition.

The Relationship element in the Customer Interface pillar refers to a relationship that a company builds with its customers. It is most important for a company to have a strong customer base to be able to survive in a competitive market. For that, managing existing relationships and building new relationships is essential. The relationship building comes at a high cost and therefore a company must carefully define the ways to do it. The BMO classifies customer relationships based on customer equity goals of a company: i.e., acquiring, retention and add-on selling. The idea behind this classification is to treat the customer as a company’s asset and to emphasize that they have to be maximally utilized like any other asset. As he describes, this analysis would help companies to optimize the acquisition, retention and selling additional products to their customers and to increase its value for the company throughout its lifetime. To attract and keep customers, a company must highlight the different features it has over its competitors, both of products and of delivering these products and services to the customers. The Relationship element is further decomposed into a sub-element Mechanism. Mechanism describes the specific actions that a company takes to build a relationship with its customers. These actions include personalization of actions, establishing trust, and strategies of promoting the brand name.

Personalization represents building a one-to-one relationship with customers. This can be done in several ways like tailoring the marketing activities to a specific customer or to customer segments, for example, personalized product recommendations to customers. The establishment of trust can happen in various ways. For example, a company could use a third party to establish the trust between them and the customers. Moreover, the brand could also play a pivotal role in attracting customers. A popular and trustworthy brand name would be an excellent way to attract and retain customers and also to establish trust with them.
Infrastructure Management

Infrastructure management in BMO is concerned with how a company creates value and what abilities they should have to create and deliver value for customers. It consists of three main elements: Capability; Value Configuration; and Partnership elements.

The Capability element in BMO refers to the ability for a repeatable use of a company’s assets to create and offer their products and services to the market. Since the resources are scarce, frequently, capabilities are outsourced to partners of a company. The use of e-business technologies enables a firm to have a tight integration between outsourced capabilities for them to function properly.

Capability is further decomposed down to Resource and Actor sub-elements. A Resource is an input to the value creation process of a company and acts as a source of a company’s capabilities. They can be tangible like equipment, intangible like brand names of a company, or human resources like a skilled labor force. An Actor in BMO is an outside organization. More precisely, it is meant for company’s trading partners and is not equivalent to the Target Customers. The company, together with its partners, offers products or services to the target customers.

The Value Configuration element shows all the activities necessary for the creation of value and specifies the relationships among them. It represents all the activities, both inside and outside and extends the Porter value chain (Porter, 1998) by two other types: value shop and value network. The activities in the value shop describe the activities ranging from understanding a problem to be solved, finding alterative solutions, evaluating them and choosing among them up to implementing a solution and measuring its successfulness to solve the problem. The activities of the value network describe the activities associated with selecting and inviting customers to join the business network, managing contracts related to a mediation, establishing, marinating and terminating links between them and keeping the network on alert to serve customer requests.

In BMO, Partnership is defined as a voluntarily initiated cooperative agreement between several companies to jointly create value for the customers by coordinating their core competencies. It describes the configuration of activities between a company and its partners and the distribution of resources between them.

In order to work partnerships properly, the terms and conditions for working together must be clearly defined. For that, BMO defines an Agreement sub-element which aims to explain the motivation behind a partnership and the conditions under which the parties will cooperate with each other. It explains the motivation from several aspects: establishing partnerships to get access to infrastructure facilities, to expand the business operations, to reduce risks and to get access to resources like knowledge, data, etc. Furthermore, an agreement describes the importance of partnering with another,
the degree of competition between them and how close they are linked together.

2.3.1.2 e³ value ontology

The e³ value ontology proposed by Gordijn (2002) focuses on describing the value creation and transfer process in a business network constellation. He argues that the main goal of business modeling is to answer the question: “who is offering what to whom and expects what in return”. The central notion of e³ value ontology is the concept of value and the main design decisions represented in an e³ value business model are:

a. Who are the business actors?

b. What offerings are there and who are the actors involved in these offerings?

c. What are the elements of these offerings?

d. What are the value-creating or value-adding activities to produce and consume these offerings?

e. Who performs them?

The e³ value ontology consists of several key elements (see Figure 4). They are actors, value objects, value ports, value interfaces, value activities and value transfers. An actor is an economically independent entity. It is often, but not necessarily, a legal entity, such as an enterprise or end-consumer. A value object is something that is of economic value for at least one actor. Examples of value objects are a car, Internet access, or a stream of music. Actors use value ports to provide or receive resources to or from other actors. It has a direction: in (e.g., receive goods) or out (e.g., make a payment), which indicates whether a resource flows into, or out of the actor. A value interface is used to group value ports. It shows the objects of value an actor is willing to exchange as compensation for another object through one of its value ports; for instance, a reader gets an article from a publisher in return for a payment. That is a value interface is used in e³ value as a means of modeling economic reciprocity. A value interface must contain at least one value port but can have many ports. However, if one port of an interface is activated, then all other ports in it must also be activated to be able to exchange value objects through that interface. This means that all ports must exchange value objects or none at all. A value transfer is a pair of value ports of opposite directions belonging to different actors. It represents one or more potential trades of resources between the actors. A value activity in e³ value is an operation that can be carried out in an economically profitable way for at least one actor.
Three sub-view points: the global actor view; the detailed actor view; and the value activity view are used in $e^3$ value business models. The global actor view models all the actors in a network business environment along with the value objects consumed, created and exchanged by them. Figure 4 shows the concepts and their relationships of $e^3$ value ontology in the global actor view.

The detailed actor view in $e^3$ value ontology provides the information such as value constellation and partnerships. It is used to model and it breaks down an actor identified in the global-actor view into more actors wherever it is applicable and shows the value that is offered by each other. This means that in the global-actor view, one can represent a complex situation of having many actors unite together to provide a certain value object to its environment. In the detailed-actor view this composite actor is decomposed down to a set of actors showing the partnerships among them and what value objects are created and offered by them. To support this, they introduce two additional concepts: a composite actor and an elementary actor, both are related to an actor via a relationship. It should be noted that in the case of a composite actor, it is not the actors which are grouped but the value interfaces belonging to them. This is due to the fact that the customer may not see who provides what, in the case of a value object, it is a bundled product and one may only see this bundled product.

Finally, the value activity view represents the assignment of value activities of actors.

The $e^3$ value ontology also facilitates carrying out a profitability analysis of the business model created based on it and can be seen as an advantage of the approach.
2.3.1.3 REA ontology

REA ontology proposed by McCarthy (1982) has its roots in accounting where every transaction is seen as either incrementing or decrementing resources. For example in a purchase, the buyer gives up money in order to receive goods. In this case while the amount of money that the buyer has is decreased, the amount of goods he has is increased. In recent years, REA ontology has been further developed to extend its usability e.g. (UMM, 2007), (ISO/IEC, 2007) as a business modeling ontology.

The basic REA ontology model is depicted in Figure 6:

[Diagram of REA ontology]

REA classifies business activities around three main aspects of an exchange: the resources that are the subject of the exchange; the economic activities that transfer these resources; and the participating agents. To facilitate binding the main components of the ontology together, REA defines three rules (Geerts & McCarthy, 2005):
1. Axiom 1 – at least one inflow event and one outflow event exist for each economic resource
2. Axiom 2 – all events effecting an outflow must be eventually paired in duality relationships with events effecting an inflow and vice-versa;
3. Axiom 3 – each exchange needs an instance of both the inside and the outside subsets.

These axioms aim to define the direction of resource flows, the rules for coupling reciprocal economic events and the rules for defining the relationship between resource exchanges and the business stakeholders. More precisely, they define the rules that underlie the structuring of core concepts and their relationships to each other in REA ontology. The intuition behind these rules is that every transaction can be described in terms of the relationship between several things: the resources, the events that transfer these resources and their relationship to each other and the actors involved in these events.

The core concepts in REA are Resource, Events and Agents which are more often called Economic Resource, Economic Events and Economic Agents. The economic resources in REA are the things exchanged between the agents. They are scarce and are under control of an enterprise. Products, service, and labor are examples of resources. Economic events facilitate the exchange of these resources between actors. REA defines two types of economic events: increment and decrement events. They mean that to receive a resource an agent must give up another resource where the event associated with receiving a resource is an increment event and the event associated with giving up a resource is a decrement event. For example, to receive a product, a customer should give up the money he has. The connection between these two reciprocal economic events is an important economic primitive in REA and is defined as the duality relationship.

Recent developments of REA (Geerts & McCarthy, 2005) distinguish two types of events: transfers and transformations. The transfer events are related to transactions with external actors while transformations are the events related to the value creation of an actor. Stock-flow relationships in REA describe the connection between the economic events and the economic resources. It differentiates among sets of stock-flow relationships related to transfer and transformation events. In the case of transfer events, the stock-flow relationship takes values: give and take. For example the customers give up cash to take products. Possible stock-flow relationships between transformation events and the resources are: use, consume and produce. According to (Geerts & McCarthy, 2005), when a resource is used, it either ceases to exist or leaves its original form so as to be unrecognizable. In contrast, consuming a resource will make it gradually decrease its original form. In a transformation process a resource is either used or consumed to produce a resource.
In addition to the core concepts mentioned above, REA is also extended to include various other constructs to model the value chain of a company. These include concepts such as commitments, contract, schedule and economic claim. Economic commitments in REA represent the planned and scheduled events for a well-defined future. The actual economic events and their respective commitments are connected by the executes relationship. Similar to the duality relationship between pair-wise actual economic events, REA also defines pair-wise required commitments having the reciprocal relationship between them. Economic agreement in REA bundles reciprocal commitments. Based on the nature of the economic event, REA differentiates two types of agreements: contract and schedule. The transfer events execute contracts while the transformation events execute schedules.

Later on, the typification of concepts is introduced in REA to abstract away an actual phenomenon and capture common descriptions applicable to a group of instances. This concept is important as if an actual phenomenon no longer exists, the abstract definition in the typification is preserved for future use. In REA these typification definitions are regarded as the components in the knowledge level while the actual phenomena are in the operational level. There are four main types of images in REA: Economic Resource Type; Commitment Type; Economic Event Type; and Economic Agent Type. A car is an example of a resource type which applies to a large number of actual cars at the operational level. An example of an agent type is a market segment containing preferred customers. In addition to that there
can also be typifications of certain other phenomena such as Economic Agreement, etc.

Recent developments of REA provide facilities to represent workflow and task specification across value chain, business process and economic event layers (Geerts & McCarthy, 2005; Gailly & Poels, 2007). Additional conceptual images such as process and task (business events) have been introduced to represent horizontal and vertical decomposition of activities within and across the layers. A process in REA represents the exchange of economic resources between actors and different activities required to realize it. A typical example of an exchange could be selling (economic event) goods (resource) for payment (economic event) of cash (resource). The actual realization of this could include a number of smaller activities and these are called tasks (business events). For instance, assessing customer needs, checking whether the goods are available and choosing the goods that match the customer requirements, etc. could be different tasks required to execute the exchange: selling goods – receiving payment.

2.4 Frameworks for modeling business collaborations

In the previous sections we presented three well-established business modeling ontologies. In this section we discuss international initiatives based on REA ontology to further facilitate business as well as process modeling. As an example, UN/CEFACT Modeling Methodology (UMM) (2003) and OeBTO (ISO/IEC, 2007), are two such initiatives aimed at developing a more comprehensive methodology for enterprise modeling. Both the UMM and OeBTO have their roots in REA ontology. In each of them, REA concepts have been extended to support reusability of process and information descriptions. From a business collaboration point of view, these frameworks are aimed at standardizing business related knowledge representation without regarding to the underlying implementation technology. Compared to business modeling approaches described above, the main focus of UMM is to capture information regarding the business processes and to provide a comprehensive process analysis methodology. The purpose of the OeBTO is to bring about different concepts in different standardization efforts into one umbrella and create a formal framework for defining the composition of business collaborations between actors.

2.4.1 Business collaborations and business transactions

Generally, business collaborations represent trading between two parties, namely the “seller” and the “buyer”. In business collaboration, a seller and a buyer are involved in activities that enable a flow of resources between them. A simple business collaboration should at least consist of two resource
flows between seller and buyer. When a time dimension is added to describe a business collaboration, these two basic events can be defined as: an event initiating a flow of resources and an event responding to that. That is, at a very basic level, in a collaborative environment there should at least be an initiating resource flow and a responding resource flow. Open-edi (ISO/IEC, 2007) defines that the business activities of collaborative space, where transfers of resources occur between actors, should be viewed from an independent viewpoint and not from the perspective involving any business partner. Figure 8 depicts business collaboration space activities between a buyer and seller.

The exchange of resources in the collaboration space provides the basis for defining business transaction. Business transactions are often used as a means to group reciprocal resource transfers between actors. A typical example of a transaction could be exchanging goods for cash.

Different business modeling approaches model business transactions in different ways. For instance, $e^3$ value uses the notion of value transaction to model a business transaction where it represents a set of requiting value transfers between different actors. Though, initial versions of REA ontology do not define the notion of business transaction, the extended versions of the ontology, such as OeBTO, include the concept of business transaction. In contrast to the $e^3$ value definition of a value transaction, a business transaction in the OeBTO is defined as an economic exchange occasioned between two independent parties where each party reciprocates with a value desirable to the other party. One of the main reasons for the difference between two definitions is the influence of their respective ontological basis for defining reciprocity. The OeBTO uses REA ontology as its basis and the reciprocity in REA ontology is modeled by the duality relationship between two economic events. Therefore the collaboration space in REA primarily consists of reciprocal events happening between two actors. However, the activities responsible for exchanging resources between actors are represented in $e^3$ value ontology by using value transfers. Though value transfers are more or less similar to economic events in REA, the difference between them is that
in $e^3$ value ontology, a value transfer is used as a means to interconnect two actors and the reciprocity between value transfers are modeled by means of using value interfaces. Thus $e^3$ value gives freedom to couple more than two value transfers to model the reciprocity.

In contrast to the OeBTO definition of a business transaction, the Open-edi framework in (ISO/IEC, 2002) defines a business transaction in a more general way. There it is defined as a pre-defined set of activities initiated by an organization to achieve shared business goals and terminated upon the achievement of previously agreed conditions with other collaborating organizations. From a number of actors who could be involved in a business transaction, this definition is more or less equivalent to the $e^3$ value definition of value transaction. Therefore, a common basis for defining a business transaction could be that it encompasses resource transfers for fulfilling a particular commitment between collaborating actors.

Often business transactions are analyzed considering business and IT aspects. For instance, Open-edi frameworks in (ISO/IEC, 2002), (ISO/IEC, 2007) and UMM (UN/CEFACT, 2007) provide methodologies for analyzing and modeling business transactions based on Open-edi reference ontology which considers both business and IT aspects of business transactions. In the business aspect, exchange of commitments among parties involved in the business transaction are considered whereas in the IT aspect exchange of data among their IT systems are considered. Moreover, the Open-edi framework in ISO/IEC 15944-1 (ISO/IEC, 2002) identifies Person, Process and Data as key elements in a business transaction. A person can be individuals or any legal entity such as organizations which can make and fulfill commitments. The process element represents a series of actions performed by persons in a defined manner to achieve expected results. Finally, the data component of a transaction refers to the exchange of information between collaborating actors. The Open-edi framework also clarifies that, though information can be available in different forms, electronic business transactions require information (data) which can be stored and retrieved by computer systems.

2.4.2 Fundamental activities of a business transaction

Actors involved in a business collaboration perform activities, for example to recognize their needs, establish a link between them and agree on terms and conditions of the exchanges, and finally exchange objects of value between them and fulfill the previously established commitments. The Open-edi framework in (ISO/IEC, 2002) for analyzing operational aspects of a business transaction defines that the activities performed in a business transaction span over five distinct phases: planning, identification, negotiation, actualization and post-actualization. Below, we briefly discuss the five phases of an Open-edi business transaction.
Planning: In the planning phase, the customer and the provider are engaged in activities to identify the actions needed for selling or purchasing goods and services. More precisely, the provider engages in activities related to publishing data pertaining to the availability of goods and services. As an example, a distributor publishes catalogues. In the planning phase, the customer engages in activities such as searching for potential suppliers, requesting additional information regarding goods and services from the potential providers, etc.

Identification: The identification phase involves the activities needed to exchange information among providers and potential customers regarding selling or purchasing goods and services. These information bundles regard more detailed data required to progress from the planning phase to the negotiation phase. For example, a provider sends a quotation, which contains detailed specification of goods, services and conditions, to a customer. The primary aim of the identification phase is to build a link between potential buyers and sellers so that a level of trust can be established between them in order to exchange more detailed information that both of them were not be willing to exchange without proper identification in the planning phase. For example, a seller may require more detailed information about the buyer, whether the buyer is an individual or an organization, to determine the level of external constrains that may be applied.

Negotiation: In the negotiation phase the buyer and seller engage in activities leading to an agreement on the detailed specification of goods or services that are to be exchanged and the conditions under which the exchange of goods may take place. That is, the process of negotiation is directed at the formation of a formal contract which specifies the terms and conditions associated with the business transaction. Furthermore, at the end of the negotiation phase, the buyer and seller agree on the involvement of third parties in the transaction and exchange rights such as complete ownership rights, short term licenses to use, etc. Information regarding the post sale services are also specified and agreed during the negotiation phase.

Actualization: Activities necessary for the execution of results agreed between the collaborating parties take place in the actualization phase. The seller starts executing activities necessary for transferring goods and/or services to the buyer as agreed in the negotiation phase. At the end of the actualization phase, the seller completes delivering goods, and/or services, rights to the buyer. The buyer in response reciprocates with an acceptable equivalent value to the seller as agreed in the negotiation phase.
Post-actualization: In the post-actualization phase, the buyer and the seller engage in activities and associated information exchanges that are deemed necessary to occur after the agreed upon good and/or services are exchanged. These activities can include invocation of warranty coverage, after sale services such as product recalls, fixing up defects, complaint handling, long term payment handling, etc.

The Open-edi framework suggests that the fundamental activities discussed above may take place in any order, for example, post-actualization aspects such as information regarding warranties of the goods or services may be made available in connection with the planning phase activities. Further, collaborating parties may terminate a collaboration based on some agreed method without going through all the distinct phases. For instance, the collaboration between a supplier and a customer may come to an end at the end of the identification phase where a customer decides that the detailed specification of goods does not fit with his needs. Though the phases comprise of distinct activities, they can be completed in a single continuous interactive dialogue or in several discrete dialogues between the collaborating parties.

2.5 Service-oriented modeling

It was highlighted in the previous sections that the goal and business modeling are used to describe a high level view of stakeholder intentions, business strategies and business activities within and between organizations. Lately, service-oriented modeling is recognized as an important aspect in provisioning e-business solutions. A primary aim of the service orientation is to hide complex and heterogeneous technical details from users by providing a standard way to communicate with business applications. Such technological independence allows services offered by different systems used in a flexible manner thus allowing flexible collaborations between them.

In this section, we first discuss different categories of service orientation, for example, business and software orientation and how service is defined in these different contexts. Then we conclude the section by giving an overview of business-oriented e-service design.

From a business point of view, a business service represents a service in general, for instance, selling goods. In an information systems context, it is generally a concept that abstracts away specific technical details of a business process allowing it to be reused in many other business processes. A software service is a special kind of service where a service is associated with a software application. However, different authors define them in different ways. In the following we list definitions from various sources and analyze them. This kind of analysis will help to identify the most basic com-
ponents attached to services notion in these contexts and to identify relations-
ships among them.

**W3C:** "A service is an abstract resource that represents a capability of per-
forming tasks that represents a coherent functionality from the point of view
of provider entities and requester entities. To be used, a service must be rea-
liized by a concrete provider agent. A Web service is a software system de-
dsigned to support interoperable machine-to-machine interaction over a net-
work. It has an interface described in a machine-processable format (specifi-
cally WSDL)." (W3C, 2004).

**OASIS:** "A service is a mechanism to enable access to one or more capabili-
ties, where the access is provided using a prescribed interface and is exer-
cised consistent with constraints and policies as specified by the service de-
scription." (OASIS, 2006).

**WSMO:** "A service in contrast is the actual value provided by this invoca-
tion. Thereby a Web service might provide different services, such as for
example Amazon can be used for acquiring books as well as to find out an
ISBN number of a book. A WSMO Web service is a computational entity
which is able (by invocation) to achieve a users goal." (Roman et al., 2005).

**Preist:** "A service is the provision of something of value, in the context of
some domain of application, by one party to another. We need to distinguish
between a particular provision of value from the general capability to pro-
vide. We refer to the former as a concrete service, and the latter as an ab-
stract service. Hence an abstract service is defined as the capacity to perform
something of value, in the context of some domain of application. An agreed
service is an abstract service agreed between two parties." (Preist, 2004).

**UN:** "Services are heterogeneous outputs produced to order and typically
consist of changes in the conditions of the consuming units realized by the
activities of producers at the demand of the consumers." (UN, 2002).

The most common view of a service among the sources listed above is
that a service is an abstract thing and once it is invoked will achieve user
goal(s). However the exact way of defining the service depends on the pers-
pective of a particular source, for example, W3C and WSMO focus on Web
services (or software) perspective while others, for example, Preist, UN,
OASIS, etc. focus on business services perspective in general.

In the business service perspective, a service is defined by aligning it with
the value it creates to users or seeing it as a way of giving them an access to
business processes. It hides away the actual implementation details of a
business process and gives a common access window. Therefore, a service in
here is a concept on the knowledge level. A service also has a provider and a
user, which are also knowledge level concepts (Preist, 2004; W3C, 2004).
Defining a service as an abstract knowledge level concept gives providers
the flexibility of implementing it in different ways in order to offer it to ser-
vice users. Preist describes this as distinguishing between a particular provisioning of service from the general ability to provide it.

When a service is offered by a particular agent to a particular user (customer), the actual number and types of resources used in the implementation of the service and the way of offering it, can be different. In realizing a service, a particular provider may perform various tasks and produce something of value to service users (UN, 2008; Preist, 2004). For example, in a hair cutting service, hair cutting could be done in different ways by using different resources.

The service realization is done with a goal of meeting certain demands of service users (UN, 2008). For example, a particular user may want to get a haircut in a short time so that the provider may use machines instead of scissors and may also skip tasks like shampooing, etc. to meet his customers timing constraints. The service realization and provisioning are also done in compliance with the business policies and constraints of the provider organization (OASIS, 2006).

E-service is another notion that is used in service-related literature. E-service is defined as the offering of a business service by Internet or any other electronic means such as Automated Teller Machines (ATMs), wireless networks, etc. Web services technology platforms are often used to realize e-services. According to Baida et al. (2005), a distinction between business service and e-service is that, a business service represents a computationally ill-defined value-oriented activity and an e-service represents a well-defined concept with concrete tasks that together realize the broadly defined value-oriented activity view of a business service by thus making it suitable for an online activity.

A Web service in above is defined in two ways. In (W3C, 2004), a Web service is defined as a special kind of a business service where a software application(s) is involved. In (Roman et al., 2005), a Web service can provide more than one services and hence for them the Web service seems more general than the service, for example, Amazon can be used for acquiring books as well as to find out an ISBN number of a book and for them these are distinct services provisioned by a single Web service. Considering the above example, it we can reasonably argue that service in (Roman et al., 2005) refers to both business and e-services.

These two definitions unveil an important aspect of a service, its compositeness. That is a service may consist of more than one service that will fully realize the first service when it is invoked. This means that, regardless of whether a service is either a general business service or a Web service, it could be a container of several other services that fully realizes the goals of that service. This further illustrates the nature of abstractness which also applies to Web services as well. When an abstract service, either Web or a general business service is invoked, it may be realized through several other services which could either be Web or general business services. In addition
to the compositeness, Web services also inherit characteristics of services such as having provider and user agents, abstractness, realization through several tasks, etc. (W3C, 2004).

Based on different characteristics of services that we discussed above, in the following, we summarize our view of a service. By service, here we mean both business and e-service.

- Services are abstract resources with well-defined common access interfaces.
- A service is always attached to a provider agent and a user agent. The former may or may not be the owner of the service but could be something or someone who can perform tasks that realize the service.
- A provider may realize a service by performing various tasks that creates some value to service users.
- The abstract nature of a service provides the flexibility to realize it in different ways by using different resource types as required by the service itself and also meeting the goals and needs of both the organization and the service users.
- The realization of a service may be carried out according to the policies and constraints of both the organization and the customer.
- A service can be composite meaning that it requires one or more other services to be executed in order to fulfill the goals of that service.

2.6 Related work on business-oriented e-service design

Having discussed general background related to goal modeling, business modeling and service design, in this section we discuss related works on business-oriented service exploration and realization.

From a business point of view, the realization of a service is defined by the description of the business process underneath the service. Therefore, it is evident that the designing and development of e-services encompass technical as well as business aspects. As such, it is important to identify right portfolio of e-services which are aligned with the business strategies of a company and integrate them together with activities of the company’s value chain.

Integration between business and information systems has been identified as a significant problem and has been comprehensively studied over recent years. As such, there have been upsurge in number of research studies that focus on business-oriented exploration of e-services; examples are (Papazoglou & Heuvel, 2006; Levi & Arsanjani, 2002; Zlatev et al., 2004; Arsanjani et al., 2008; Gordijn et al., 2006a; Gordijn et al., 2009), (Andersson et al., 2008). In general all these approaches focus on assuring that the right set of e-services are identified using a top-down approach. That is, the methods start with a high-level business analysis to identify e-services that may even-
tually be realized by, different technologies such as Web services technol-
gy. Closer analysis of these approaches shows that, they use goal, process
and business models as points of departure for identifying e-services.

Often, the relationship between high-level business goals and technical
architecture in software projects, differ (Levi & Arsanjani, 2002). In order to
integrate technology and e-services that fulfill these business goals, a num-
ber of studies propose using business processes as a point of departure (Levi
& Arsanjani, 2002; Papazoglou & Heuvel, 2006; Arsanjani et al., 2008).

The approach proposed in Service-Oriented Modeling and Architecture
(SOMA) by IBM focuses on the top-down analysis of business domains to
identify their constituent business processes as a part of their method for
designing e-services and aligning them with existing systems (Arsanjani et
al., 2008). The proposal does not provide explicit information about how
business models are used in the e-service design but it identifies the impor-
tance of business modeling as a part of identifying the focal area that the
service-oriented solution is required (Arsanjani et al., 2008). Further, the
approach uses a goals hierarchy for the gradual decomposition of business
strategies down to a set of actionable business goals from which e-services
that fulfill business strategies are identified.

The e-services identification approach (Papazoglou & Heuvel, 2006) fo-
cuses on a process-oriented framework for the identification of e-services
and their relationships. It emphasizes the importance of aligning technical
aspects of e-service design to business environment during planning, and
analysis and design phases of e-service design and development life cycle.
However, the approach is primarily focused on the business process aspect
of the business environment as a means to identify e-services. As such, it is
not clear how the alignment of e-services to business strategies is done
which is what we do in this thesis.

The approaches proposed in (Gordijn et al., 2006a; Gordijn et al., 2009;
Andersson et al., 2008; Zlatev et al., 2004, Baida et al., 2005) use needs,
goals and business models as the point of departure. The general argument is
that customer needs, goals and business models offer a solid platform for
justifying the choice of e-services and give a precise understanding of the
environment in which the e-services will function. In particular, the ap-
proaches mentioned above suggest that the service-oriented requirements
engineering should begin with identifying goals of different actors and de-
signing a goal-aligned business model. Additionally, some of them provide a
means to quantitatively analyze business processes and IT resources required
to implement them as e-services and evaluate profitability of them (Gordijn
et al., 2006a; Gordijn et al., 2009).

In Gordijn and Petit (2006a), the authors discuss the relationship between
goal and business models as a foundation for the identification of goal
aligned and economically sustainable business services. Nevertheless, their
approach does not propose a method for relating goals with business model
components and e-services; issues that we address in this thesis. Also, the approach proposed in Baida et al. (2005), uses ontologically founded method for describing consumer needs to elicit resources and map them to e-services. However, the proposal does not relate the services to a business model which is an important aspect that we consider in our work.

The e-services identification and realization approach presented in Gor-dijn et al. (2009) suggests that three viewpoints: value, process, and information systems, should be considered in service-oriented requirements engineering. In the value viewpoint, three types of descriptions of e-services are produced. Firstly, top-level customer needs are identified and mapped them to e-services to be offered by various business actors. Secondly, activities related to the creation of these e-services are modeled. Finally, the profitability of the proposed e-services is evaluated. In the process view, interorganizational business processes are identified considering all the actors involved in the business case. These business processes are then examined and tasks performed by individual actors are identified and modeled using Unified Modeling Language (UML) activity diagrams showing the orchestration of tasks. Finally, in the information systems viewpoint Web services specification standards such as Web Services Description Language (WSDL) (Christensen, Curbera, Meredith & Weerawarana, 2001) and Web Services Business Process Execution Language (WS-BPEL) (OASIS, 2007) are used to describe the business processes. To obtain the information system viewpoint, the approach uses the UML Profile for Automated Business Process developed by IBM (Amsden, Gardner, Griffin & Iyengar, 2003). However, even being model-oriented, the approach does not define business and system-oriented models and model transformation as recommended by MDA discipline. Besides, even being primarily goal-oriented, the approach does not utilize goal modeling as a technique to assist systematic modeling of a business and also focuses on the consumer perspective, that is the goals of consumers.

2.7 Running business scenarios

In this thesis, we use two business scenarios from different domains to demonstrate the utilitarian value of the created artifacts. These two business scenarios; Massively Multiplayer Online Games (MMOG) from the online gaming domain and the eye-care health case (Henkel et al., 2007) from the healthcare domain are discussed in detail below.

2.7.1 Massively Multiplayer Online Games (MMOG) case

In this business scenario there are three actors and market segments involved: the Game Provider, the Internet Service Provider (ISP) and the
Game Player. The Game Provider is responsible for producing the game content and selling and distributing its software on CDs (CD delivery) to the Game Players. In order to play the game, the Customers need Internet access, which they get from the ISP by paying a fee (Payment). They also need access to the game server (Game access), which they get from the Game Provider. The Game Player obtains both Games access and CD delivery by paying a fee (Payment) to the Game Provider. In order to provide game access to the Game Player, the Game Provider gets Hosting service from the ISP in return for a fee (Payment). The simple business model in the figure below depicts the MMOG business case explained above. Actors are shown by straw man, resource transfers by arrows between actors with the names of resources as labels.

![Figure 9. An e3 value business model for the MMOG case](image)

2.7.2 Eye-care health case

Figure 10 depicts a simple business model of the eye-healthcare case. The model is an excerpt of a larger case defined in the REMS project (Henkel et al., 2007) that will be used as a running example throughout this thesis. The model depicts the resource transfers (by arrows between actors) taking place between three actors: a Patient, a Primary care physician and a Healthcare specialist (represented by straw man). Having a problem with her eye(s), the patient contacts the local primary care physician, to get an opinion and treatment. If necessary, the primary care physician refers the patient to an eye specialist clinic. The resources, that the patient gets, are the treatment including a diagnosis in return for a fee ($). If primary care decides that the patient needs further treatment, they will refer the patient to the
healthcare specialist. When the patient is referred to the healthcare specialist, the primary care offers a referral to the healthcare specialist. The patient visits the healthcare specialist and receives advance treatment in return for a fee ($).

Figure 10. Major actors and their relationships in the eye-care case
3 Analyzing Resources, Resource Transfers and Conversion Activities

3.1 Introduction

In this chapter, we set the basis for designing business models by analyzing the notions; resource, resource transfers and conversion activities used in business modeling. The results of the analysis are used as a part of developing the business modeling and service designing methods presented in forthcoming chapters.

Resource, resource transfers and conversion activities are fundamental notions of business modeling. Different business modeling approaches use different naming conventions to denote the resources and resource transfers. For instance, e³ value business modeling ontology uses the notion of value object to represent a resource, value transfer and value activity to denote resource transfers and conversion activities. The REA ontology uses the notions economic resource, economic event and conversion event to denote resource, resource transfer and conversion activities respectively. A resource, in both these business modeling ontologies, is something that has a value and that can also be transferred from one actor to another. However, a value object in e³ value represents a more general notion of a resource and accommodates things such as consumer experience, in addition to goods, services and money which are often defined as resources in other business modeling approaches such as REA and BMO. From a broader perspective, what is perceived as a value by a consumer may include more than conventional resources such as goods, money, services. Value may lie in a resource as well as in the way it is offered to him. For instance, when a customer buys a book (resource) from Amazon.com, the book itself and the way it is offered such as one-click shopping may produce value to the customers. While the book may give him an opportunity, for instance, to increase his knowledge, one-click shopping may create him value by saving his time required to buy the book.

From a value point of view, a single resource transfer may include a transfer of different components that delivers some value to a consumer. For instance, consider an offering of a movie by a cinema. While the movie is the
resource of primary concern (or simply, core resource), the cinema may also offer tickets to customers to use as tokens of the right to see the movie. However, they are often modeled in business models as a single resource transfer activity considering the movie as the resource. Yet, clearly, movie and ticket are different but interrelated things of value that are offered by cinema to its customers. They may carry different values and therefore it is important to represent them in a business model. Such an elaboration of resource transfers will make a business model a better platform to design other types of models such as process models and to design e-services.

In contrast to resource transfers, conversion activities are mainly responsible for producing resources. They represent internal activities of an actor that creates resource to be either used by another conversion activity or transferred to another actor by a resource transfer activity.

3.2 Resources

Typically, customers rate objects of value based on their fitness to achieve the goals of buying them. Here, objects could be products like books, cars, or even typical services like haircuts, and medical treatments. The, value created by these objects can be of a more psychological and social nature, such as beauty, pleasure, health state, honor, and the feeling of safety. Furthermore, Gordijn (2002) also recognizes consumer experience as having a value. To distinguish the objects of value mentioned above from value created by them, we call the former economic resource.

Economic resources

An economic resource is a resource that can be under the control of an actor, in the meaning that the actor may have legal rights on the resource. That is an economic resource is an object that can be offered by one actor to another. They can be physical products like cars and refrigerators, or can also be services such as haircuts and medical treatments. Economic resources have utilitarian value to consumers. Therefore, they can also fit the extrinsic value category in Holbrook’s classification of consumer values (1999).

However, there is no very precise agreement of what an economic resource could be. In REA ontology, the concept is called economic resource and is defined as something of value under control some actor. In e³ value, the notion value object is used to represent an economic resource. A value object in e³ value is defined as some object of value to at least one of the collaborating actors. Generally, goods and services are identified as economic resources (Gordijn, 2002; McCarthy, 1982). Physical objects such as cars and books are examples of goods whereas things such as transportation, haircuts, and eye treatments are examples of services. In addition to goods and services, rights are also identified as an economic resource that has a
value to the receiving actor (Weigand et al., 2006; ISO/IEC, 2007). In addition to that *information* is also treated as an economic resource (Henkel et al., 2007; Ilayperuma & Zdravkovic, 2009). For instance, data in certain contexts such as referrals in the healthcare sector and customer profile information can be regarded as information goods.

The Open-edi framework in (ISO/IEC, 2007) presents a structured list of possible economic resource types and subtypes. The Open-edi categorization of economic resource includes three primary types: goods, services and rights (see Figure 11). Goods are tangible resources such as capital assets (e.g. vehicles), raw materials and natural resources (e.g. steel and petroleum) and monetary resources (e.g. money), etc. Services represent abstract value adding activities offered by a provider to consumer. Typical examples of services are consultancy, transportation, treatments, etc. Rights are intangible resources and can be exchanged between actors as economic resources.

Among the above mentioned economic resources rights can play a dual role. They are always attached to some other object such as a car, real estate or even information goods in a tangible form such as books, songs. In some cases it is meaningful to discuss rights as resources of their own. A typical example could be music rights. In this case, though the right is attached to a specific object, a piece of music, it is sold as an economic resource.

Rights also specify what the possessor of them is eligible to do. For instance, a person who rents a car has a limited use right during the period he has access to it. In contrast to a situation where he owns the car, the things he is eligible to do are bound by the agreement between him and the renting actor.

![Figure 11. Resource types and possible sub-types (taken from ISO/IEC, 2007)](image-url)

As a fundament for analyzing economic resources in this thesis, we utilize the following categories:

- **Goods**, which are physical objects, like cars, refrigerators, and cell phones.
- **Information**, which is data in a certain context, like blueprints, referrals, and customer databases.
• **Services**, which are economic resources that encapsulate other resources, and are used to increase the value of some other resource. Examples of services are haircuts and eye treatments.

• **Rights**, which describe the activities that the resource-holder can perform. For example, buying a book does not transfer the right to the buyer to reprint it and sell. For that the buyer may need to obtain the economic resource “copyright”.

• **Money**, which is a media for exchange without any restriction on economic resources and actors.

For simplicity, in the rest of the thesis, we use the term *resource* to denote *economic resource* discussed above.

### 3.3 Resource transfers

The business model ontologies presented in the previous chapter, identify and define different types of business events with respect to the role that they play in creating and transferring different resources within and between actors. For instance, *activity* in BMO is defined as actions performed by a company in its value creation, marketing and profit-generating process. It includes internal value creation activities of an actor as well as activities needed to transfer objects of value to its customers. An *economic event* in REA represents an activity that transfers an economic resource from one agent to another. REA economic events primarily aim to model external resource transferring activities. In contrast to BMO and REA, e³ value distinguishes between the activities that create value and the activities that transfer these resources between the business stakeholders. The internal value creating activities in e³ value are represented by *value activities* as the resource transferring activities represented by the *value transfer* activities. In the business and service designing methods in this thesis, we primarily use the notion of resource transfer to represent the transfer of an economic resource between actors.

**Different components of a resource transfer**

A *resource transfer* is defined as an activity that transfers a resource between the trading parties. We identify that every resource transfer that happens between two actors, for instance A and B, should include at least one or more of the following:

1. transfer of right from A to B;
2. transfer of custody (enabling access to the resource) to B;
3. evidence documents from A to B.

Transfer of right means that the provider gives away his right to a resource (to obtain the right to a different resource: e.g., money). In a resource transfer, the transfer of right is not enough and the buyer should be enabled
access to the resource. Enabling access to a resource is important as otherwise a buyer would not be able to exercise his right on it.

In a resource transfer, a customer may also be given documentary evidence. The documentary evidence is optional in a resource transfer but could be useful in cases where there are post-actualization activities such as damage distribution and/or cases where there is an assessment of partial fulfillment of commitments. An evidence document can play different roles in a resource transfer (Gordijn, Petit & Wieringa, 2006b). It can be used as a token of a right to transfer and is useful in obtaining the access to exercise the right. For example when one buys a movie ticket, the cinema transfers the right to see a movie to the buyer. The movie ticket is the evidence that the buyer has the right to see a movie. Here, it plays the role of an evidence document for the right transfer. When a buyer wants to watch the movie, he hands over the ticket to the cinema and gains access to the movie. In this case, he does not transfer anything new to the cinema but uses the ticket as an evidence document to obtain access to the movie.

3.4 Conversion activities

*Conversion activity* changes some features of a resource thereby either increasing or decreasing a resource’s value. They represent the activities internal to an actor. Typically, a conversion activity answers the following questions:

1. What are the activities carried out by an actor and with the use of what resources?
2. What resources are produced?
3. What features of the resources are changed?

If the conversion activity produces a new resource or change of feature(s) of an input resource to increase its value, it is called a produce activity. If the input resources cease to exist after the conversion event, it is a consume activity and if they exist after the conversion event then it is a use activity. Among them, the produce activity is an increment activity and the use and consume events are decrement activities.

3.5 Summary

Resources and activities that transfer and produce them are important notions in business modeling. Different business modeling methods use different notions to represent them.

In business modeling, a common understanding of a resource is that, it is something that has a value and that can be transferred between actors. In our work, we call this: economic resource (or resource). We identify, goods,
services, rights, information and money and voucher as a classification of economic resources. In addition to these economic resources, internal values play an important part in business modeling. Internal values can be defined as some property such as beauty, health state attached to an actor or properties attached to facilitating services such as delivery of an economic resource. An example could be convenience attached to home delivery. These internal values are often regarded as success factors that facilitate a firm’s value proposition and distinguish the firm from its competitors. To use them in business modeling, we suggest a tentative list of internal values and discuss their possible relationships to planning, identification, negotiation, actualization, and post-actualization phases of a business transaction.

A resource transfer transfers economic resource between actors. A resource transfer is often modeled as a single component without referring to different aspects of it such as giving away of control of a resource either temporarily or permanently and giving access to it to a buyer. In this thesis, we represent these aspects by identifying three components of a resource transfer: right transfer, custody transfer and evidence document. While the right transfer is always included in a resource transfer, the latter two components are optional. For instance, when buying a piece of land, typically, the buyer is given right to the land. It may also include a legal document such as the deed of the land which could be considered as the evidence document. Clearly, the custody transfer does not typically happen in this case. Furthermore, both custody and evidence document transfer may sometimes be trivial so that they are not explicitly modeled.
4 Designing Business Models Based on Goal Models

4.1 Introduction

Goal models are used to capture vital information in different stages of business and information systems design. They primarily help in explaining the interests and intentions of actors and relationships between them. Thus, goal models also play an important role in defining business strategy of an organization.

Goal modeling techniques are often used in requirements elicitation and requirements specification in a systems development life cycle. For instance, goal modeling techniques such as \( i^* \) (Yu, 1995) and BMM (2007) are used in requirements elicitation to represent different interests of actors, opportunities and barriers to achieve them. In the requirements specification, goal modeling techniques such as KAOS (Dardenne et al., 1993) provides a means to represent relationships between elicited requirements and desired system functions. Regardless of which phase in systems development life cycle goal modeling techniques are used, they are aimed at facilitating traceability of design decisions. That is they try to answer, for instance why a certain requirement is modeled.

On the other hand business models aim to model different business stakeholders, activities performed by them and resources or values they offer to each other. That is business models aim to model the what of the business in a more abstract way. The design decisions made by a business modeler are often based on experience. In the business management context, a business model provides a means for modeling the way business orchestrates its internal as well as external activities in a more abstract way and to identify any need for changes to survive in a competitive business environment. In the information systems development context, it provides a means for communicating technical level design decisions to business users. In both these contexts, to make the process of understanding more effective, there is still a need for linking business model components to the interests of business users. This helps business users better understand the design decisions thereby helping them to negotiate better design decisions. For business modelers or
system analysts, this could provide a methodology for the systematic derivation of business model components and system functions.

In this chapter, we discuss a method for designing goal-aligned business models. Figure 12 depicts the overview of the method proposed in this chapter. The method consists of two main steps where in step one a goal model is created. We utilize the goal modeling approach – BMM – for designing the goal model in this step. A set of templates for formulating means will be used to design the goal model. In the second step, the goal-aligned business model will be created. Transformation rules, which define possible actions associated with each means template, will be used as a means for identifying business model components.

Figure 12. Overview of the method for designing goal-aligned business models

4.2 Relating goal and business contexts

Relating goal and business has been identified as an important issue in requirements engineering. A number of studies have focused on aligning the strategic goals of business stakeholders and business activities as an integral part of designing e-business solutions, for instance, business-aligned e-
services. Among them, (Gordijn et al., 2006b) explore the use of strategic goals for modeling value constellations. They suggest identifying goals of an actor based on the Holbrook classification of consumer value (Holbrook, 1999) and then to design a business model that satisfies the identified goals. The methodology uses the goal modeling technique $i^*$ (Yu, 1995) for modeling goals and the business modeling methodology $e^3$ value to operationalize them. However, the method does not facilitate formulating goals and means in terms of business modeling notions. Nor does it explain how the goal model can be used to derive components of the business model. Zlatev et al. (2004) discuss a goal-oriented approach for designing business models as a part of designing e-services. The approach discusses developing a goal tree that represents the goals of the business and designing a business model from a set of existing business model patterns that are aligned with goals in the goal tree. To align business strategies to business models (Weigand et al., 2007) takes a different approach from the sources mentioned above. They argue that a business model could be better aligned with the goals of an actor by analyzing rationale behind them in three perspectives: customer, capability and competitor perspectives. They are primarily focused on identifying different value creation strategies from these three perspectives and how these strategies can be represented by means of designing different types of models that show the relationship between the identified values and business activities of respective actors. Taking a similar line of argument, Pijpers et al. (2008) highlight the importance of aligning business strategy with the value creation process in order to align business strategy with information systems. They suggest that the process of alignment may consider some or all of four perspectives: business strategy, value creation, business process and information systems depending on their relevance to the business context under consideration. Nevertheless, the business strategy in this approach is limited to consider how other organizations influence the business strategy of the organization under consideration.

Naturally, the business strategies of an organization are influenced by the goals of its business stakeholders. However, if the goals are not properly expressed and documented, it makes it hard to clear out business strategies that outline the business activities and carried out by business stakeholders to create and deliver value to each other. Therefore, clear expression of goals is an integral part of drawing out business strategies that define different types of activities and relationships between the business stakeholders. The overall goals of a company can remain stable over a long period of time while actual strategies and activities may change over time and therefore the separation of general business concerns from specific business activities should be done (Andersson et al., 2008). This, they argue, would help to focus on different layers and making more stable models. In this chapter we focus on goal and business layers and aligning them to each other.
Kavakli and Loucopoulos (1999) argue that, when modeling enterprise knowledge, it is important to understand the current situation of an enterprise, where it wants to position itself in the future and its plans to transform the enterprise from its current situation to an expected future situation. Considering these aspects, they introduce a framework for developing and documenting enterprise knowledge, called the EKD framework (see Figure 13).

Figure 13. EKD framework for modeling knowledge (taken from Kavakli & Loucopoulos, 1999)

The EKD framework in the Figure 13 shows requirements engineering as modeling activities ranging from the current situation to an expected future state. Different states in the figure concern four different modeling aspects. They are: modeling current state or more precisely the As-Is state, modeling stakeholder goals with respect to expected changes and alternatives for changing as-is state, developing a To-Be model by mapping of change requirements to expected future state, and finally defining an evaluation criteria and evaluating the extent to which the stakeholders expectations are met. Though the EKD framework primarily concerns modeling enterprise knowledge and goals, it highlights the importance of separating different modeling aspects so that the models can be easily managed and systematically linked to each other.

4.3 Modeling goals

The difficulty of finding the correct level of abstraction in formulating goals is a common problem in goal modeling and often, goal models become unfocused since the formulation of goals can range from broad value proposi-
tions to specific strategic actions to get a competitive business position (Weigand et al., 2007). They further argue that the unformalized relationship between goal and business models acts as a barrier in aligning them. As mentioned previously, goal modeling techniques are used to achieve different purposes in GORE. Goal modeling techniques such as i* and BMM are used in business analysis to model business goals specifying relationships between them.

Among these goal modeling techniques, i* focuses on modeling strategic dependencies between the business stakeholders, their goals, tasks and associated resources. In general, i* models the intentions of business stakeholders. It explores various dependencies among them and suggests various configuration options to achieve their goals in a collaborative environment. It consists of two main modeling components: the SD model and the SR model. The SD model focuses on describing dependencies among actors in a business context while the SR model describes interests of business stakeholders and different configuration options of the business context. Principal notions of i* includes actor, goal, soft-goal, task, resource and dependency links, goal dependencies, task-decomposition and means-end. These dependency links specify the kinds of relationships between dependee actor and dependee actor, actions to accomplish intentions of actors and why a certain task is performed by an actor.

The BMM (2007), concerns identifying motivating factors behind business activities and defining the relationships between them. The concepts in the technique are grouped around three primary concepts: Ends, Means and Influencers. They describe intentions of business stakeholders and the environmental factors that influence the possible achievement of these intentions. Below, we discuss these three concepts in brief.

- **End**: An *End* defines something that business seeks to accomplish without indicating how it will be achieved. For instance, an *End* could be some broad picture of the future state of the enterprise such as vision or it could be a more concrete state or condition the enterprise wants to achieve or sustain such as goals or objectives. A goal in BMM is a statement about a state or condition of the enterprise that it wishes to achieve. A typical goal of a car renting company could be: “to be the leading rental service provider”. In contrast to a goal, an objective is a time target and measurable statement.

- **Means**: A *Means* on the other hand represents different business capabilities and instruments that can be used to achieve *Ends*. BMM arranges means in two forms: *Course of Action* and *Directives*. In general *Course of Action* describes how to achieve goals and objectives. For instance, course of action to achieve the goal “to be leading rental service provider” could be “encourage rental extensions”. In addition to defining actions to achieve *Ends*, *Means* also define business rules or policies or
more precisely directives that govern the execution of the course of actions to achieve *Ends*.

- **Influencers**: An *Influencer* is anything that may affect achieving the goals. Influencers can be internal factors such as resource related issues, traditions or habits of the enterprise, or even be infrastructure related issues. They can well be external influencers such as competitors, technological factors, partnerships, etc. For instance, an internal influencer for the goal mentioned previously could be the: “availability of branches in all major cities”.

To exemplify our approach, we use BMM as the goal modeling technique. Yet, the goal modeling technique $i^*$ can also be used for the same purpose (Andersson et al., 2008). It was mentioned previously, that unfocused goal models make it difficult to develop goal-aligned business models. We suggest overcoming this problem by formulating goals in terms of business model components. While goal models describe the intentions of actors in a business context, business models describe activities that create and exchange resources between actors. A common characteristic between them in regards to enterprise modeling is that both of them are concerned with the arrangement of resources and activities to optimize profits in business contexts. Actors want to make the best arrangement of creation and exchange of resources (that is business models) according to their business goals (that is goal models). Since the business models are focused on describing creation of resources and transfer of them between business stakeholders, in a business context, the goals of actors largely concern acquisition, production, maintenance, or provisioning of resources. Based on these observations, to design a goal model we use the following set of rules as proposed in Andersson et al. (2008).

- A goal is defined as a *desired condition on one or more features of a resource*.
- A means describes a course of action. This action could impact one or several business model components.
- An influencer is defined as some condition that could lead to support, review or remove one or more means.
- Conflicts between goals could be identified either at goal model level considering their importance over one another or at the business level when the means are realized by employing business model components.

At the goal model level, conflicts among goals are typically identified and removed by evaluating their importance and determining which are to be removed and which are to be preserved (Dardenne et al., 1993). In the business level, the business modeler could identify conflicting goals by considering means that lead conflicts among business model components. For instance, if some means lead to preventing the introduction of a certain com-
ponent while another means requires the same, the goals that lead to the means are identified as having conflicts with each other.

4.4 Designing a goal-aligned business model

In this section, we present an overview of the method for designing a goal-aligned business model. As depicted previously in Figure 12, the method starts with a business scenario where a simple as-is business model can be drawn. Then it creates a new business model using a goal model as an input. The main instruments used in the method are the means templates and the transformation rules.

The method has two main steps, where the first concerns goal modeling and the second business modeling. The objective is to use the goal model developed in the first step as an instrument to design a business model.

Step 1: Strategic Goal Modeling. In this step, the goal modeler elicits goals of business stakeholders and constructs a goal model using the means templates.

Step 2: Goal-aligned business modeling. In this step, the business modeler designs a business model based on the information in the goal model produced in Step 1. In order to design the business model, the business modeler should complement the means by filling in the optional parts of the templates when needed. In this thesis, we make use of e³ value ontology to design the goal-aligned business model.

The above steps provide the overview of the method for designing goal-aligned business models. Below, we discuss each step in detail providing how the means templates should be used to develop a goal model and thereafter to derive components of the to-be business model.

4.4.1 Means templates

In this section, we discuss how strategic goal modeling in Step 1 is done. Means play a key role in aligning a business model with a goal model. Therefore, we propose more detailed rules, in the form of templates, for formulating means in a goal model. As stated in the previous subsection, almost all means concern the acquisition, production, maintenance, or provisioning of resources. In other words, means addresses the fundamental entities of business models. Means describes with whom the principal actor exchanges resources, what resources are exchanged and what value activities there are to produce and consume these resources. Thus, it becomes possible to formulate next to all means according to a small number of templates.

The intuition behind a template is that it generally should form a triplet, \(<\text{Action}, \text{Resource}, \text{Actor}>\). For instance, in template 1 “offer resource to actor”, offer corresponds to Action, resource to Resource, and actor to Actor.
The following syntax is used for the templates. Each template has two parts, one compulsory and one optional, which is written within square brackets. These two parts are more or less similar to strategic and tactic parts discussed in (Andersson et al., 2008). The compulsory part consists of information regarding the possible business strategies, for instance, offering, procuring and producing resources. The optional part describes possible actions that could be carried out to fulfill the action named in the compulsory part. Parentheses are used for grouping of alternatives. The components of the group are separated by a pipe sign “|” with the standard exclusive-or interpretation. The “AND” sign is used to indicate a combination of parts with the meaning that parts combined must all be present in the means. Words in italics are non-terminals and are replaced by actual goal model terms when formulating the means. An optional discriminator can be prepended to a resource filling the same function as a grammatical adjective. A “good book” is an example of a resource “book” prepended with the optional discriminator “good”.

The compulsory part contains the most important piece of information, while the optional part provides complementary information about the consequences of the compulsory part. A goal modeler may choose to fill in the optional part to provide complete information, but in many cases it is preferable to leave it out to make the goal model less complex.

The following nine means templates have been identified.

1. offer resource1 to actor1 [AND (start using conversion activity1 | start producing resource1 | start procuring resource1 from actor2)][AND start receiving resource2 from actor1]
2. stop offering resource1 to actor1 [AND (stop procuring resource1 from actor2 | stop producing resource1)]
3. procure resource1 from actor1 [AND (start using resource1 in conversion activity1 | offer resource1 to actor2)][AND provide resource2 to actor1]
4. stop procuring resource1 from actor1 [AND (stop offering resource1 to actor2 | start producing resource1 in conversion activity1)]
5. start producing resource1 in conversion activity1 [AND start offering resource1 to actor2]
6. stop producing resource1 in conversion activity1 [AND (start procuring resource1 from actor1 | stop offering resource1 to actor2)]
7. (increase | decrease) production of resource1 in conversion activity1
8. insource production of resource1 in conversion activity1
9. outsource [fraction of] production of resource1 in conversion activity1
The above templates describe how means in a goal model should be structured and defined. In the next section, we present a set of actions, associated with each means template, to add or change the as-is business model.

4.4.2 Transformation alternatives and transformation rules

It should also be noted that the means formulated according to means templates in the goal model may provide insufficient information to do the transformation. Thereby, a business modeler should be provided with additional tools to complement any missing information in the templates. We try to address this by defining the alternatives available for each means template and defining rules that describe a basic set of actions associated with these alternatives.

Considering the different combinations of compulsory and optional parts, each means template can be broken down to a set of alternatives. We call them transformation alternatives since they represent different choices that a business modeler can use to transform the means in the goal model to activities in a business model. These transformation alternatives are used to define transformation rules in the form of a conditional statement. For each means template, there will be exactly one transformation alternative specifying how the means of this template will influence the to-be business model. For each transformation alternative, there will be exactly one set of actions in the transformation rule that specifies what actions a business modeler should perform to design the to-be business model. Designing the to-be business model by the business modeler should be done in the following ways.

- By choosing a means given in the goals model, described in the form of a means template and associate it with the appropriate transformation alternative.
- By complementing the transformation alternative with actual instances of the business notions in the means template.
- By applying the actions in the transformation rule corresponding to the chosen transformation alternative.

The means templates can be categorized into three main groups based on their effects on the to-be model: templates leading to the introduction of new business model components, templates leading to the deletion of certain business model components, and templates require some process level actions. While the first two groups have a visible effect on the to-be business model, the effects of the means of the third group is not visible in this model but will have an impact only on the process model.

Below, we define a set of transformation alternatives and a transformation rule associated with each means template. The business modeler should choose one of the transformation alternatives and then apply the corresponding actions in the transformation rule.
This template addresses the business activity of exchanging resources between actors. The compulsory part deals with the business activity of providing a resource to an actor. The first optional part addresses the origin of the resource and offers three alternatives: using an existing conversion activity, starting a new conversion activity in the principal actor to produce the resource, or procuring it from another actor. The second optional part specifies what resource is received as compensation for the resource provided by the principal actor. Following this, below we first outline transformation alternatives associated with this means template and then define the transformation rule associated with them.

**Transformation alternatives:**

a. Offer resource1 to actor1 and receive resource2 from actor1.

b. Produce resource1 and offer resource1 to actor1 and receive resource2 from actor1.

c. Procure resource1 from actor2 by providing resource3 to actor2 and offer resource1 to actor1 and receive resource2 from actor1.

d. Stop producing resource1 and procure resource1 from actor2 by providing resource3 to actor2 and offer resource1 to actor1 and receive resource2 from actor1.

e. Stop procuring resource1 from actor2 and produce resource1 and offer resource1 to actor1 and receive resource2 actor1.

**Transformation rule**

If alternative a is chosen then:

Add new actor if actor1 doesn’t exist.
Add new resource transfer to offer resource1 to actor1 and connect this new resource transfer to an existing conversion activity.
Optionally, add new resource transfer to receive resource2 from actor1.

Else if alternative b is chosen then:

Add new actor if actor1 doesn’t exist.
Add new conversion activity to produce resource1 and a new resource transfer to offer resource1 to actor1.
Optionally, add new resource transfer to receive resource2 from actor1.
Else if alternative c is chosen then:
  Add new actor if actor2 doesn’t exist.
  Add new resource transfer to procure the resource1 from actor2
  and add new resource transfer to provide resource2 to actor2.
  Add new actor if actor1 doesn’t exist and add a new resource transfer to offer resource1 to actor1
Else if alternative d is chosen then:
  Delete the conversion activity that produces resource1 with the related resource transfers if this conversion activity only produces resource1.
  Add new actor if actor2 doesn’t exist and add new resource transfer to procure the resource1 from actor2.
  Add new resource transfer to provide resource2 to actor2, if necessary.
  Add new actor if actor1 doesn’t exist and add a new resource transfer to offer resource1 to actor1.
Else if alternative e is chosen then:
  Delete actor2 if there is only one resource transfer related to procurement of resource1 with actor2.
  Delete the resource transfers related to procuring resource1 from actor2.
  Add new conversion activity to produce resource1.
  Add new resource transfer to offer resource1 to actor1.
  Add another resource transfer to receive resource from actor1 of necessary.

| Template 2 | stop offering resource1 to actor1 |
| [AND (stop procuring resource1 from actor2 | stop producing resource1)] |

This template addresses the issue of stopping providing a certain resource. The optional part of the template has an effect only if the principal actor stops offering the resource to all actors. In that case, the optional part says that this can be done by either stopping producing the resource or by stopping procuring it from another actor.

**Transformation alternatives:**

a. Stop offering resource1 to actor1 and stop receiving resource2 from actor1
b. Stop procuring resource1 and stop providing resource2 to actor1 and stop offering resource1 to all.
c. Stop producing resource1 and stop offering resource1 to all.
Transformation rule

If alternative $a$ is chosen then:
- Delete resource transfers related to offering and receiving of resource1 and resource2 with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- If necessary delete conversion activity1 associated with deleted resource transfers with actor1.

Else alternative $b$ is chosen then:
- Delete resource transfers related to procuring and providing of resource1 and resource2 respectively with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- Delete resource transfers related to resource1 with all actors.
- Delete all actors associated with the exchange of resource1, if there are no other resource transfers with them.

Else if alternative $c$ is chosen then
- Delete resource transfers related to offering and receiving of resource1 and resource2 respectively with all actors.
- Delete conversion activity1 associated with resource1 if it does not associate with any other resources.
- Delete all actors associated with the exchange of resource1, if there are no other resource transfers with them.

<table>
<thead>
<tr>
<th>Template 3</th>
<th>procure resource1 from actor1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[AND (start using resource1 in conversion activity1</td>
</tr>
<tr>
<td></td>
<td>AND start providing resource2 to actor1]</td>
</tr>
</tbody>
</table>

The compulsory part in this template is related to the procurement of a resource by the principal actor from another actor. The optional part describes the possible effects of the procurement of the resource. The resource procured may be used as an input to produce a certain resource or it may be offered directly to the principal actor’s customers.

Transformation alternatives:

a. Procure resource1 from actor1 and provide resource2 to actor1 and use resource1 in conversion activity1.
b. Procure resource1 from actor1 and provide resource2 to actor1 and offer resource1 actor2 and receive resource3 from actor2.
c. Stop producing resource1 in conversion activity1 and procure resource1 from actor1 and provide resource2 to actor1 and offer resource1 to actor2 and receive resource3 from actor1.
Transformation rule

If alternative \( a \) is chosen then:
Add new actor if actor1 doesn’t exist.
Add new resource transfer to procure the resource1 from actor1
and add new resource transfer to provide resource2 to actor1.
Connect new resource transfers to conversion activity1 if it exists
or add conversion activity1 and associate new resource transfers.
Else if alternative \( b \) is chosen then:
Add new actor if actor1 does not exist.
Add new resource transfer to procure the resource1 from actor1
and add new resource transfer to provide resource2 to actor1.
Add new actor if actor2 does not exist
Add a new resource transfer to offer resource1 to actor2 and re-
ceive resource3 from actor2
Else if alternative \( c \) is chosen then:
Delete conversion activity1 associated with resource1 if it does not
associate with any other resources.
Add new actor if actor1 does not exist.
Add new resource transfer to procure the resource1 from actor1
and add new resource transfer to provide resource2 to actor1.
Add new actor if actor2 does not exist.
Add new resource transfers to offer resource1 to actor2 and receive
resource2 from actor1 or associate existing resource transfers re-
lated to resource1 and resource2 with conversion activity1

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<thead>
<tr>
<th>Template 4</th>
<th>stop procuring resource1 from actor1</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[AND (stop offering resource1 to actor2</td>
</tr>
</tbody>
</table>

This template addresses the issue of stop procuring a resource from
another actor. The possible effects of this action are that the principal actor
may have to start the production of the resource in order to be able to contin-
ue providing the resource to the customers or he may have to stop offering
that object. However, the actions in the optional part depend on whether the
principal actor stops procuring the resource from all the suppliers or not.
Depending on that, one of the alternatives in the optional part is chosen.

Transformation alternatives:

a. Stop procuring resource1 from actor1 and stop providing resource
   2 to actor1 and stop offering resource1 to all.

b. Stop procuring resource1 from actor1 and stop using resource1 in
   conversion activity1.
c. Stop procuring resource1 from actor1 and stop providing resource2 to actor1. Produce resource1 in conversion activity1 and offer resource1 to actor1 and receive resource2 actor1.

**Transformation rule:**
If alternative *a* is chosen then:
- Delete resource transfers related to procuring and providing resource1 and resource2 respectively with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- Delete resource transfers related to resource1 with all actors.
- Delete all actors associated with the exchange of resource1, if there are no other resource transfers with them.

Else if alternative *b* is chosen then:
- Delete resource transfers related to procuring and providing of resource 1 and resource2 respectively with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- Delete conversion activity1 if it does not have associations to other resources.

Else if alternative *c* is chosen then:
- Delete resource transfers related to procuring and providing of resource1 and resource2 respectively with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- Add new conversion activity if conversion activity1 does not exist.
- Add new actor if actor2 does not exist.
- Add new resource transfer to offer the resource1 to actor2 and add new resource transfer to receive resource2 to actor1. If these resource transfers exist, associate these resource transfers with conversion activity1.

| Template 5 | start producing *resource1* in conversion activity1  
  [AND start offering *resource1* to actor2] |

The above template states that if the production of a resource is started then it must be offered to some actor.

**Transformation alternatives:**

a. Produce resource1 in conversion activity1 and offer resource1 to actor1 and receive resource2 actor1

b. Stop procuring resource1 from actor1 and stop providing resource2 to actor1. Produce resource1 in conversion activity1 and offer resource1 to actor1 and receive resource2 actor1.
Transformation rule

If alternative \( a \) is chosen then:
- Add new conversion activity if conversion activity1 does not exist.
- Add new actor if actor2 does not exist.
- Add new resource transfer to offer the resource1 to actor2 and add new resource transfer to receive resource2 to actor1.

Else if alternative \( b \) is chosen then:
- Delete resource transfers related to procuring and providing of resource1 and resource2 respectively with actor1.
- Delete actor1 if there are no other resource transfers with actor1.
- Add new conversion activity if conversion activity1 does not exist.
- Add new actor if actor2 does not exist.
- Add new resource transfer to offer resource1 to actor2 and add new resource transfer to receive resource2 to actor1. If these resource transfers exist, associate these resource transfers with conversion activity1.

Template 6

| Template 6 | stop producing resource1 in conversion activity1 | [AND (start procuring resource1 from actor1 | stop offering resource1 to actor2)] |

The compulsory part in this template deals with the issue of stopping the production of a resource. The optional part describes the possible actions to deal with that situation. The first choice is to start procuring the resource in order to offer it to the customers. The other option is to stop offering the resource to all the customers.

Transformation alternatives:

a. Stop producing resource1 in conversion activity1 and procure resource1 from actor1 and provide resource2 to actor1. Offer resource1 to actor2 and receive resource2 from actor2.

b. Stop producing resource1 in conversion activity1 and stop offering resource1 to all.

Transformation rule

If alternative \( a \) is chosen then:
- Delete conversion activity1 associated with resource1 if it does not associate with any other resources.
- Add new actor if actor1 does not exist.
- Add new resource transfer to procure the resource1 from actor1 and add new resource transfer to provide resource2 to actor1.
Add new actor if actor2 does not exist.
Add new resource transfers to offer resource1 to actor2 and receive resource2 from actor1 or associate existing resource transfers related to resource1 and resource2 with conversion activity1.

Else if alternative b is chosen then:
Delete resource transfers related to offering and receiving of resource1 and resource2 respectively with all actors.
Delete conversion activity1 associated with resource1 if it does not associate with any other resources.
Delete all actors associated with the exchange of resource1, if there are no other resource transfers with them.

| Template 7 | (increase | decrease) production of resource1 in conversion activity1 |
|-------------|---------------------------------------------------------------|

This template deals with the increment or decrement of the production of a resource. Furthermore, means of this kind have no effect on the business model but only on the process model.

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<tr>
<th>Template 8</th>
<th>insource production of resource1 in conversion activity1</th>
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This template considers the situation where the production of a resource is insourced. If the production is insourced, then it will lead either to an increase of the production in an existing conversion activity or to start a new conversion activity to produce the resource. In this case too, the actions under b have no visible effects on the business model. Thereby alternative b is not considered in the transformation rule.

**Transformation alternatives:**

a. Insourse production of resource1 and offer resource1 to actor1 and receive resource2 from actor1. Stop procuring resource1 from actor1 and stop providing resource2 to actor1.

b. Insourse fraction of production of resource1 and decrease fraction of procuring resource1.

**Transformation rule**

If alternative a is chosen then:
Add new conversion activity if conversion activity1 does not exist.
Add new actor if actor2 does not exist.
Add new resource transfer to offer resource1 to actor2 and add new resource transfer to receive resource2 to actor1.
This template is applicable to the situation where the production of a resource is outsourced, which will lead to either a decrease or stopping of production. In addition to that the principal actor must also start procuring the resource, whose production has been outsourced, and start providing a resource as compensation. Outsourcing a fraction of production will primarily affect on a process level rather than business level. However, procuring the outsourced fraction will have a visible effect similar to bullet a in the list.

**Transformation alternatives:**

a. Outsource production of resource1 to actor1 and procure resource1 from actor1 by providing resource2 to actor1

b. Outsource fraction of production of resource1 to actor1 and decrease fraction of production of resource1 in conversion activity and procure resource1 from actor1 by providing resource2 to actor1

**Transformation rule**

If alternative a is chosen then:

Add new actor if actor1 does not exist.
Add new resource transfer to procure the resource1 from actor1 and add new resource transfer to provide resource2 to actor1.

The alternatives and rules defined above deal with basic business notions such as resource transfers, resources, value activities and actors and basic actions associated with them such as introduction, deletion that should be performed by business modeler. In addition to them, a business modeler should be able to identify general actions which need to be performed. For instance, he should be able to identify when a new resource transfer can associate with an existing conversion activity instead of introducing a new conversion activity.

In the next section we illustrate the method application considering several means in the goal model.

### 4.4.3 Modeling specifics

When designing the business model, the following rules must be considered to ensure that the final business model is created according to the semantics of the e³ value ontology.
• Resources and resource transfers and conversion activities are mapped to value objects, value transfers and value activities in an $e^3$ value business model.
• Every value transfer must have a direction. The direction “out” or “in” indicates the offering actor and receiving actor of a resource, respectively.
• An outgoing/incoming value transfer must be grouped together with at least one incoming/outgoing resource transfer to ensure the economic reciprocity.
• Potential alternatives, for the transfer of the same value objects, should be considered when grouping value transfers. For instance, in a situation where a firm offers two value objects; goods and delivery, in return for payment, potential alternative value object bundles may be goods in return for payment and, goods and delivery in return for payment. In an $e^3$ value business model, these alternatives should be modeled by grouping them into two value interfaces, thus allowing the flexibility to perform one set of transfers for any given customer.
• Appropriate join or split (“AND” or “OR”) conditions must be used to indicate possible alternative resource offerings or connections of more than one value interface to a single value activity.

4.4.4 Application of the method to the eye-care health case
In this section, we apply the method for designing a goal-aligned business model to the eye-care health scenarios presented in Section 2.7.2. Following the method presented in above sections, we first build the goal model which will then be used to design the business model.

4.4.4.1 Designing the goal model
The analysis regards the patient’s demand to get the right treatment, which is therefore articulated as a major goal for the primary care physician and the healthcare specialist. This major goal is further refined into a set of sub-goals to create a goal tree which is further refined to identify a course of action, i.e. means.

Using the outlined definitions for goals, means and influencers in Section 4.3, Figure 14 shows a goal model for the eye-care health case scenario from Section 2.7.2. The major goal is refined further in two branches considering the primary care physician and the healthcare specialist. Since the patient is the consumer of treatment services from the primary care physician and healthcare specialist, the patient’s intentions are considered when the goals of the latter two are derived. Therefore, the goals of the patient are not explicitly modeled in the goal model in Figure 14.
Considering the patient’s demand to get the right treatment, the major goal (Goal 1) is defined as “Level of treatment (resource) shall be right (feature)”. Considering the primary healthcare center, the major goal is refined into the goal (Goal 2); “Diagnosis (resource) shall be correct (feature)”. Two sub-goals; (Goal 3) “Knowledge (resource) about the disease shall be high (feature)” and (Goal 4) “Treatment or referral (resource) shall be available (feature)”. The means (Means 1); “Procure knowledge on symptoms and disease” is identified as the course of action to achieve Goal 3. The influencer “Availability of various sources of gaining knowledge” is identified as an opportunity that supports the Means 1. The means; (Means 2) “Offer right to give advance treatment to Patient”, (Means 4) “Offer treatment to patient” and (Means 3) “Offer right to get advance treatment to Patient” are identified as a course of actions to achieve Goal 4. Furthermore Goal 4 is further refined to “List of special clinics and their competencies (resource) shall be available (feature)” (Goal 5). Means 5 “Offer information on healthcare specialist clinics” supports achieving Goal 5.

Taking the healthcare specialist into account, Goal 1 is refined to “Level of treatment (resource) shall be advanced (feature)” (Goal 6). We identify the means “Offer advance treatment to Patient” (Means 6) as a course of action to achieve Goal 6. Furthermore, as influencer “Availability of improved healthcare facilities” is identified as an opportunity that supports this course of action. Goal 6 is further refined into “Patient information (resource) shall be accessible (feature)” (Goal 7) which is achieved through the means “Offer access to treatment status to Patient” (Means 7).

The goals and means derived above are depicted in Figure 14.

Every means elicited in Figure 14 follows the structure of the means templates as they are defined in the previous section. As such, they provide a
basis for structuring certain components in the business model. Furthermore, some means elicit both the compulsory strategic parts and the optional parts, while some others focus only on the strategy. For instance, in the primary care physician means “Offer treatment”, only the strategic part is provided. In contrast, the means “Offer information on specialized clinics and start procuring”, suggests even the tactics, i.e., to obtain the information on clinics by procuring it from another actor.

4.4.4.2 Designing the goal-aligned business model

In this section, we illustrate the method for designing the goal-aligned business model. For illustrative purposes, we use means in the goal model in Section 4.4.4.1 and apply the method outlined in Section 4.4.

Each means in the goal model is addressed by applying one transformation rule. According to the method this should be done in three steps: first selecting the means template before complementing the means with the optional part of the template, and finally applying the transformation rule.

Means 1: Procure knowledge on symptoms and diseases in diagnosing.

- **Step 1**: Select transformation alternative.
  Procure resource1 from actor1 by providing resource2 and use resource1 in conversion activity

- **Step 2**: Complement the transformation alternative by replacing business model notions by actual instances.
  Procure knowledge on symptoms and diseases (resource1) from Health services office (actor1) by providing Registration (resource2) and use knowledge on symptoms and diseases (resource1) in Diagnosing and referring special care (conversion activity)

- **Step 3**: Apply corresponding actions in the transformation rule.
  Introduce new Actor Health services office (actor1) to procure knowledge on symptoms and diseases (resource1).
  Add one resource transfer for procuring knowledge on symptoms and diseases (resource1) from Health services office (actor1) to Primary care physician.
  Add another resource transfer to provide Registration (resource2) as a compensation for knowledge on symptoms and diseases (resource1)
  Connect new resource transfers to the Diagnosing and referring special care (conversion activity).

The actions in Step 3 will lead to introduce a new actor, Health services office (see Figure 15), to procure the knowledge on symptoms and diseases. Furthermore there will be two new resource transfers between the primary care physician and the new actor, Health services office, for procuring knowledge on symptoms and diseases and for providing registration as a compen-
sation for procuring the resource. These new resource transfers will be connected to the conversion activity treatment and referring to special care in the primary care physician.

Means 2 – Offer Right to give advance treatment to Healthcare specialist.

- **Step 1:** Select transformation alternative.
  - Offer resource1 to actor1 and start receiving resource2 from actor1
- **Step 2:** Complement the transformation alternative by replacing business model notions by actual instances.
  - Offer **Right to give advance treatment** to Healthcare specialist (actor1).
- **Step 3:** Apply corresponding actions in the transformation rule.
  - Add a new resource transfer for offering **Right to give advance treatment** (resource1) from Primary care physician to Healthcare specialist (actor1).

The action in Step 3 will lead to the addition of two new resource transfers to offer **Right to give advance treatment** and **Fee**. Considering the fact that the Healthcare specialist must be provided referral (right to give treatment) together with the offering of referral (right to get treatment) to the patient, this resource transfer will be offered via the same interface as the Right to get advance treatment from the Primary care physician to the Patient.

Means 3 – Offer Right to get special treatment (referral) to Patient.

- **Step 1:** Select transformation alternative.
  - Offer resource1 to actor1 and start receiving resource2 from actor1
- **Step 2:** Complement the transformation alternative by replacing business model notions by actual instances.
  - Offer **Right to get special treatment (referral)** to Patient (actor1) and start receiving **Fee** (resource2) from Patient (actor1)
- **Step 3:** Apply corresponding actions in the transformation rule.
  - Add a new resource transfer for offering **Right to get special treatment (referral)** (resource1) from Primary care physician to Patient (actor1).
  - Add new resource transfer to provide **Fee** (resource2) as compensation for **Right to get special treatment (referral)** (resource1).

The actions in Step 3 will lead to the addition of two new resource transfers to offer **Right to get special treatment (referral)** and **Fee**. Considering the fact that a patient must get some form of treatment from a primary care physician before being referred to a healthcare specialist, we model this as an alternative of Treatment (in return for fee), resource offering, thereby making the resource; **treatment** included in this grouping by default. As such in the business model in Figure 15, these two resource transfers are modeled together with the resource treatment as an alternative to, treatment in return for fee, in a separate interface.
Means 4 – Offer treatment to Patient.

- **Step 1:** Select transformation alternative.
  Offer resource1 to actor1 and start receiving resource2 from actor1
- **Step 2:** Complement the transformation alternative by replacing business model notions by actual instances.
  Offer treatment to Patient (actor1) and start receiving Fee (resource2) from Patient (actor1).
- **Step 3:** Apply corresponding actions in the transformation rule.
  Add a resource transfer for offering treatment (resource1) from Primary care physician to Patient (actor1).
  Add another resource transfer to provide Fee (resource2) by Patient (actor1) as compensation for treatment (resource1).

The actions in Step 3 will lead to the addition of two resource transfers; treatment and Fee. These two resource transfers are connected to the conversion activity; treatment and referring to special care.

Means 5 – Offer Information on Healthcare specialist clinics

- **Step 1:** Select transformation alternative.
  Offer resource1 to actor1 and start procuring resource1 from actor2 and start receiving resource2 from actor1
- **Step 2:** Complement the transformation alternative by replacing business model notions by actual instances.
  Offer to Information on Healthcare specialist clinics (resource1) Patient (actor1) and start procuring Information on Healthcare specialist clinics (resource1) from Health services office (actor2) and start receiving Fee (resource2) from Patient (actor1)
- **Step 3:** Apply corresponding actions in the transformation rule.
  Add a new resource transfer for procuring Information on Healthcare specialist clinics (resource1) from Health services office (actor2) to Primary care physician.
  Add new resource transfer to offer Information on Healthcare specialist clinics (resource1) to Patient (actor1).

The actions in Step 3 will lead to the introduction of a new actor – Health services office to procure the Information on Healthcare specialist clinics (see Figure 15). Thereby, there will be two new resource transfers between Primary care physician and the Health services office, for the procurement of this new resource. This new resource could be obtained within already established value interface in the Means 1. Thereby, the new resource transfer will be added to this existing value interface (see Figure 15). These new transfers are connected to the conversion activity Treatment and Referring to special care in the Primary care physician. Also to offer Information on
Healthcare specialist clinics to Patients, another resource transfer will be added to the model. Since this information is offered to Patients who are referred to healthcare specialists, the corresponding resource transfer is added to an existing value interface (that offers right to advance treatment) between the Primary care physician and the Patient.

Means 6 – Offer Advance treatment to Patient.

- **Step 1**: Select transformation alternative.
  Offer *resource1* to *actor1* and start receiving *resource2* from *actor1*

- **Step 2**: Complement the transformation alternative by replacing business model notions by actual instances.
  Offer *advance treatment* to *Patient* (actor1) and start receiving *Fee* (resource2) from *Patient* (actor1).

- **Step 3**: Apply corresponding actions in the transformation rule.
  Add a resource transfer for offering *advance treatment* (resource1) from Primary care physician to Patient (actor1).
  Add another resource transfer to receive *Fee* (resource2) from Patient (actor1) as compensation for *advance treatment* (resource1).

The actions in Step 3 will lead to the addition of two resource transfers; *Advance treatment* and *Fee*. The conversion activity; Specialist Treatment is used to produce the resource; advance treatment and hence these two resource transfers are connected to this conversion activity.

Means 7 – Offer Access to treatment status to Patient

- **Step 1**: Select transformation alternative.
  Produce *resource1* and offer *resource1* to *actor1* [and receive *resource2* from *actor1*]

- **Step 2**: Complement the transformation alternative by replacing business model notions by actual instances.
  Produce *Access to treatment status* (resource1) and offer *Access to treatment status* (resource1) to *Patient* (actor1).

- **Step 3**: Apply corresponding actions in the transformation rule.
  Add one conversion activity in the Healthcare specialist to produce *Access to treatment status* (resource).
  Add one resource transfer for *Access to treatment status* (resource) from Healthcare specialist to Patient in an existing value interface.
  Produce *Access to treatment status* (resource) using the conversion activity *Specialist treatment* and connect new resource transfer to it.

Offering Access to treatment status leads to the addition of one resource transfer from the Healthcare specialist to the Patient. As there will be no resource received as compensation to offering the resource Access to treat-
ment status, it will be produced by using an existing conversion activity Specialist treatment and will be offered via an existing value interface (that offers advance treatment).

Figure 15 shows the result of applying the method to the eye-care case presented in Section 2.7.2.

4.5 Summary

In this chapter, we have presented a method for aligning business models with goal models. The method takes a goal model and an as-is business model as inputs and transforms the as-is business model into a new business model that conforms to the goal model. Goal and business model are primarily linked to each other through the notion of means. To facilitate means formulation, a number of templates have been proposed. We have argued that these templates cover a large part of the basic activities of an enterprise: acquire, provide, produce, or maintain resources. The proposed approach offers a number of benefits. Firstly, formulating goals and means in terms of business model notions not only benefits a business modeler but also benefits a goal modeler. For a goal modeler, it provides a method for developing uniform goal models. For a business modeler, it describes the intention of
business stakeholders in a more business-oriented way using clear business-oriented expressions. The goal-aligned business modeling method also helps to design business models that are well-founded and firmly based on intentions of business stakeholders. Since the components of the business model are directly motivated by the goal model, it enhances traceability between business model elements and business intentions that lead to the identification of these elements. The method could also assist business users to assess whether or not a designed business model correctly interprets and models their business intentions. In addition to the above, the proposed method can also be used as an explorative basis for eliciting and designing e-services (e.g. Andersson et al., 2008). The method can also be used as a basis for formalizing goal and business alignment (Jayaweera & Petit, 2009).
5 Analyzing Business Collaborations to Improve Business Modeling

5.1 Introduction

The major task in business modeling concerns the identification of resources, and their transfer among the involved actors. However, in this context, there is still a lack of systematic approaches for creating more exploratory business models in regards to how consumers evaluate offered values and how values are derived along different phases of business collaborations. In this chapter, we discuss how business collaborations with different objectives can be used to overcome these shortcomings.

Business collaborations occur with the aim of achieving different business objectives. In some situations, actors collaborate with each other with the aim of increasing the knowledge about goods, services, and product preferences, or even as a means of establishing certain business commitments for the future. Business actors could also collaborate with each other with the aim of exchanging objects of value such as goods, services, etc. Thereby, from the collaboration perspective, there seems to be different purposes of business collaborations, such as establishing commitments for the future, or fulfillment of those commitments, their maintenance, etc.

Consumers characterize a value based on various factors – such as the cost, the fitness to their needs, the time and effort they have to use to obtain the value, and so forth (Weigand et al., 2007). These factors may be classified into different facets, such as interactive, relativistic, preference and experience (Holbrook, 1999). Since the value of an object may lie either in the object itself or it may be elicited at the time the object is consumed (Holbrook, 1999), it is important to investigate all the stages of a business collaboration to identify what values an enterprise aims to offer. Therefore, we examine the interaction between an enterprise and its customers from two perspectives: collaboration life cycle and value perspectives to identify different objects offered at each stage, and the value these objects provide to customers.

From the collaboration life cycle perspective, a business passes through several phases. ISO Open-edi initiative (ISO/IEC, 2002) defines a business
transaction as consisting of five phases: planning, identification, negotiation, actualization and post-actualization. These phases encompass the activities to identify resources, establish relationships between the actors, transfer resources between them, as well as the activities related to post-sale services.

From the value perspective, each of these activities may transfer some resource that has some value to participants in a business collaboration. Thereby, a problem is how to consider the different purposes of business collaborations mentioned previously in business modeling and identify resources along different phases such as planning, identification, negotiation actualization and post-actualization? From the business-IT alignment perspective, any method to create more explorative and strategically-aligned business models should consider the activities from the planning up to the post-actualization services.

Following the outlined concerns above, we think a better approach for obtaining an explorative enterprise business models is to identify different types of business transactions, analyze the consumer values and thereby identify the resources that are to be exchanged across the whole business collaboration life cycle. The final objective is the obtainment of an explorative business model, which can be used as a prosperous basis for identifying the e-services of the involved enterprises. To achieve that is the research objective of this paper.

In this chapter, we analyze different types of business collaborations and thereby identify the resources that are to be exchanged in planning, identification, negotiation, actualization and post-actualization phases of these collaborations. The final objective is the obtainment of a value-explorative business model, which, thereby, can be used as a comprehensive basis for identifying the e-services. Figure 16 below depicts the overview of the approach presented in this chapter.

Figure 16. Method overview
5.2 Classifying business transactions

Business collaborations occur in different ways. In some cases, customers need to register some information prior to the actual transfer of the acquired resources. For example, a person may need to register himself in a healthcare unit before getting a medical treatment from it. This ordering of activities happen due to various reasons, such as:

a. the risks associated with the resource transfer; and
b. the need for the assessment and allocation of human and other resources required to handle customer demands, and so forth.

In some other cases however, buyers do not necessarily need to provide some personal and product-related information to establish commitments before the actual transfer of resources. For instance, to purchase a book from an online book shop, a customer may only need to provide his credit card information as a means of making the payment. In such cases, there will not be any transaction aiming to establish commitments prior to the actual resource transfer. Following the described, we identify the two major transaction types.

**Future settlement-oriented**

In these transactions, actors collaborate with the aim of exchanging information such as personal details (e.g. complete an authorization), product preferences, etc. The main concern here is to attract customers and expectantly establish specific commitments for future transactions for selling actual products or goods. The goals of these transactions may be twofold. A provider may engage with a customer with a goal of providing a specific product over a certain time period. He could also have a goal of identifying customer preferences, i.e. advertising his products to make customers aware of them. In the latter case, the transaction would not be aiming at selling some specific product or service within a particular time frame, but only to make an awareness of the available resources. Considering these two goals, we distinguish product-dependent and product-independent transactions.

**Immediate settlement-oriented**

In immediate settlement-oriented transactions, collaborating parties start with providing resources, i.e. goods, services, and also prepare and complete the resource delivery. As we have explained above, certain businesses require having an authorization transaction established between the resource provider and the customer before a potential resource transfer occurs. In such cases, we call the transaction concerning the transfer of resources as dependent on an authorization. An example would be that a patient seeking medical treatment at a local healthcare unit may first need to perform an authorization from the latter by means of obtaining an acceptance registration in it. However, obtaining an authorization is not a must in every busi-
ness. For example, to buy some goods from an online shop, a customer may only need to provide their credit card information as a means of making the payment. In such cases, the actual transfer of goods is authorization independent.

Considering the two categories of business transactions identified above and their sub-classifications, in the following, we distinguish four basic transaction types for business collaborations:

1. Future settlement-oriented, product-independent.
2. Future settlement-oriented, product-dependent
3. Immediate settlement-oriented, authorization-dependent
4. Immediate settlement-oriented, authorization-independent

In what follows we discuss possible dependencies among the outlined transactions, to get an understanding of possible orderings of their execution.

The first two transaction types do not involve the actual transfer of the resources. The first transaction (1), focuses on exchanging personal and product related information. Here, the involved actors do not identify the concrete products or services to be exchanged. As such, this transaction cannot be a prerequisite for other transaction types in the list. In the second transaction (2), actors exchange not only personal and product-related information but also agree on the products or services to be later exchanged. As such, it must precede an immediate settlement-oriented, authorization-dependent transaction type (3). Since the resource types had been already identified in a future settlement-oriented transaction, here actors set the focus on agreeing on facilitating services such as delivery, or allocation of human and other resources. Regarding the fourth transaction type in the list, the actors agree both on the resources to be exchanged and completing the delivery, and therefore this transaction type is not dependent on any other one.

In the following section, we identify different types of resources transferred in each of the defined transaction types along the five fundamental activities defined in Open-edi: planning, identification, negotiation, actualization and post-actualization. In the process of identifying different types of resources, we consider resource types: goods, services, rights and information as discussed in Section 3.2. As was mentioned previously, core resource transfers that occur in the actualization phase are often considered in business modeling. However, if we need to use a business model as a basis to capture requirements for an e-business application, it is beneficial to have a detailed analysis around the fundamental activities of a business transaction. This is to identify a comprehensive set of resources transferred between the actors.
5.3 Creating design templates for business transaction types

From a business modeling perspective, the activities performed in the Open-edi phases, may be defined as follows: in the planning and identification phases, actors and resources are identified respectively; in the negotiation phase the commitments to particular resource exchanges are established; in the actualization phase the agreed resource transfers are carried out, and in the post-actualization phase possible complaints are entertained. To elicit resources across these phases, we utilize categories of resources discussed in Section 3.2.

Considering these aspects we use five phases proposed by the Open-edi framework (ISO/IEC, 2002) as discussed below.

In the planning phase, actors exchange resources primarily of informational value to each other. These could include, information regarding products such as catalogues and information regarding the services such as customer registration (see Figure 17).

In the identification phase, the customer is primarily responsible for introducing himself to the provider by offering information such as personal information and product preferences to the provider. A provider could use such information, for instance to determine the ways to achieve his business goals. As an example, a provider may use customer product preference information to determine how to increase the offerings resource. Additionally, the provider is responsible for provisioning additional information regarding resources to be delivered in the actualization phase (see Figure 17).

In the negotiation phase, the provider and the customer establish commitments by exchanging rights regarding resources. These rights may be related to a particular product that will be offered later or it could well be about a service such as customer registration or about both. It is also possible that the customer and the provider agreed on possible rights regarding the post sale services. For instance, in a regional healthcare center, the healthcare service provider and the patient may agree on possible services regarding post-treatment examinations to evaluate health status (see Figure 17).

In the actualization phase, the provider delivers the product as agreed in the negotiation phase and the customer completes or starts making payment for the products delivered to him (see Figure 17).

In the post-actualization phase the provider may offer post-sale services agreed in the negotiation phase (see Figure 17). Typical examples could be post health examinations offered to patients by a healthcare provider.

Considering them, we summarize possible resource types transferred in each phase.
In the following section, we discuss different transaction types identified in Section 5.2 and propose a template for each transaction type by outlining major resource transfers in each of the phases as described above. We outline the proposals in the form of $e^3$ value model templates.

5.3.1 Future settlement-oriented, product-independent transactions

This type of transaction focuses on a prospective buyer registration, independent of any resource transfers. The primary aim is to make the buyer aware of the products of a company. This type of transaction involves the transfer of the economic resources aiming at increasing the knowledge of actors. For example, personalized recommendations offered by Amazon.com to its registered users aim to make them aware of the items of their preferences.

The resources transferred between the actors in this transaction are mainly restricted to information resources. However, it is also possible that a provider sends some other complementary resources as a means of advertising his products.

In Section 2.4.2, we gave a brief overview of the different phases in business transactions defined by (ISO/IEC, 2002). Further, in Section 5.3, these phases are discussed in relation with the $e^3$ value ontology. Thereby, in the following, we outline different categories of resources exchanged in different Open-edi phases of a business collaboration conforming to the future settlement-oriented, product-independent transaction type. In the planning phase, a provider may offer a certain level of information regarding the products in general and the information regarding the registration service and its availability. Since the transaction aims to establish commitments between actors without committing to a specific economic resource, identification and negotiation may be performed in a single continuous interactive dialogue where customers submit information requested by the provider and eventually agree on the terms and conditions of using the registration service. In contrast, actualization may happen over a period of time until the
relationship ends at a mutually agreed way. Though no clear margin can be drawn to identify activities in the planning, identification, and negotiation phases, we can tentatively identify the activities in these phases as shown below.

**Planning:** In the planning phase, the provider offers the information regarding the data required by the registration service to the customer (*Reg. service info*).

**Identification:** The customer submits information requested by the registration service (*Personal info*).

**Negotiation:** The customer accepts the terms and conditions and receives the registration from the provider (*Registration*).

**Actualization:** The provider offers product-related information to the registered user (*Product-related info*).

The e³ value model in Figure 18 depicts this transaction.

![Figure 18. Template 1: e³ value model for a future settlement-oriented, product-independent transaction](image)

Although the given business template is modeled as a collaboration between two actors, in practice the provider may use an intermediate for the provisioning of the discussed resources. However, since the focus in this transaction type is to model the interaction between the customer (of a registration service) and the provider, we do not include a third actor.

### 5.3.2 Future settlement-oriented, product-dependent transactions

In some businesses, the customer registration becomes a prerequisite for the actual transfer of economic resources. For example, a resident needs to be registered at a primary healthcare center before he or she gets medical treatment. This registration could happen well before someone receives a medical treatment. Thereby, these are two separate transactions aiming to achieve different objectives where the first aim is to achieve the registration of patients and the second treating the patients.
The transactions of this type may have two particular goals: register customers and establish rights regarding a particular resource. Accordingly, in the planning phase, the provider offers both registration service information and product information. The customer subsequently, provides the information required by the registration service in the identification phase. In the negotiation phase the customer receives registration and also, the right to receive resource, later by a different transaction. The right to resource that the customer receives in the negotiation phase is a conditional one in the sense that certain conditions such as payment on delivery of the resource may be applied when the resource is actually delivered later on by a different transaction. In the actualization phase, the provider may offer updated information about the resource to registered customers.

In the following, we outline possible resources exchanges at different phases for the transaction type in discussion:

**Planning**: The provider offers information regarding the registration service in connection with the resource committed to offer later (*Registration service info*).

**Identification**: The customer offers information needed for registration (*Personal info*).

**Negotiation**: The provider grants registration and thereby the right to receive the resource (possibly later, by a different transaction) to the customer (*Right to receive resource*).

**Actualization**: The provider offers resource-related information to the registered customers (*Updated resource info*).

In Figure 19, we depict the described transaction using an $e^3$ value model.

![Figure 19. Template 2: $e^3$ value model for a future settlement-oriented, product-dependent transaction type](image)

The above figure models the commitment establishment stage for a particular resource. The commitment fulfillment stage is modeled within a different template in Section 5.3.3. This is basically to make the template flexible to handle a situation where a registered user may not consume his right to receive a resource obtained at the commitment establishment stage. For
example, a registered resident may never take medical treatment and in such a case the template should be able to handle it.

5.3.3 Immediate settlement-oriented, authorization-dependent transactions

We have explained in Section 5.2 that an immediate settlement-oriented, authorization-dependent transaction requires the future settlement-oriented, product-dependent transaction to be carried out first (i.e. template 2). In the following we go through the planning, identification, negotiation, actualization and post-actualization phases and identify the different types of resources transferred in each phase.

Planning: Since the resource types are already identified in the future settlement-oriented, product-dependent transaction, planning need not be performed.

Identification: The registered customers submit the registration information to the provider (Accreditation).

Negotiation: Since the right for the resource has been established earlier (i.e. using transaction template 1, here the provider and the customer may engage in negotiations regarding the facilitating services such as time allocation, delivery of the resource, third actors involved in the transaction, etc (Right to additional resources). In addition to that, the customer makes an obligation to pay, for instance by providing their credit card information (Right to payment).

Actualization: The customer gets the custody of the resource. The provider gets the compensation, for example, money (Payment, Resource).

Post-actualization: Post-sale services may be performed by the provider according to a possible commitment established in the preceding transaction (template 2) (Post sale services).

Figure 20. Template 3: e³ value model for an immediate settlement-oriented, authorization-dependent transaction type

In template 3, we model right to payment and payment as two resource transfers from customer to provider. In reality the provider may receive credit card information from the customer and the actual payment (money) from a third actor (e.g. bank). The same is true regarding the transfer of the re-
source from the provider to the customer. Although, we model this transac-
tion from the provider to the customer, in reality a third actor may be in-
volved in the delivery of resource.

5.3.4 Immediate settlement-oriented, authorization-
independent transactions

In some businesses, the customer registration is not a required activity for
the transfer of economic resources. For example, when someone buys a book
from a conventional book shop, the buyer does not necessarily register him-
self. Even in Web-based transactions, buyers may only need to provide in-
formation to register their payment obligations such as credit card details.
In the following, we examine the planning, identification, negotiation, actual-
ization and post-actualization phases, to identify the types of resources
transferred at each phase.

In the planning phase of this type of transactions the provider may offer
general information about the resource. An additional resource specific in-
formation, terms and conditions under which the transaction may work out
could be offered by the provider to the customer in the identification phase.
In the negotiation phase the buyer will get the right to the resource and the
provider will get the obligation to make the payment. The buyer will receive
the resource and the provider will receive the payment in the actualization
phase. The provider may offer post-sale services in the post-actualization
phase.

Planning: The provider offers information regarding the concerned resource
(Catalogue).

Identification: The provider may send additional information requested by
the buyer (Product specific info).

Negotiation: The provider offers the right to the resource to the buyer (Right
to resource). The buyer offers the right to payment (obligation to make pay-
ment) to the provider (Right to payment). This may possibly be a resource
such as credit card information.

Actualization: The buyer gets custody of the resource and the provider gets
custody of payment (Payment, Resource).

Post-actualization: The provider offers warranty-related services (Post-sale
services).
The figure below models this business template in an e³ value model.

![Figure 21. Template 4: e³ value model for an immediate settlement-oriented, authorization-independent transaction type](image)

In the above figure, we model both obligation to payment (Right to payment) and the custody transfer of the money (Payment). However as mentioned in the previous section, the provider may get custody of money from a third actor such as a bank. The same is true for the resource transfers regarding the offering of the resource.

5.4 Summary

In this chapter, we have analyzed value-based business collaborations and thereby we have defined four possible types of business transactions. Using them, we have proposed a set of templates that span the five major phases in business collaboration as defined by the Open-edi initiative.

Two primary types of business collaborations; Future Settlement-Oriented and Immediate Settlement-Oriented, are identified in this chapter. For each of them, we have also identified a set of attributes based on the goals of collaborations. Considering these attributes and the collaboration types, the four basic transaction templates have been derived. In addition to this, these four transaction types are investigated along different phases of business collaboration such as planning, identification, negotiation, actualization and post-actualization to identify possible values exchanged in each phase. The results are modeled using an e³ value business modeling approach.

From a business modeling point of view, a modeler will desire to be able to design business transactions by choosing a particular scenario from a set of scenarios and applying it to the intended business. Obtaining a smaller number of mandatory business transaction scenarios and distinguishing them from each other has been identified as a problem (ISO/IEC, 2002). In this chapter, we suggest overcoming this by proposing two types of major business transactions and combining them based on attributes such as product dependency and authorization dependency. The resulting set consists of four types of business transactions that a modeler can choose from and apply it to
the intended business. Thereby, the proposed classification of business transactions can benefit the designing of business models by systematizing the identification of business transactions. It will also help them to create new and innovative business models that extend the assortment of the exchanged resources, thereby improving the economic performance of a network of actors in business collaborations.
6 Designing Explorative Business Models by Analyzing Business Collaborations

6. 1 Introduction

Designing a business model involves identifying different actors, transactions and resources exchanged by them. In the work presented in this chapter, we use the goal-aligned business model designed in Chapter 4 as the basis for designing an enhanced business model. The focus of Chapter 4 was to analyze the intentions of business actors and to propose a set of templates to design goal model and transformation rules to identify business model components from the means in the goal model. Therefore, the goal-aligned business modeling method in Chapter 4 was not aimed at grouping different resource transfers to business transactions. Hence, from a business transaction point of view, the completeness of the business model obtained at the end may be highly dependent on the experience of goal and business model designers.

As such, in this chapter, we set our focus to discuss how to use the different transaction types proposed in Chapter 5 to improve business modeling. Figure 22 depicts the business model designing process. The figure depicts two possible modeling scenarios:

- A business modeler may start from a business case (*business information*) to identify different business transactions and further explore them along planning, identification, negotiation, actualization and post-actualization phases to identify resources and resource transfers and design a business model. The curved left arrow (solid) depicts this path (see Figure 22).

- A business modeler may use a goal-aligned business model as proposed in Chapter 4 to identify different business transactions and further explore them along the business collaboration phases mentioned above to design an explorative business model. This scenario is shown by curved right arrows (dashed) which link *business information* to the goal-aligned business model and finally to the *method for designing an explorative business model* (see Figure 22).
6.2 Overview of the business model designing process

In this section, we give an overview of the designing process by briefly introducing and defining the concepts that will be used in the method in Section 6.3. The designing of an explorative business model involves using different results that we have already obtained in previous chapters. We utilize the goal-aligned business model obtained in Figure 15 to identify different transactions based on the transaction types presented in Chapter 5. The obtained transaction will be further investigated to elicit resources along different phases; planning, identification, negotiation, actualization and post-actualization. For elicitation of resources, we consider both extrinsic and intrinsic aspects of consumer value (Holbrook, 1999). Considering extrinsic aspects, we first investigate each business transaction along the planning, identification, negotiation, actualization and post-actualization phases to identify economic resources (i.e., resources). To do this, we utilize the resources as defined in Chapter 3. Once the resources are identified consider-
ing the extrinsic aspect, we go through the business collaboration phases again and consider intrinsic aspects to identify zero or more resources. For this, we utilize internal values that are discussed below.

![Diagram of the designing process]

**Figure 23. Overview of the designing process**

### 6.2.1 Eliciting resources across Open-edi business collaboration phases

In business modeling, the actualization phase is often considered when determining the exchange of resources in a business constellation (Gailly et al., 2008). Thereby, it is reasonable to argue that business models designed based on a goal-aligned business modeling method will include resource transfers pertaining to the actualization phase. However, from a business modeling perspective, the activities performed in the other phases of a business collaboration can create value to consumers by transferring resources other than the major resources. Thereby, it is important that the whole business collaboration life cycle is considered in eliciting resources. To elicit resources across these phases, we utilize categories of resources discussed in Section 3.2 and their relationship to different phases as discussed in Section 5.3.
6.2.2 Eliciting resources considering internal values

Once the resources are elicited along different phases considering extrinsic aspects, we next consider intrinsic aspects and use internal values to elicit zero or more resources.

An internal value is a particular way of providing a resource. It highlights a way of delivering the resource that steers or influences the choices to be made during different stages of a business collaboration. Internal values are not objects but they are features whose existence are dependent on some object. An example for this could be the convenience attached to the home delivery of a product. They cannot be directly transferred between actors. It is not meaningful to talk about legal rights on these values, neither it is possible to transfer any of these resources from one actor to another. Internal values are also identified as playing an important role in modeling the business strategy of a company (Heinrich & Winter, 2004). There, internal values are considered as success factors describing how different sales processes facilitate the value proposition of a company. Additionally, internal values can be classified as ends in themselves, or as the instruments for other purposes. For instance, someone might desire more knowledge without any intention to use it in a particular way. Someone else might desire knowledge in order to make money through lecturing or other knowledge services, i.e. they use knowledge as an instrument for producing some other resource. The first categorization of internal values fits into the intrinsic value category of Holbrook’s classification (Holbrook, 1999).

Internal values can also be used to distinguish a firm from its competitors. Weigand et al. (2007) have analyzed the role of these as second order values alongside the core resources exchanged between actors. They propose a list of such values and argue that these internal values can be characterized in a more precise way by utilizing such a list. They further state that at the end these internal values can lead to identifying features that a firm can use to distinguish itself from its competitors.

In the following, we utilize the following tentative list of internal values as proposed in Weigand et al. (2007):

- speed
- responsiveness
- customizability
- convenience
- safety
- reliability

We believe that the above list may be extended and standardized. Theoretical frameworks such as multiple-item scale for measuring service quality (SERVQUAL) (Parasuraman, Zeithaml & Berry, 1988) could be used in this regard. In the following, we discuss the possible use of the above outlined internal values in the planning, identification, negotiation, actualization and post-actualization phases discussed in Section 2.4.2.
• In the planning phase, an actor typically provides informative-type resources, such as catalogues. For a consumer, time and effort in obtaining this information are two important factors. Therefore, in a planning phase, the medium of information delivery such as electronic or print; the quality of information such as relevance, up-to-date and correctness are the vital aspects which give a consumer a pleasant experience. As such, we identify convenience and reliability as the internal values related to the planning phase collaborations between actors.

• Similar to the planning phase, the identification phase also regards the exchange of information among actors. This is basically to establish a literal link between actors. Thus, for the provider, what is most important in this phase is the reliability of the information that he gets from the consumer. Therefore, in this phase, we examine the identified resources against the internal value reliability to investigate the correctness of the information, in order to examine if there are additional resources that may support the desired internal value. This could lead to the derivation of new resources, for example, the verification of consumer accreditation correctness, provided by a third actor.

• In the negotiation phase, actors exchange different rights on the resources. Customizability, safety and reliability are identified as internal values in this phase. The customizability addresses the issue of being able to agree on different forms of a resource such as game CDs and their delivery, or home delivery, etc. In the context of agreements, the latter two internal values mainly concern the issues related to risks, an aspect that we do not consider in this chapter.

• In the actualization phase, actors carry out the custody transfers of the resources agreed in the negotiation phase. We identify safety and reliability as internal values here. The former concerns the risks of custody transfers, while the latter concerns whether the custody transfers are according to the agreements in the negotiation phase.

• In the post-actualization phase we identify responsiveness as the major internal value. In this phase a consumer should be able to obtain the post-sale services that they need to be able to effectively consume the resources that they have purchased. For example, a provider should be willing to provide additional services such as replacements, or repairs for the sold objects.

From the REA and $e^3$ value modeling perspectives, resources that we discussed above are similar to economic resources and value objects. However, internal values are unsupported, they are used as a basis for identifying additional resources in a given business model that may fulfill the requirements for internal values.
6.3 Method for designing a business model

The designing of an explorative business model involves different steps where the business modeler identifies different transactions from the goal-aligned base business model and further investigates each transaction along different phases: planning, identification, negotiation, actualization and post-actualization to identify more resource transfers.

In the remaining sections, we present steps involved in the business model designing process. We conclude the section by providing a detailed discussion of the process using the eye-care health case used as the running example.

6.3.1 Identifying business transactions

In the first step, the business modeler identifies the business transactions by analyzing and refining the resource transfers of all the involved actors, as elicited in the base business model. The business modeler performs the tasks by pursuing two guidelines:

**Guideline 1**: Analyze reciprocal resource transfers in the business model, to identify business transactions.

The given guideline concerns the exchange of resources between actors. Here the main concern is on identifying transactions with immediate settlement-orientation. These transactions may include potential alternatives for the transfer of the same resource. As an example, a patient may get from a primary care provider either a full treatment, or an initial treatment followed by a referral to an eye-care specialist.

**Guideline 2**: For each transaction elicited using Guideline 1, consider addition of transactions concerning establishments of commitments between that mandatory precede actual resource offerings.

This guideline concerns the identification of future settlement-oriented, product-dependent transactions. The goal of the transactions defined here is to establish commitments for the transactions identified in Guideline 1. These transactions concern one-time activities pertaining to the establishment of the right to future transactions where the right is exercised a number of times over some period of time. Examples of such transactions could be user profile creations at Amazon.com, residents’ registration at healthcare centers, and so forth. Transactions concerning the establishment of commitments can either be done by the actors who provide the main resources, or they can be carried out by the actors not visible in the base business model.
For example, the resident registration can either be done by the primary care provider itself, or it can be carried out by some other actor.

Here, commitments are established by means of exchanging information between actors regarding some resource type. They could be later fulfilled by different transactions or they may never be fulfilled meaning for example, a resident never take treatments from his registered healthcare center.

6.3.2 Identifying resources

In this step, the business modeler examines the transactions identified in the above step to identify additional resources and resource transfers according to the following guidelines:

**Guideline 3**: For each transaction identified using Guidelines 1 and 2:

a. Identify resources that are to be exchanged in the planning, identification, negotiation, actualization and post-actualization phases of a given transaction.

b. Identify internal values that are to be exchanged in the planning, identification, negotiation, actualization and post-actualization phases of a given transaction. Thereby elicit the resources that will realize the wanted internal values.

Thus, in the first outlined task, the modeler should analyze every transaction across the whole collaboration life cycle (i.e. from planning to post-actualization) to identify additional resources. This is needed as the given transactions are identified for the actualization phase only. In the second task, we examine the elicited resources across business collaboration phases to identify zero or more additional resources.

To elicit resources, the modeler should consider possible resource types associated with business transactions that have been discussed in Section 3.2. In addition to that, he should consider the analysis of internal values that we have presented in Section 6.2.2 to elicit additional resources that will realize the identified internal values. The modeler will then use the information about business transactions, actors and resources to improve the goal-aligned business model obtained by applying the goal-aligned business modeling method.

Utilizing the classification of resources and discussion on internal values presented, and the goal-aligned business model in Figure 15 as an input, below we illustrate the application of the method presented in this section.

6.4 Application of the method to the eye-care case

In this section, application of the method presented in Section 6.2 is illustrated using the eye-care health case as the business scenario. To obtain the
final business model, we further investigate the goal-aligned business model (Figure 15) to identify additional business transactions, actors and resources.

6.4.1 Identifying business transactions in the eye-care case

The goal-aligned business model in Figure 15 in Chapter 5 models four business transactions. These transactions are depicted in Figure 24. Resource transfers in interfaces 1 and 2 model alternatives offerings of the resource treatment by the primary care (i.e. treatment without referral to specialist care and with referral to specialist care). Interfaces 3 and 4 models resource transfers related to the offering of advance treatment by the healthcare specialist to patient and resource transfers related to procuring information by the primary care physician from the healthcare knowledge center.

![Figure 24. A goal-aligned business model for the eye-care case showing different business transactions](image)

Utilizing Guideline 1, we elicit the following transactions for the goal-aligned business model in the above figure. Considering the alternatives in the interface 1 and 2, we consider following cases for the offering of the resource treatment by a primary care physician to a patient.

- Primary care physician offers full treatment to a patient.
Primary care physician offers basic treatment and refers patient to a healthcare specialist.

From the above cases, it is clear that there are three types of resources offered by the primary care physician: full treatment, initial treatment and referral. Considering these resources, we identify `FullTreatment`, `InitialTreatment` transactions associated with the interfaces ① and ②. Interface ③ concerns the offering of advance treatment by a healthcare specialist to a patient referred by a primary care physician. Thereby, we identify the transaction `AdvanceTreatment` connected to interface ③. Concerning the offering of the resources information about healthcare specialists and knowledge on symptoms and diseases, we identify the transaction `InformationProvisioning` associated with Interface ④. Below, we summarize the transactions identified utilizing Guideline 1.

a. `FullTreatment`: for providing a full treatment by the primary care provider to the patient. (Interface ①)
b. `InitialTreatment`: for providing an initial treatment and referral by the primary care provider to the patient and healthcare specialist. (Interface ②)
c. `AdvanceTreatment`: for providing an advance treatment by the healthcare specialist. (Interface ③)
d. `InformationProvisioning`: for providing information by the health services office. (Interface ④)

Next, each of the above transactions, is investigated to identify additional business transactions that concern the establishment commitments (future settlement-oriented, product-dependent). Thereby, the following transactions are identified utilizing Guideline 2.

e. `PatientRegistration`: for registering patients by the health services office (concerning transaction `FullTreatment` and `InitialTreatment`).
f. `SpecialistRegistration`: for providing registration to the healthcare specialists and providing healthcare specialist information to the primary care physician (concerning the transaction `AdvanceTreatment`).
g. `PrimaryCareRegistration`: registering primary care centers by the health services office to establish commitment concerning the transaction `InformationProvisioning`.

6.4.2 Identifying resources in the eye-care case

Below, we explore several transactions elicited in Section 6.3.1, along the planning, identification, negotiation, actualization and post-actualization phases, to identify the resources as proposed in Guideline 3. For each set of transactions identified there, we first search for resources across the collaboration phases (Guideline 3a). Then we consider internal values along these phases and derive more resources (Guideline 3b).
In this section, we only explore FullTreatment and PatientRegistration transactions as identified in Section 6.3.1. A discussion on identifying resources and internal values, for the rest of the transactions, is available in Appendix A.

In the table below, we report the results when applying Guideline 3a for FullTreatment and PatientRegistration transactions.

Table 4. Economic values of FullTreatment and PatientRegistration transactions

<table>
<thead>
<tr>
<th>Planning</th>
<th>FullTreatment</th>
<th>PatientRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment for the treatment has been already established in the PatientRegistration transaction and hence no resources are identified in here.</td>
<td>The Registration Office offers Registration service information Resource: RegistrationServiceInfo</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Identification</th>
<th>FullTreatment</th>
<th>PatientRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients provide Accreditation information to primary care. Resource: Accreditation</td>
<td>Patients provide personal information to register them to with the primary care center. Resource: PersonalInformation</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Negotiation</th>
<th>FullTreatment</th>
<th>PatientRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary care offers Right2TimeSlot to the patients. Patients offer Right to payment to the primary care. Resources: Right2TimeSlot, Right2Payment</td>
<td>Patients get Right2Services. Resource: Right2TreatmentServices</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actualization</th>
<th>FullTreatment</th>
<th>PatientRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary care offers Full treatment to the patients. Resource: FullTreatment</td>
<td>Registration Office sends Information bulletin to the registered patients Resource: InformationBulletin</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Post-actualization</th>
<th>FullTreatment</th>
<th>PatientRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary care offers Timeslot to post health examination. Primary care offers Post-health examination to the patients. Resources: TimeSlot2PostHealthExamination, PostHealthExamination.</td>
<td>No resources could be identified in the post-actualization phase of this transaction.</td>
<td></td>
</tr>
</tbody>
</table>

For the transactions FullTreatment and PatientRegistration, we have identified a number of new economic values (i.e. resources) in the table above. These are valued for their usage as a utility to achieve some goals of any of the actors involved in the transaction. For example, the RegistrationServi-
ceInfo has a useful value to the Patient since it provides the Patient with an opportunity to get information about the healthcare services offered by primary care centers and to understand whether or not the Patient should register at a particular primary care center.

Next we re-examine each of the elicited resources, to identify internal values, along all the five phases.

In the planning phase of PatientRegistration, the Patient may find it is convenient if the Primary care offers registration service information in different formats such as e-catalogues and printed catalogues. Hence, we derive a new resources: eCatalogue and PrintedCatalogue as different choices that replace a previously identified resource: RegistrationServiceInfo. For the transaction FullTreatment, no new resources are identified in the planning phase.

In the Identification phase of the transaction FullTreatment, the accreditation of the patient should be checked against the original registration data. Therefore, considering the reliability of information provided by the patient, we derive a resource, PatientData to be received by the Primary care from the Health services office. This resource is offered within the transaction InformationProvisioning, in addition to the resources already provided by the Health services office to the Primary care physician.

Considering the customizability in the negotiation phase, we derive new resources: Right2CancelAppointment regarding the transaction, FullTreatment and Right2UpdatePersonalInfo regarding the transaction PatientRegistration other than ones already derived in the table above.

In the actualization phase, considering fast and reliability, we identify economic values: eDeliveryOfInformationBulletin for the transaction PatientRegistration. In addition to the already identified economic values for the FullTreatment transaction, we derive HomeVisitService4Elders as the other option of the resource FullTreatment. That is, they are not offered simultaneously.

Considering the intrinsic values in the post-actualization phase for the transactions FullTreatment, and PatientRegistration, we could not derive new resources other than the ones we have already identified.

In Figure 25, we summarize and depict the excerpt-business model including the complete set of resource transfers for transactions FullTreatment and PatientRegistration, as elicited using our method. Thereby, the given business model includes the resource transfers that originate from the exploration of the collaboration phases, as well as from the consideration of the consumer-related internal values.
6.4.3 Designing a business model for the eye-care case

In this section, we integrate the business model fragments presented above and in Appendix A to create the business model for the eye-care case (see Appendix A for the business model fragments that concern the business transactions that are not discussed in Section 6.3.2). In comparison with the goal-aligned business model given in Figure 15, and by applying the method presented in Section 6.2, new actors as well as new resource offerings are identified. The final business model in Figure 26 below, models four actors, the Patients, the Primary care, the Specialist Care Center, and the Health Services Office.
In Figure 26, the Patients first register themselves at the Health service office and this is modeled by transaction $c$. The Health service office records specialist care centers and this is shown in transaction $d$ in the model.

The provisioning of a full treatment by the Primary care physician is modeled by the previously explored transaction *FullTreatment* and this transaction is marked as $e$ in Figure 26. The transaction *InitialTreatment* between the Patients and the Primary care is depicted with $f$.

The transaction *AdvanceTreatment* between the Patients and the Specialist is shown by transaction $g$.

Finally, the provisioning of the information services (*InformationProvisioning*) to the Primary care by the Health services office and the transaction associated with the registration for required for it (*PrimaryCareRegistration*) is modeled by transactions $h$ and $i$ respectively.
6.5 Summary

To summarize, in this chapter, we have presented a method for designing an explorative business model. The method uses the goal-aligned business model in Chapter 5 as an input to identify business transactions. To elicit business transactions, we have considered the classification of business transactions proposed in Chapter 6. These business transactions are further explored to elicit resources across the business collaboration lifespan and for this we have utilized resources, resource transfers and internal values discussed in Chapter 4.

As emphasized in the beginning of the study, the practical relevance of an explorative business model such as the one exemplified in Figure 26 is twofold: the business modeler can use the obtained business model, for in-depth analysis of its viability from both business and economic perspectives. The system analyst can use the model to gain a detailed understanding of enterprise collaboration models, to identify e-services, for instance.
7 Using Business Models for Designing E-Services

Since the emergence of the Internet, enterprises have opened their core functions to customers, suppliers, business partners and financial institutions. The intensive growth of the World Wide Web has created opportunities for all kinds of enterprises to make their value offerings available to consumers as e-services. An example of this is the proliferation of bookstores on the Web that let Internet users browse their catalogues, place orders, and make payments.

A problem common to actors participating in such collaborations is to identify what offerings they should make available as e-services for others. Identifying such value offerings lies primarily on the business model level. In previous chapters, we have discussed exploring business collaborations using business models. A business model clarifies the roles played by different stakeholders of a given business scenario and the relationships between them. It also captures vital information regarding the creation and distribution of economic resources between the stakeholders.

From the technical perspective, Web services have become a common technology for modeling interactions of Web applications. So far, the development of Web services has focused on structural and operational aspects. As a result, the designing process lacks the visibility of business functionality. To make the process more business-oriented we need to start the designing of service-oriented applications from a higher level of abstraction. Raising the level of abstraction to separate business specifications from implementation details is a well-established trend in system development and is one of the main goals of MDA (Kleppe et al., 2003).

The MDA process typically involves the creation of three different types of models. Computational Independent Model (CIM) is used to describe business level information, independent of technology considerations. This model is further refined to a Platform Independent Model (PIM), which specifies a high-level design of an IT system. Finally, the PIM is transformed into a Platform Specific Model (PSM), which adds the technology details necessary for the implementation on a specific software platform.

One of the major issues in the MDA discipline is the choice of model types to be used for CIMs and PIMs. In this chapter, we explain how business models can be used at the CIM level, to provide a clear and a declara-
tive foundation for identifying the business services of an enterprise. Exploring a business model across a whole collaboration life cycle, i.e. starting from planning to post-actualization, enables us to describe the entire enterprise-wide business service portfolio within the CIM. At the same level, process models are used to describe the behavior these business services. To enable mapping of the elicited top-level business services further to the e-services at the PIM level, we rely on the use of UML profiles that provide a standard way to set a model focus on a specific architectural style, such as in this case – service-oriented. Conceptualized in this way, the method that we propose is able to support the integration and alignment of economic value propositions of the collaborating business actors with the ICT realizations, formed using Web services technology. The method has a practical relevance for exploring the enterprise models in more depth from the business perspective, in order to identify e-services and design systems accordingly.

7.1 Designing e-services on the MDA basis

E-service design has so far been mainly focused on operational aspects such as the standardization of message transfers and the coordination of e-services leaving business aspects less concerned. With the influence of networking facilities growing, the use of e-services across organizational boundaries has evolved from point-wise uses to large scale uses. This large scale usage of e-services justifies the focus on aspects mentioned above since it has become important to concern the coordination of e-services to form an e-network (Piccinelli & Stammers, 2001) and to standardize message exchange mechanisms between them. It equally highlights the importance of analyzing business aspects to identify economically viable e-services.

E-services that are not derived from business values could be hard to understand and implement. As such business organizations are increasingly interested in assessing the economic viability and alignment to underlying business values of e-services before implementing them as e-services. Thereby recent research in the area (e.g. Gordijn et al., 2009; Andersson et al., 2008; Baida et al., 2005; Zlatev et al., 2004) are more focused on obtaining constructive results by analyzing business values in the beginning of the process for identifying and designing service-oriented software solutions. Much research in e-service design has recognized (Baida et al., 2005; Andersson et al., 2008) that in multi-enterprise business environments, modeling and managing business knowledge of each enterprise plays an important role in identifying competitive resource offerings to their customers and realizing them as e-services. Thereby, they have identified two classes of services as important in realizing such multi-enterprise business scenarios. They are:
• High-level services (business services) that businesses wish to offer to their customers. These are identified on the basis of business models.
• Low-level services that realize these business services, as e-services which will be further refined into processes and tasks. These e-services are typically implemented using Web services.

This relationship between top and low level services (e-services) has resulted in the introduction of a top-down style approach for designing and implementing e-services considering strategic business aspects of deriving value to consumers.

The work presented in this chapter proposes an MDA-based approach for designing business-oriented e-services which may be implemented using Web services or related technology. We utilize business models and process models to define the CIM level model in our approach.

In the remaining parts of this section, we give a brief overview of business models, process models and their uses as CIM level models in MDA-based approaches.

7.1.1 Modeling business activities – business models

Business models abstract away operational and procedural aspects of business activities. As mentioned in previous chapters, business models focus on modeling the what of the business. They typically describe business actors, different objects of value exchanged between them, different levels of collaborations between them, etc. Business models are also used as a tool to evaluate the economic viability of value constellations. They are often used as a basis for identifying economically viable candidates for implementing as e-services. In such contexts business models support analysis of consumer needs, mapping them to different activities and quantifying resource transfers between different actors. We have discussed business modeling in detail, especially in Chapter 2, and therefore avoid more detailed discussion in this section.

A number of business modeling techniques are available for designing business models. They are REA, \( e^3 \) value and BMO (for more information, please refer to Chapter 2). For the illustration purposes of the work presented in this chapter, we use the well-established business modeling technique \( e^3 \) value to model the CIM. Since the focus in this chapter is to identify candidates for e-services, we primarily focus on the collaboration space between actors and thereby to identify various resource transfers and associated resources. In this regard we use the enhanced business model obtained considering planning, identification, negotiation, actualization and post-actualization, at the end of the previous chapter as the basis for modeling and identifying e-services.
7.1.2 Modeling operational aspects of business – process models

Process models are used to describe operational aspects of business specifying how activities are structured and channeled from one to another to fulfill the goals of some business activities. They typically describe the procedural and communication aspects of a business activity (e.g. order management) articulating various flows like control, data and message flows between the different process model components. Therefore business process is primarily defined as the specific ordering of activities across time and space with a clearly defined starting point, end point, inputs and outputs (Davenport, 1992).

Process models are designed using various languages and notions. Among them, the most popular are the Business Process Modeling Notation (BPMN) (White, 2006) and UML Activity Diagrams (UML, 2009). In particular MDA recommends UML as the modeling standard in MDA-based approaches. UML enables modeling at different abstraction levels and thus facilitates much needed interoperability between different models used in MDA approaches.

Modeling business processes involves the consideration of different aspects. Curtis, Kellner & Over (1992) propose four perspectives: organizational, functional, informational and behavioral should be considered in designing business processes.

The organizational perspective describes who is responsible for which business activities. Hence the central focus here is on the notion of the actor, for instance, an organization unit, or a software system. UML 2 uses the partition notion to depict this perspective.

The functional perspective concerns the composition of activities and their execution. An activity can be either atomic, or composite. These notions correspond to activities and actions in UML 2 notation, respectively.

The informational perspective concerns the resources produced and manipulated by a process. A resource can be products, services and informational objects such as data. UML 2 offers the object node to depict the informational aspect.

The behavioral perspective specifies the different control flows that describe how activities are executed. UML 2 provides a number of control-flow components such as decision and merge nodes, fork-and-join node, start and end nodes, and so forth.

We utilize the described framework to elicit the components of process models that the business modeler should consider as mandatory when modeling the service behavior in CIM and PIM, to enable a complete elicitation of that behavior.
7.2 Designing e-services using business models

In this section, we describe a methodology for identifying and designing e-services starting from a business model. The method essentially consists of different steps where we develop CIM and PIM models. Below, we discuss the different steps involved in designing CIM and PIM models.

7.2.1 Creating business-oriented (CIM) models

Generating a CIM model is a two step process where we consider business and behavioral aspects of the top-level business services to be designed. In the following, we discuss each step in detail.

**Step 1**: We identify business transactions and design the business model to identify candidates for business services.

In this step, we utilize the business modeling design methodology discussed in Chapter 7 to design a business model that will be used to identify candidates for e-services. Individual resource transfers in the designed business model will become candidates for designing e-services. It was observed in the previous chapter that exploring the transactions from the base model along the five phases, results in the identification of new economic events and resources for supporting the planning and identification activities, negotiating and establishment of the rights on the core resources, delivering the custody of the resources, and finally, the activities for facilitating successful resource utilization.

Often, when offering a resource, an actor expects some other resource(s) as compensation. This relationship can be observed among the events performed in the planning, identification and negotiation phases of a business collaboration, where an event acquiring some resource is unavoidably accompanied by the other event giving away another resource. For instance, to get a product catalogue, a consumer must identify himself by providing his contact details. As another example, a negotiation cannot be completed before both involved actors agree on the rights to the resources that they will provide to each other.

Therefore, reciprocal events in each of the above phases, give rise to one business service. However, following the negotiation, due to a variety of business agreements alternatives, it may be possible for the actors to give away certain resources without getting compensation at the same time. A typical example could be, a seller agreeing with a buyer to paying for certain goods after the goods are delivered. That is, in the actualization and post-actualization phases, it is possible to refine the granularity of business services to correspond to single economic events, such as payment, or delivery performed in those phases.
At the end of Step 1 all the desired resources exchanges are explored and depicted in the business model and the business services for their provisioning are elicited. These high-level services elicited during Step 1 are of composite nature and hence their behaviors could be modeled by decomposing them down to several lower level activities.

Step 2: Where we design the process models to describe the behavior of the business services elicited in Step 1.

In this step, we focus on deriving processes from the business model created in Step 1. Each process identified here corresponds to a single business service elicited in the previous step and designed without regarding any technological concerns. Also when designing processes, the designer should use his domain knowledge and properly reflect on organizational, functional, informational and behavioral modeling perspectives to get a complete process model.

At the end of this step, the high-level services, drawn from the business model, are well-described exploring their behaviors using the corresponding process models. These process models are documented using UML 2 Activity Diagrams.

To summarize, the CIM model that we propose in this chapter consists of a business model and process models. The business model is designed considering the whole collaboration life cycle from which the business services are drawn out. The process models depict the behavior of each of the business services and are designed from four perspectives: organizational, functional, informational and behavioral.

7.2.2 Creating system-oriented (PIM) models

The business and process models designed in Step 1 and Step 2 are used as the complete CIM model input for creating a UML-based PIM.

Obtaining PIM from a CIM involves defining transformation rules to derive the former from the latter. We use UML 2 Profile for Software Services, proposed by IBM (Johnston, 2005) to capture map information at CIM-level down to PIM-level.

We utilize UML 2 Activity Diagrams to specify data and control flows between different activities in a e-service. Hence, the PIM will be a system model describing e-service structure and its behavior. In the next section we explain, in detail, how different components of PIM are derived. We also define the rules for mapping out these components from the CIM-level.

Figure 27 below depicts the conceptual model of the UML 2 Profile for Software Services. Primarily, the model consists of stereotyped extensions of different elements of UML 2.0 meta-model such as Classes, Classifiers, Col-
In the table below, we briefly explain the major elements of the profile that we use in this chapter.

**Table 5. Different elements of UML 2 Profile for Software Services.**

<table>
<thead>
<tr>
<th>Element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Partition</strong></td>
<td><em>The Partition</em> element defines the responsibility or system boundaries for offering different services.</td>
</tr>
<tr>
<td><strong>Service Provider</strong></td>
<td>A <em>Service Provider</em> provides one or more <em>Services</em>.</td>
</tr>
<tr>
<td><strong>Service Consumer</strong></td>
<td>A <em>Service Consumer</em> element in the profile is used as a classifier to identify consumers of a service.</td>
</tr>
<tr>
<td><strong>Service</strong></td>
<td>The <em>Service</em> element acts as a name tag of a service offered by the <em>Service Provider</em>, where the actual definition of what it offers, is given with the <em>Service Specification</em>.</td>
</tr>
<tr>
<td><strong>Service Specification</strong></td>
<td>The <em>Service Specification</em> element identifies the service interface, that is, a set of operations. The element can also specify the order of invocation of the operations associated with it, using the protocol state machine (i.e. <em>Protocol</em>).</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>The <em>Operation</em> element defines the atomic functionalities of the <em>Service</em> element.</td>
</tr>
<tr>
<td><strong>Message</strong></td>
<td>The <em>Message</em> element represents the containers for the service input or output data.</td>
</tr>
<tr>
<td><strong>Message Attachment</strong></td>
<td>The <em>Message Attachment</em> is associated to <em>Message</em> element as a property of the <em>Message</em> element. For example, a <em>Message</em> element may contain product details while the images of these products are delivered as <em>Message Attachment</em> elements.</td>
</tr>
<tr>
<td><strong>Service Gateway</strong></td>
<td>The <em>Service Gateway</em> considers the openness of the service, by denoting the <em>Service Specification</em> elements available to access within a partition.</td>
</tr>
</tbody>
</table>
In our approach, certain profile elements are not modeled explicitly in PIM. *Service Collaboration* and *Service Channel* contain the details belonging to a platform specific level and therefore, we omit the use of these elements. As for the service *Protocol* element, we define it using the UML 2 activity diagram, to define a complete orchestration for every identified e-service. In this way, the final PIM will reflect a system model including both structural (i.e. *service contract*) and behavioral aspects of e-services.

**Defining CIM to PIM transformations**
The transformation from CIM to PIM essentially involves a number of high-level rules that map the components from the CIM, i.e. from the business model and the process models, to the elements in the PIM model. In the mapping process we have taken functional, organizational, behavioral and informational aspects into consideration and classified the mapping rules into these perspectives; we present the transformation rules, below.
Organisational Aspect: The organizational aspect is concerned with the distribution of the responsibilities for executing e-services at a system level. The provider of a business service is considered as the principal actor.

<table>
<thead>
<tr>
<th>Rule 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Organisational Aspect</strong></td>
</tr>
<tr>
<td>a. Each non-principal actor partition in the CIM/Process Model is mapped to a partition in the PIM to host the interaction activities of the principal actor toward that actor.</td>
</tr>
<tr>
<td>b. The partition of the principal actor is refined to the partitions that will include information retrieval/storing activities, by determining the providers of these activities.</td>
</tr>
</tbody>
</table>

Design considerations: for every added Partition element type in PIM/Service Profile by following Rule 1, the elements of type Service Provider, Service, Service Specification and Service Gateway (optionally) are created.

Functional Aspect: the second rule concerns the transformation of the activities from CIM to PIM:

<table>
<thead>
<tr>
<th>Rule 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Functional Aspect</strong></td>
</tr>
<tr>
<td>a. Every activity in the CIM/Process Model concerning the interactions between partitions is transformed to a send, receive, or send-receive operation.</td>
</tr>
<tr>
<td>b. Additional send, receive, send-receive operations are created for every new partition identified in Rule 1, to model the interaction activities for that partitions.</td>
</tr>
<tr>
<td>c. An activity modeled in CIM is decomposed, or aggregated to conform to the functions of the existing systems (for example, “receive customer profile” in a CIM may be decomposed to “receive customer contact” and “receive customer history” in a PIM, if those information are provided by different existing system services).</td>
</tr>
</tbody>
</table>

Activities that concern assignments (i.e. “delegations”), rules and calculations will be mapped only to the PIM/Service Behavior, as such activities do not correspond to service operations. Those activities are the part of the internal process system logic of the principal actor.
Design considerations: following Rule 2, operation elements are added in PIM/Service Profile;

*Informational Aspect:* the third rule concerns the transformation of information resources from CIM to PIM.

<table>
<thead>
<tr>
<th>Rule 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Informational Aspect</strong></td>
<td></td>
</tr>
<tr>
<td>a. Every information resource is transformed to a message.</td>
<td></td>
</tr>
<tr>
<td>b. If an information resource (artifact) is supported differently due to changes in the functional aspect (<em>Rule 2</em>), then the resource granularity will be changed (decomposed, or aggregated).</td>
<td></td>
</tr>
</tbody>
</table>

The system modeler should derive information objects in parallel to the functional aspect discussed above.

Design considerations: information objects in CIM are mapped to *Message* and, optionally to, *Message Attachment* elements in PIM/Service Profile, according to the described rule.

**Behavioural Aspect:** the fourth rule concerns the transformation of control-flow from CIM to PIM.

The Service Profile model does not support modeling of control-flow between different operations, messages, etc. As such, we use CIM and PIM level activity diagrams to define the behavioral aspect of a business or electronic service. Generally, the flow of the PIM level activity diagram will follow the flow of the CIM level activity diagram. Yet, the flow may be adjusted to suit the identification of new activities and messages.

<table>
<thead>
<tr>
<th>Rule 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Behavioural Aspect</strong></td>
<td></td>
</tr>
<tr>
<td>The control flow as given in the CIM/Process Model is reused in PIM/Service Behavior Model; the flow is refined to support the orderings of new elements, as added with <em>Rule 2</em> (functional aspect). The internal, flow-related activities, such as rules and assignments, are mapped from CIM (rules), or created at this stage (assignments).</td>
<td></td>
</tr>
</tbody>
</table>
From the PIM to a PSM

Finally, the obtained PIM is transformed into a PSM, which includes the details necessary for getting an executable software model. The primary aim of this chapter was to give an approach for transforming a value-oriented CIM to a service-oriented PIM. For that reason, in this section we will give only brief guidelines for how a PSM can be obtained from the proposed PIM.

The PIM structure as we have defined it in the previous sections includes both the structural and behavioral aspects of e-services. As such, the model supports creating executable service-oriented solutions including service static specification and coordination. For instance, in case the Web services are the target technology platform, then the given PIM will be automatically converted to:

a. WSDL documents, from the UML Profile class diagram, for specifying the Web service interfaces, operations and messages (for more details, the reader is referred to IBM UML 2 Profile for Software Services (Johnston, 2005); and

b. to a workflow-like specification, such as BPEL (OASIS, 2007), from the UML activity diagram, for getting the sequences of invocations of the obtained Web services, i.e. their operations.

In our running example, the PIM/Service Profile model (see Figure 30) can be used to create WSDL specifications for two e-services: Contract Communication and Contract Data. For instance, the Message and Service Specification profile elements associated with these e-services can be mapped to WSDL Message types and PortTypes respectively. An excerpt of WSDL specification for the e-service Contract Communication as obtained from the PIM, will look as follows.

```xml
<wsdl:message name="accreditation">
  <wsdl:part name="accreditationInfo" type="someType"/>
</wsdl:message>
<wsdl:message name="scheduleTerms">
  <wsdl:part name="scheduleContractTerms" type="xsd:string"/>
</wsdl:message>
...
...
<wsdl:portType name="treatmentContractInterface">
  <wsdl:operation name="receivePatientAccreditation">
    <wsdl:input message="accreditation"/>
    ...
    ...
  </wsdl:operation>
</wsdl:portType>
```
The BPEL specification for the PSM can be obtained by mapping the PIM models and their constituent components to different BPEL elements. For instance, the UML activity diagram is mapped to the BPEL control-flow, Operations in the class diagram to the BPEL activities, Partition elements to the BPEL partner declarations, etc. Below, we exemplify a BPEL specification that will be obtained for the previously explored top e-service Establish Contract. In particular, the UML class diagram in Figure 30 in Section 7.3 is converted to BPEL process declaration. The control flow and the activities in the UML activity diagram from Figure 31 in Section 7.3 define the BPEL activity flow.

```xml
<process name="establishContract">
    targetNameSpace=http://abc.com/simpleContractProcessing
    xmlns:lns="http://contracts.org/wsd1/contract-establishment"
    ................../
    <partners>
        <partner name="patientManager"
            serviceLinkType="lns:contractApproveLinkType"
            myRole="approver"/>
        <partner name="DataService"
            ................../
    </partners>
    <sequence>
        <receive name="receiveAccreditationInfo" partner="patientManager"
            portType="...
            operation="receivePatientAccreditation"
            ....../>
        <invoke name="invokeScheduleManager"
            partner="scheduleManager"
            portType="...
            ....../>
    </sequence>
</process>
```

The automatic transformations from UML models to BPEL specifications are discussed and proposed in a number of papers; for more details the reader is referred to White (2006) and Amsden et al. (2003).
7.3 Application of the method to the eye-care case

In this section, we use the eye-care health case example, to explore the method presented in the previous section. We set our focus on providing service-oriented solutions to the primary care physician. As such, we concentrate on business transactions between the primary care physician, their healthcare associates and patients in Figure 26. The figure below depicts a simplified version of the business model in Figure 26 which shows the business transactions that happen between the primary care physician, their healthcare associates and the patient.

![Figure 28. An excerpt of the eye-care business model showing the primary care physician and their business transactions](image)

Figure 28 depicts six business transactions between a primary care physician, their associates and patients. FullTreatment (①), InitialTreatment (②), InformationProvisioning (③), PrimaryCareRegistration (④). To explore the e-service design method presented in this chapter, we consider the transaction; FullTreatment. The selected transaction will be explored along planning, identification and negotiation phases to identify business services that can be offered online, i.e. e-services. Finally, we show the application of
the method, exploring one of the e-services identified along above phases and creating CIM, and PIM models by utilizing the transformation rules presented in Section 7.2.2.

Developing CIM for the eye-care case
Following the method for creating the CIM, and using the FullTreatment transaction as explained in the previous section, we continue in this section with a deeper explanation of how the method is applied.

Application of Step 1: Creating CIM/Business Model
In this step, we utilize the business model in Figure 28 as the starting point for identifying high-level services. As stated in the beginning of this section, we consider the transaction FullTreatment to identify business services. In the table below, we summarize, resource transfers of the transaction FullTreatment across planning, identification, negotiation, actualization and post-actualization phases.

Table 6. Summary of resource transfers across different phases of the business transaction FullTreatment.

<table>
<thead>
<tr>
<th>Resource transfers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning Commitment for the treatment has been already established in the PatientRegistration transaction and hence no resources identified in here.</td>
</tr>
<tr>
<td>Identification Patient provides Accreditation information to Primary care physician Primary care physician provides Access to health services to Patient. Resource: Accreditation, Access2HealthServices Resource transfers: Obtain Accreditation (Patient), Provide Access2HealthServices (Primary care physician)</td>
</tr>
<tr>
<td>Negotiation Primary care physician offers Right2timeSlot to Patient. Primary care physician offers Right2CancelApoinment to Patient. Patient offers Right to Payment to Primary care physician. Resources: Right2TimeSlot, Right2Payment, Right2CancelAppointment Resource transfers: Obtain Right2Payment (Patient), Provide Right2TimeSlot (Primary care physician), Provide Right2CancelAppoinment (Primary care physician)</td>
</tr>
<tr>
<td>Actualization Patient gets Full treatment Primary care physician gets Fee Resource: FullTreatment, Fee Resource transfers: Provide FullTreatment (Primary care physician), Obtain Fee (Patient)</td>
</tr>
</tbody>
</table>
Following the argumentation given in the previous section, in Step 1, by default, resource transfers in every phase in Table 6 correspond to a single business service. In the identification and negotiation phases, an actor to obtain a resource should give away some other resource(s). Therefore, the reciprocal events in the identification and negotiation phases give rise to single business service in each phase. For instance, the Primary care gets Accreditation from the Patient and in return provides Access to Health Services. However, following the negotiation phase, as argued previously, since the contract has been already established, single resource transfers in actualization and post-actualization phases can give rise to a set of single business services. For example, Primary care can provide treatment first and later receive the Fee from the Patient.

Therefore, from the above business model, we identify the following business services.

- **Access Provisioning** which corresponds to the resource transfers Obtain Accreditation – Provide Access to Health Services, in the identification phase.
- **Treatment Scheduling** which corresponds to the resource transfers Provide Right to Time Slot and Provide Right to Cancel appointment – Obtain Right to Payment in the negotiation phase.
- **Treatment Provisioning**, and **Payment Handling** which corresponds to the resource transfers provide full treatment, and obtain fee, respectively in the actualization phase.
- **Post Treatment Management** which corresponds to the resource transfers provide time slot to post-health examination and provide post-health examination, respectively, in the post-actualization phase.

**Application of Step 2: Creating CIM/Process Models**

In this step, we consider the resource transfers; Provide Right to Time Slot and Provide Right to Cancel appointment – Obtain Right to Payment, which form the business service *Treatment Scheduling*. Aligning with Step 1, the process model in this step shall be created from the Primary care physician’s perspective.

Considering the organizational, functional, behavioral and informational aspects, by using the UML 2 Activity Diagram notation, the process model corresponding to the Treatment Scheduling is created. Examining the organizational perspective, the business modeler will create two Basic UML 2
partitions: Primary care and Patient. Then, the modeler will explore the two major tasks in this service: obtaining accreditation from a Patient and sending back a treatment schedule. The modeler will then, concerning the functional perspective, create an orchestration of the activities as depicted in Figure 29 (using UML 2 activities and control-flow elements). Also, he will use an informational perspective to model message/document exchanges within the process using UML 2 objects. In particular, the process begins when the Primary care provider receives the accreditation from the Patient. This information will then be checked against the registration information to see whether the Patient is registered with the Primary care physician or not. If the Patient is registered with the Primary care physician, then his registration data will be checked to see whether the Patient has an existing treatment time allocation. Based on these, the Primary care provider decides whether to offer the Patient a treatment schedule, offer him a cancellation of the existing time schedule or accept of the Patient’s request.
Developing PIM for the eye-care case

The business model and the process models, developed in the previous section, together define the CIM that will be used as the input to create the UML-based PIM. To make the transformation from CIM to PIM, we will utilize the transformation rules and the UML Profile presented in Section 7.2.2.

In this section, we will use the transformation rules 1–5 to illustrate the derivation of the elements in the PIM from the CIM created in the previous section for the service Treatment Scheduling and in the negotiation phase of the transaction FullTreatment.
Application of Rule 1:

- (Rule 1,a) The partition Patient in the CIM-level activity diagram is mapped to the PatientManagement partition element in the PIM-level class diagram. The PatientManagement partition will include the interactions of the Primary care provider to the Patient. For this partition, a Service Provider, Service, Service Specification and Service Gateway elements are created and named PatientManager, TreatmentContract, TreatmentContractInterface and PatientManagementGateway. The Gateway element is added to define that the service specification is accessible outside its hosting partition. (see Figure 30).

- (Rule 1,b) The ScheduleManagement partition is added to host the information retrieval activities of the Primary care provider, such as Check if the patient has a registration in CIM-level activity diagram in Figure 29. As in the previous example, for the created partition, Service Provider, Service and Service Specification and Gateway elements are added, as depicted in Figure 30.

Application of Rule 2:

- (Rule 2, a) The activity “Provide accreditation” from the CIM-level activity diagram (see Figure 29) is mapped to the Operation element “receivePatientAccreditation” within the TreatmentContractInterface (Figure 30). In the same way, “Get cancellation details and terms”, “Get schedule and terms”, “Provide schedule acceptance/rejection”, “Provide cancellation acceptance/rejection” and “Get cancellation notification” activities from the CIM-level activity diagram are mapped to “sendCancellationTerms”, “sendScheduleAndTerms”, “receiveConsent4Schedule”, “receiveConsent4Cancellation” and “sendCancellationNotice” within the TreatmentContractInterface. The activities “Get patient accreditation”, “Offer schedule proposal and terms”, “Get schedule acceptance/rejection”, “Get cancellation acceptance/rejection” and “Offer cancellation confirmation” of the Primary care partition in the CIM-level activity diagram are mapped to “sendPatientAccreditation”, “receiveAvailableTimeSlots”, “sendPatientTimeSlotSelection”, “sendCancellationInformation” elements within the scheduleInterface of the scheduleManagement partition (Figure 30).

- (Rule 2, b) The Operation elements “receiveRegistrationStatus”, “sendRegistrationInformation”, “receivePatientStatus”,
“sendPatientInformation”, “receiveCancellationConfirmation” and “receiveContractDetails” within scheduleInterface are added (Figure 30). These Operation elements facilitate the interaction between different send and receive Operation elements already introduced in the respective partitions. For instance, the Operation element “receiveRegistrationStatus” receives information regarding a Patient registration status based on the information requested by the send Operation element “sendPatientAccreditation”. Similarly, the Operation elements, “sendRegistrationInformation”, and “receivePatientStatus” models interaction activities by requesting information regarding a Patient's status (i.e. whether the Patient has a existing treatment schedule or not) and receiving the result.

- (Rule 2, c) The activity element Provide contract/registration status in the CIM-level activity diagram is decomposed to Operation element “sendContract” within the treatmentContractInterface (Figure 30). Registration status information, to be sent to Patients who are not registered with Primary care, is received by the Operation element receiveRegistrationStatus in Rule 2, b, above.

The activities “Check if the patient has a registration” and “check if the patient has a treatment schedule” in the CIM-level activity diagram, that concern assignments, are mapped to “selectPlayerInformation” and “selectPatientAndRegistrationInformation” in the PIM/Service Behavior (Figure 31). Additional activities such as “selectPatientInformation”, prepareRegistrationNotice, etc (see Figure 31) are created to delegate messages between send and receive activities of “patientManagement” and “scheduleManagement” partitions.

Application of Rule 3:
- (Rule 3, a) The information resource “Accreditation”, “Cancellation details/Terms”, “Schedule/Terms”, “Schedule decision”, “Cancellation decision”, and “Cancellation notice” from the CIM (see Figure 29) is mapped to the Message element “accreditation”, “cancellationTerms”, “schedule/Terms”, “consentForSchedule”, “consentForCancellation”, and “cancellationNotice” (Figure 30).
- (Rule 3, b) Considering the decomposition of the activity Provide contract/termination notification in the functional aspects in Rule 2(c), the information resource “Contract/termination notice” from the CIM-level activity diagram (see Figure 29) is decomposed to the Message elements “contract” and “registrationStatus” in PIM/Service Profile (Figure 30). Considering the introduction of Operation elements “receivePatientStatus”, “sendRegistrationInformation”, “sendPatientInformation”, “receiveCancellationConfirmation” and “receiveContractDetails” within scheduleInterface are added (Figure 30). These Operation elements facilitate the interaction between different send and receive Operation elements already introduced in the respective partitions. For instance, the Operation element “receiveRegistrationStatus” receives information regarding a Patient registration status based on the information requested by the send Operation element “sendPatientAccreditation”. Similarly, the Operation elements, “sendRegistrationInformation”, and “receivePatientStatus” models interaction activities by requesting information regarding a Patient's status (i.e. whether the Patient has a existing treatment schedule or not) and receiving the result.

- (Rule 2, c) The activity element Provide contract/registration status in the CIM-level activity diagram is decomposed to Operation element “sendContract” within the treatmentContractInterface (Figure 30). Registration status information, to be sent to Patients who are not registered with Primary care, is received by the Operation element receiveRegistrationStatus in Rule 2, b, above.

The activities “Check if the patient has a registration” and “check if the patient has a treatment schedule” in the CIM-level activity diagram, that concern assignments, are mapped to “selectPlayerInformation” and “selectPatientAndRegistrationInformation” in the PIM/Service Behavior (Figure 31). Additional activities such as “selectPatientInformation”, prepareRegistrationNotice, etc (see Figure 31) are created to delegate messages between send and receive activities of “patientManagement” and “scheduleManagement” partitions.

Application of Rule 3:
- (Rule 3, a) The information resource “Accreditation”, “Cancellation details/Terms”, “Schedule/Terms”, “Schedule decision”, “Cancellation decision”, and “Cancellation notice” from the CIM (see Figure 29) is mapped to the Message element “accreditation”, “cancellationTerms”, “schedule/Terms”, “consentForSchedule”, “consentForCancellation”, and “cancellationNotice” (Figure 30).
- (Rule 3, b) Considering the decomposition of the activity Provide contract/termination notification in the functional aspects in Rule 2(c), the information resource “Contract/termination notice” from the CIM-level activity diagram (see Figure 29) is decomposed to the Message elements “contract” and “registrationStatus” in PIM/Service Profile (Figure 30). Considering the introduction of Operation elements “receivePatientStatus”, “sendRegistrationInformation”, “sendPatientInformation”, “receiveCancellationConfirmation” and “receiveContractDetails” within scheduleInterface are added (Figure 30). These Operation elements facilitate the interaction between different send and receive Operation elements already introduced in the respective partitions. For instance, the Operation element “receiveRegistrationStatus” receives information regarding a Patient registration status based on the information requested by the send Operation element “sendPatientAccreditation”. Similarly, the Operation elements, “sendRegistrationInformation”, and “receivePatientStatus” models interaction activities by requesting information regarding a Patient's status (i.e. whether the Patient has a existing treatment schedule or not) and receiving the result.

- (Rule 2, c) The activity element Provide contract/registration status in the CIM-level activity diagram is decomposed to Operation element “sendContract” within the treatmentContractInterface (Figure 30). Registration status information, to be sent to Patients who are not registered with Primary care, is received by the Operation element receiveRegistrationStatus in Rule 2, b, above.

The activities “Check if the patient has a registration” and “check if the patient has a treatment schedule” in the CIM-level activity diagram, that concern assignments, are mapped to “selectPlayerInformation” and “selectPatientAndRegistrationInformation” in the PIM/Service Behavior (Figure 31). Additional activities such as “selectPatientInformation”, prepareRegistrationNotice, etc (see Figure 31) are created to delegate messages between send and receive activities of “patientManagement” and “scheduleManagement” partitions.

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- (Rule 3, a) The information resource “Accreditation”, “Cancellation details/Terms”, “Schedule/Terms”, “Schedule decision”, “Cancellation decision”, and “Cancellation notice” from the CIM (see Figure 29) is mapped to the Message element “accreditation”, “cancellationTerms”, “schedule/Terms”, “consentForSchedule”, “consentForCancellation”, and “cancellationNotice” (Figure 30).
- (Rule 3, b) Considering the decomposition of the activity Provide contract/termination notification in the functional aspects in Rule 2(c), the information resource “Contract/termination notice” from the CIM-level activity diagram (see Figure 29) is decomposed to the Message elements “contract” and “registrationStatus” in PIM/Service Profile (Figure 30). Considering the introduction of Operation elements “receivePatientStatus”, “sendRegistrationInformation”, “sendPatientInformation”, “receiveCancellationConfirmation” and “receiveContractDetails” within scheduleInterface are added (Figure 30). These Operation elements facilitate the interaction between different send and receive Operation elements already introduced in the respective partitions. For instance, the Operation element “receiveRegistrationStatus” receives information regarding a Patient registration status based on the information requested by the send Operation element “sendPatientAccreditation”. Similarly, the Operation elements, “sendRegistrationInformation”, and “receivePatientStatus” models interaction activities by requesting information regarding a Patient's status (i.e. whether the Patient has a existing treatment schedule or not) and receiving the result.
“sendPatientInformation”, “receiveCancellationConfirmation” and “receiveContractDetails” within scheduleInterface in Rule 2(b), new Message elements “patientStatus”, “registrationInformation”, “patientInformation”, “cancellationConfirmation”, “contractDetails”. Additionally, considering the identification of different assignment elements, to delegate messages between send and receive operations between different partitions, in Rule 2, the Message elements “timeSlots”, “patientTimeSlotSelection”, “scheduleCancellationInformation” are identified and associated to Operation elements “receiveAvailableTimeSlots”, “sendPatientTimeSlotSelection”, and “sendCancellationInformation”.

Application of Rule 4:

The control-and data flow of the CIM Activity Diagram (AD) (i.e. the behavioral aspect) and the created service partitions (organizational aspect), service operations (functional aspect), and the messages (informational aspect) in the PIM class diagram model, are used to create a PIM/Service Behavior model (see Figure 31). In the PIM/Service Behavior model, the flow is generally defined by the CIM-level activity diagram in Figure 29. It depicts the behavioral details for the e-service Treatment Scheduling.
Figure 30. Service model class diagram
PIM/Service Behavior model in Figure 31 explores the service coordination aspect while the PIM/Service Profile model in the Figure 30 above defines the service contract for Treatment Scheduling.

Figure 31. UML activity diagram at PIM level

Similarly, CIM and PIM level models can be created for other elicited business services related to the transaction FullTreatment.

7.4 Summary

In this chapter, we have introduced a MDA-based method for designing e-services, which may be implemented using Web services or some other related technology.

We propose the use of a business model at CIM level to identify economically viable business services and a UML based process model to define the arrangement of the events of the identified business services. The business model and process models corresponding to the high-level services identified
at the CIM level is converted to e-services in PIM level through a set of transformations. The proposed method offers several advantages.

First it provides an explorative basis for identifying business services illustrating a high level description of a whole business scenario in a single and easily understandable view. Here we have shown that the business modeler can elicit an explorative business service portfolio that enables the provisioning of economic values along five phases: planning, identification, negotiation, actualization and post-actualization of the business collaboration. This business model is further elaborated by the modeling behavior of every business service elicited in there and these two models form the CIM. The CIM model will then be transformed into a high-level system model, i.e. PIM which describes the elements and its structuring of e-services. This PIM level system model can be converted to an executable service specification and service coordination, using for instance, Web service technology.

The benefit of the proposed method is twofold. First, it enables a systematic and explorative identification of value-founded e-services, which improves the overall performance of a network of actors in the business collaborations. Secondly, the method describes a clear and straightforward approach for the development of e-services and their coordination. Using the MDA as a cornerstone, the method enables traceability of low-level executable e-services toward economic value offerings, thus justifying the economic viability of these e-services.
8 Conclusion and Discussion

In this section, we first discuss the research results achieved in relation to the problems and goals that we presented in Sections 1.2 and 1.3. Next we briefly compare the artifacts that we have presented in this thesis with similar approaches for business modeling to improve e-business application designing. Finally, based on the Hevner (2004) framework for design science research, we discuss different steps involved in the research work presented in this thesis.

8.1 Concluding Remarks

In this thesis, we address the problem of designing business models to improve e-business solutions designing.

Business models are used to represent a high-level view of resource offering and producing activities of an organization. Thereby, it is important that intentions of business stakeholders and different business environments are taken into account when designing business models as well as e-services. Goal models are often used to capture stakeholder intentions and map them down to operational aspects such as concrete activities that realize the goals. In recent years, developing a business strategy that calls for an IT strategy has been identified as a critical success factor for any organization. As a consequence organizations are looking to develop distinctive competencies, more often by means of IT, that enable them to add value in a unique way to outshine the competition. To identify what competencies are needed and how to differentiate them from others, companies need a comprehensive understanding of what their business partners and customers expect from them or more precisely, stakeholder intentions. Such an understanding will help them to adjust their value creation process to offer value-added resource offerings to their customers. Thus it can be argued that business models, which are used as a part of capturing requirements for e-business applications development, should reflect on the intentions of different business stakeholders. An important consequence of such a reflection will be traceability between business strategies and system components thus giving better alignment between e-business applications and business strategies. While stakeholder intentions can be thought of as describing an internal view by defining actions performed by actors towards the others, it is equally impor-
tant to consider business environments or the external shared space where the business collaborations between actors occur. The business collaboration space defines the business transactions between business actors and their underlying resources offerings. From a service exploration point of view, the consideration of stakeholder intentions or more precisely, goals, and business collaborations is important to identify a strategically-aligned and economically sustainable set of e-services.

Considering the above aspects, we have defined the basic research question for this work as: How to design business models and e-services whilst taking into account stakeholder intentions and business environments? The basic research question was addressed by decomposing it down to three specific questions. These specific research questions concerned:

- designing business models considering goal models;
- designing business models business collaborations; and
- using business models to design economically viable e-services.

Novel artifacts in the form of constructs and methods were developed concerning research problems discussed in Section 1.2. Below, we discuss the proposed artifacts in relation to the research problems in Section 1.2.

As a basis for business modeling, important concepts such as resource and resource transfers were investigated. Considering resources, we had identified economic resources and internal values as being important concepts in business modeling. Considering the transfer of resources between different business stakeholders, we made a distinction between different components, such as rights, custody and evidence documents.

- The problem of designing a goal-aligned business model was addressed by means of analyzing, different business notions and goal and business alignment. A set of instruments for designing a business model were presented considering goal-business alignment. Goal and business model are linked to each other through the notion of means. To facilitate means formulation, a number of templates have been proposed. These templates represent the basic activities of an enterprise: acquiring, providing, producing, or maintaining resources.

![Figure 32. Research results in relation to Problem 1 and Goal 1](image-url)
To address the second research problem, business modeling was further facilitated by classifying business transactions that happen between business stakeholders, into four different types. These transactions were identified considering different goals that a business collaboration should have. Furthermore, a method was proposed, to investigate these transactions further, to identify more resource transfers along different phases of a business collaboration such as planning, identification, negotiation, actualization and post-actualization phases proposed in (ISO/IEC, 2004). This process of identifying resource transfers across the business collaboration lifespan should provide the business modeler with additional instruments to extend the goal-aligned business model, considering the aspects that may have not been covered in the formulation of means templates. The method could also be used to design business models without the goal-aligned business model as an input.

The figure below summarizes the research results achieved in relation to the research Problem 1 and Goal 1, presented in Section 1.1 and 1.2, respectively.

Figure 33. Research results in relation to the second research problem and goal.

The problem of designing e-services was addressed by proposing a designing methodology that uses the business model as the basis for identifying economically viable e-services. Here, we proposed a model driven approach for designing e-services. The designing methodology uses several instruments (see Figure 34) that address the third research problem and goal. The proposed method uses a goal and collaboration-aligned business model as the explorative basis for designing business-oriented model – CIM for identifying a services portfolio that is aligned to business strategies. Additionally, a set of guidelines for mapping business-oriented (CIM-level) models to system-oriented (PIM-level) models were proposed.
The business model design methodology and e-service design methodology provides a modeler with a useful set of tools. Firstly, to design a detailed business model that is aligned to the intentions of various business stakeholders. It also provides a systematic approach for designing a business model considering goals and different types of business transactions. The designed business model provides an explorative basis for identifying an e-services portfolio that is clearly aligned to business strategies. As such the business and e-service design methods provide important instruments for designing strategically-aligned business models and economically sustainable e-services. Figure 35 depicts the overall research results in relation to the goals of the thesis.
8.2 Comparison to similar research

In this section, we briefly discuss work similar to our research work. These comparisons are done to evaluate goal-aligned business modeling method in Chapter 4, and the method for designing e-services using business models presented in Chapter 7.

Goal-based business modeling method

The Business-oriented Approach Supporting Web Services Idea Exploration (BASSIE) approach proposed in Raadt et al. (2005) uses the qualitative aspect of strategic goal modeling to complement the quantitative aspect of the $e^3$ value business modeling approach. The BASSIE approach proposes to design a goal model that represents the current situation of an enterprise. The
designed goal model is then used to develop a business model for the enterprise. In general, we follow the same line. This means that, the business modeling method introduced in Chapter 4 first considers the strategic interests of actors and then designs the business model that describes the resources offerings between them. However, there are fundamental differences between the BASSIE approach and the goal-aligned business modeling method presented in Chapter 4. One of the key differences is that the business modeling method presented in Chapter 4 provides templates for formulating goals and means while the BASSIE approach does not. On the positive side, the use of business notion-based design templates to formulate means enables different designers to express different goals and means in a similar way. As such the uniform goal model creation can be regarded as an advantage of the method presented in Chapter 4. Besides means templates, our method in Chapter 4 also defines the alternatives associated with each means template and actions that will realize them at the business level. These should help business modelers to arrive at major design decisions about what design choices they have to make and how these choices will affect the realization of means. This will enable the creation of uniform business models. The BASSIE approach provides a set of guidelines for mapping a goal model to a business model. Since BASSIE does not use templates to assist goal modeling, the guidelines used to transform the goal model to the business model are defined at a general level. For example, taking a goal model component such as an actor and mapping it to an actor in a business model. Therefore, they take different forms than the transformation rules that we have defined in Chapter 4.

**Business model-based e-service design method**

The methods presented in Gordijn et al. (2009) and Cherbakov et al. (2005) show the importance of considering consumer needs and their fulfillment aspects when designing e-services. The e-service design method in Gordijn et al. (2009) uses three different requirements viewpoints: value, process and information systems viewpoints. The purpose of the value viewpoint is to design a business model taking the consumers’ needs into consideration. This viewpoint has been used as the starting point to obtain a profitable portfolio of e-services. The process viewpoint is used to decompose interaction between different actors into processes. This viewpoint elaborates the relationship between the consumers’ needs identified in the value viewpoint and the different tasks required to realize them. Finally, the information systems viewpoint defines workflow specifications for e-services elicited in the value viewpoint by utilizing the task decomposition in the process viewpoint. However, the approach does not provide clear information on how the information regarding resource transfers on the value viewpoint is used in the process viewpoint. These viewpoints are abstractly related to each other by eliciting processes at the process viewpoint for consumer needs elicited in
the value viewpoint. Unlike the use of consumer needs to elicit processes by Gordijn et al. (2009), we investigate resource transfers across the planning, identification, negotiation, actualization and post-actualization phases of business collaborations. The reciprocal resource transfers obtained are mapped to business services which are further elaborated using business processes. We also propose mappings from business-oriented models to system-oriented models by considering organizational, functional, informational and behavioral perspectives in process designing. Both approaches use UML profiles to obtain high-level non-technical-oriented models describing, for instance work-flow type specifications for obtained e-services. Another important distinction is that, in contrast is that, even being model driven, Gordijn et al. (2009), does not define models and model transformations as recommended by the MDA discipline.

On the business level, Cherbakov et al. (2005) uses a Component Business Model (CBM) to define business functions that can be implemented as, for instance, e-services. CBM is used by IBM as a method to create business models as an organized collection of business components. The IBM approach for realizing a service-oriented enterprise in Cherbakov et al. (2005), uses the CBM framework for modeling business by organizing business activities into components. Each of these components is ideally supported by IT-enabled services. The method uses SOMA to map business model components to e-services that realize the associated business functions. The similarities between the e-service design method that we present in Chapter 7 and the methods discussed above, are that they all identify the importance of considering the business aspect to obtain an economically sustainable set of e-services. They all use business models as a point of departure to elicit business services which are further elaborated to elicit and define processes that realize them. For the differences, in the method presented in Chapter 7, we follow the MDA-based approach. However, even being model-oriented, the above mentioned proposal does not define models and model transformations. Also, in IBM CBMs components seem to represent aggregated business functions such as product sales which may include a number of resource transfers. In contrast we elicit atomic resource transfers across the planning, identification, negotiation, actualization and post-actualization phases of each business transaction between actors. This facilitates traceability meaning that elicited e-services can be traced back to their corresponding economic resource transfers at the business level.

MDA principles are used in a number of research studies to propose methods to design e-services. Typically, these approaches use PIM as a starting point for designing MDA-based solutions for developing e-services. For instance, Johnston (2005), López-Sanz, Acuña, Cuesta, & Marcos (2008) and Amsden et al. (2003), use UML profiles to define technology-independent models at PIM level as the starting point of designing MDA based e-services. Some other studies have used models at CIM level as the
starting point for designing MDA-based e-service design approaches. For instance, approaches in Rosen (2003), Vidales, Sánchez, Fermoso & Aguilar (2008), and Kherraf, Lefebvre & Sury (2008) add a business perspective to the development process using business process models for developing CIM-level models and mapping them further to PIM-level. Since these process models focus on the operational aspects of business, the aforementioned approaches do not describe the association between the designed e-services and business activities in general.

8.3 Discussion about the research process

Hevner et al. (2004) present a conceptual framework that could be used to evaluate the design science research for its usefulness, applicability and the effectiveness in the problem domain. It consists of seven guidelines that should be satisfied by effective design science research. In the following we analyze our work according to these guidelines. More information about these guidelines can be obtained from Hevner et al. (2004).

Guideline 1: Design as an artefact

“Design-Science research must produce a viable artefact in the form of a construct, a model, a method or an instantiation” (Hevner et al., 2004, pp. 83).

In this thesis, we propose novel methods for designing business models and e-services.

For business modeling, the methods provide: identification of components of a resource transfer, templates to formulate goals and means using business notions, transformation rules to identify business model components to build a business model based on the goal model, a structured way of identifying resource exchanges across the business collaboration lifespan.

For e-service design, we employ an MDA-based approach which uses a business modeling method mentioned above at CIM-level and a set of transformation rules to transform it to a PIM.

Thereby, there are two clearly identifiable artifacts created in this research work. They are: methods for designing business models and a method for designing e-services.

Guideline 2: Problem Relevance

“The objective of design-science research is to develop technology-based solutions to important and relevant business problems” (Hevner et al., 2004, pp. 83).

With inter-organizational e-commerce growing rapidly, there is an increased interest in designing business models and e-services as prominent activities in e-business application development. However, there is still lack of under-
standing about how business goals and strategies should be aligned with business models and how business models could be used to design e-services. One issue with the current business modeling methods is that they often consider core resource exchanges such as goods for money and do not consider the other forms of resources exchanged between collaborating parties during the collaboration lifespan. Yet, these other resource exchanges need to be considered in business modeling as they could identify vital information needed for e-business application development, for instance providing some clues about how business processes should be designed. From an e-service designing point of view, business models should be used as a means for designing economically sustainable e-services. As it was for business modeling, this is an area that has captured the interest of researchers. However, when business models are not designed in an explorative way by considering all the resource exchanges across the entire business collaboration lifespan, it is often difficult to obtain a comprehensive business service portfolio.

These are the very relevant problems that we address by this research.

Guideline 3: Design evaluation

“The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods” (Hevner et al., 2004, pp. 83).

As explained in Hevner et al. (2004), evaluation is a crucial component in a research process. It proves whether or not a developed artifact is actually useful to solve the problem that it is intended to solve.

We have shown the applicability of the proposed methods through a descriptive method using a scenario-based evaluation and informed arguments.

Two business scenarios, from different domains are, used for the evaluation: the MMOG case and Swedish health case from the REMS project (Henkel et al., 2007). The healthcare business case from the REMS project is used to evaluate the business modeling methods whereas the MMOG case is used to evaluate the method for e-service design. The first hand information of the researchers involved in the REMS project were used in the evaluation process. In addition to that, various research publications were used to obtain the details of the business cases as mentioned above. Naturally, the business requirements of the two business scenarios were different. For instance, the MMOG business scenario had more online transfer of resources offerings between actors. The REMS healthcare case involved more physical interaction between actors to exchange resources such as treatments. These differences helped us to evaluate the artifacts by showing their applicability in different domains. In terms of complexity, both these cases had variety of resource exchanges that represented all the basic types of business collaborations that we have identified in Chapter 5. As such, these business cases
helped us show, to what extent, the methods proposed in the thesis could help business modelers and service designers to think beyond traditional producer-consumer roles and design innovative e-business solutions by exposing the multiplicity of resource types and flows between different activities that interact with each other.

In addition to using business scenarios to evaluate the obtained artifacts, we have used informed argument to illustrate the effectiveness of the solutions proposed in the thesis for the problems and goals presented in Chapter 1. In Section 8.1, we compare the business modeling and e-service design methods to similar research studies, from both academia and industry.

**Guideline 4: Research contributions**

“Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies” (Hevner et al., 2004, pp. 83).

The main contributions of this research include methods for designing business models and e-services.

Concerning designing business models, we propose:

a. a way of using goal models as a basis for designing business models;

b. a classification of business transactions;

c. a way of designing business models by identifying resource transfers across an entire business collaboration lifespan, i.e. from initial planning activities to possible post-sale activities.

Regarding e-service design, we propose a model-driven approach:

a. which uses business models at the CIM level;

b. which uses a set of transformation rules to obtain high-level system models (PIM) that specifies structure and behavior of the e-services.

**Guideline 5: Research rigor**

“Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact” (Hevner et al., 2004, pp. 83).

The work presented in this thesis is grounded on well-established theories, standards and modeling approaches. For instance, the reference ontology is designed based on the analysis of three well-established ontologies: REA; BMO; and $e^3$ value. Among them, REA has its origins in accounting theory where every transaction is seen as either an increasing or decreasing resource of an organization. The BMO has its roots in the Balance Scorecard approach (Kaplan & Norton, 1996) and business management literature such as Markides (1999). The $e^3$ value ontology is based on the value-based requirements’ engineering theories such as Holbrook (1999) and Porter (1998). Other than the above sources, other well-established business management frameworks such as the Porter value chain (1998), consumer value frame-
work by Morris Holbrook (1999), goal modeling approaches such as BMM (2007) and standards for business collaboration modeling such as ISO Openedi 15944-1 (ISO/IEC, 2002) and 15944-4 (ISO/IEC, 2007) serve as foundations for the work presented in this thesis. The presented artifacts are evaluated using a descriptive business scenario to demonstrate their utilitarian values.

Guideline 6: Design as a search process

“The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment” (Hevner et al., 2004, pp. 83).

The solutions to the problems of designing business models and e-services, mentioned in Chapter 1, are determined through several steps. First, existing theories of consumer value creation and three well-established business modeling frameworks are used to identify different components of a resource transfer: rights transfer (of resource), custody transfer (of resource) and documentary evidence transfer, between actors involved in a business collaboration. In the second step, these results are used to develop methods to design business models. Here, goal and collaboration aspects are considered to develop methods to design business models. Existing goal modeling techniques, standards regarding business collaborations are used in the development of the methods. Important results in the second step include: a set of design templates for formulating goals and means in terms of business modeling notions, a classification of business transactions that are used to develop methods for designing business models presented in this thesis. The capabilities of existing approaches for business modeling are extended by means of capturing and using goals to develop business models and extending their ability to capture resources across the entire business collaboration lifespan. The latter is an important requirement for developing a e-service design method. The search process for these design methods is iterative in the sense that the results are fine-grained over several research publications and the capabilities of the methods are presented using several examples.

Guideline 7: Communication of research

“Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences” (Hevner et al., 2004, pp. 83).

Two types of artifacts are presented in this thesis. They include the methods for designing business models, which focuses on the exchange of different values in a networked business constellation and a method for designing e-services. These methods are communicated to both types of audiences by using well-established graphical value modeling tools to exemplify the methods proposed and highlighting the advantages of the methods. Also, the research results were presented at leading scientific research forums.
8.4 Future research directions

In this thesis, we have presented a set of artifacts aimed at improving e-business solutions design. They include methods for business model design and e-service design. In business model design methods, we have set focus on defining a business model by aligning business goals with business models and identifying resource transfers along different phases of a business collaboration life-cycle. In the MDA based e-service design method, we have set focus on defining a business-oriented model (CIM) which elicits value-oriented business services utilizing business model designed based on aforementioned business model design methods. This business-oriented model (CIM) is further transformed into system-oriented model (PIM) by capturing e-service structure and behavior. Considering these aspects of business modeling and e-service design, we see number of possible directions for future research. These directions are briefly discussed below.

- **Goal-business alignment**: in regard to goal-aligned business model design, assessment of sufficiency of the means templates would be of high importance. This will enable us to see if the means templates proposed in this thesis are sufficient for modeling courses of actions in any business environment. Such an assessment can be achieved by, for instance, performing an industry-wide survey considering how business actors in different domains define their strategic interests. In addition to that, it is also worthwhile to investigate how elicitation of goals can be structured. This may be achieved, for instance, considering aspects such as customer, competitor and capability analysis and developing contribution models to make formulation of goals easier. As an example, a contribution model designed based on a customer perspective may define a number of activities that a business wishes to carry out on one dimension and then mapping these activities to internal resources (e.g. knowledge) of customers on the other dimension.

- **Business-driven e-service exploration**: identification of customer needs and mapping them to the activities required to fulfill those needs is of high importance to develop a complete and easily understandable business-oriented model (CIM). One way to achieve this is by creating a business-oriented model (CIM) with separate layers that illustrate how generic value chain activity of a business is decomposed to specific resource exchanges and to finally elicit business services along different phases of that business collaboration life-span. In addition to that, capturing business semantics at the business-oriented model (CIM) level and mapping them to the system-oriented model (PIM) level is another important aspect to consider in future research work. One way to achieve this is to use meta-data model for developing business-oriented model (CIM). By doing so we should be able to achieve smoother transformation between different models.
Finally, in order to perform a comprehensive validation, the business model
design methods and e-service design method should be applied to industry-
based complex case studies.
References


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Appendix A

Transaction: InformationProvisioning

Application of Guideline 3,a: Identification of resources across planning, identification, negotiation, actualization and post-actualization

Table A1. Resources across different phases of the transaction InformationProvisioning

<table>
<thead>
<tr>
<th>Planning</th>
<th>InformationProvisioning</th>
<th>PrimaryCareRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment for the treatment has been already established in the PrimaryCareRegistration transaction and hence no resources identified in here.</td>
<td>The Health services office offers Registration service information. Resource: RegistrationServiceInfo</td>
<td></td>
</tr>
<tr>
<td>Identification</td>
<td>Primary care provides Accreditation information to the Health services office. Resource: Accreditation</td>
<td>Primary care provides information regarding its services and resources to register them to the Primary care center. Resource: PrimaryCareInformation</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Rights for the resource transfers are already established in the PrimaryCareRegistration transaction. Therefore no resources are identified in this phase.</td>
<td>Health services office gets Right2RegisterPatients. Primary care gets Right2AccessPatientData from the Health services office. Primary care gets Right2AccessKnowledgeServices from the Health services office. Primary care gets Right2AccessSpecialistClinicInformation from the Health services office. Resource: Right2TreatmentServices Right2AccessPatientPersonalData, Right2AccessSpecialistClinicInformation</td>
</tr>
</tbody>
</table>
Actualization

| Health services office offers *PatientData* to the Primary care provider. |
| Registration office offers *SpecialistClinicInformation* to the Primary care provider. |
| Registration office offers *KnowledgeOnSymptomsAndDiseases* to the Primary care provider. |
| Resource: *PatientData, SpecialistClinicInformation, KnowledgeOnSymptomsAndDiseases* |

| No resource flows are identified in this phase |

Post-actualization

| No resources could be identified in the post-actualization phase of this transaction. |

| No resources could be identified in the post-actualization phase of this transaction. |

**Application of Guideline 3,b: Identification of resources across different phases considering internal values.**

Next we re-examine each of the elicited resources, to identify internal values, along all the five phases.

- In the planning phase of the transaction RegistrationInformationProvisioning, as in the case of the PatientRegistration transaction, the Primary care provider may find it is convenient if the Registration Office offers registration information services in different formats such as e-catalogues and printed catalogues. Hence, we derive a new resources: *eCatalogue* and *PrintedCatalogue* as two alternatives that replaces previously identified resource: *RegistrationServiceInfo*.

- In the Identification phase, of this transaction, we assume that the information verification had been already done by the Registration office.

- Also in the negotiation phase of this transaction, we do not derive any new resources after considering the internal values.

- Considering the speed and reliability of the custody transfers in the actualization phase, we derive *OnlineAccess2PatientRegistrationInfo*.

- In the post-actualization phase of this transaction, we do not derive any new resources, after considering internal values.
The figure below depicts the resource transfers between the Primary care physician and services office.

![Diagram](image)

*Figure A1. e³ value business model depicting resource transfers between the primary care physician and the healthcare specialist.*

**Transaction: InitialTreatment**

The transaction InitialTreatment and FullTreatment are alternative business transactions offering two choices of resource treatment to a patient. That is, for a particular patient, the Primary care physician offers either FullTreatment or InitialTreatment in any given situation. The difference between these two transactions is that in the former transaction, the primary care physician, Patient and Healthcare specialist collaborate with each other while in the latter only the Primary care physician and the Patient involved in the collaboration. As such, by applying Guideline 3 (3, a and 3, b), the identified resources in this transaction show similarities to the resources identified in the transaction FullTreatment.

**Application of Guideline 3,a:** Identification of resources across planning, identification, negotiation, actualization and post-actualization
### Table A2. Resources across different phases of the transaction InitialTreatment

<table>
<thead>
<tr>
<th>Phase</th>
<th>Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Commitment for the treatment has been already established in the PatientRegistration transaction and hence no resources identified in here.</td>
</tr>
<tr>
<td>Identification</td>
<td>Patient provides Accreditation information to primary care. Resources: Accreditation</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Primary care offers Right to time slot to the patients. patients offer Right to payment to primary care. Resources: Right2TimeSlot, Right2Payment</td>
</tr>
<tr>
<td>Actualization</td>
<td>Primary care offers InitialTreatment to the patients. Primary care offers Right2GetAdvanceTreatment to the patients. Primary care offers Right2GiveAdvanceTreatment to the Specialist. Resources: InitialTreatment, Right2GetAdvanceTreatment, Right2GetAdvanceTreatment.</td>
</tr>
<tr>
<td>Post-actualization</td>
<td>Primary care offers Timeslot to post health examination. Primary care offers Post-health examination to the patients. Resources: TimeSlot2PostHealthExamination, PostHealthExamination.</td>
</tr>
</tbody>
</table>

**Application of Guideline 3,b:** Identification of resources across different phases considering internal values.

Considering the similarity between the FullTreatment and InitialTreatment transaction, below, we summarize the resources identified by applying Guideline 3, b.

- **Planning:** this phase leads to identifying the eCatalogue and PrintedCatalogue as different choices that replace the previously identified resource: RegistrationServiceInfo.
- **Identification:** two new transactions; PatientInformationProvisioning for providing registration information of patients to primary care physicians and another; PrimaryCareRegistration for establishing commitments for the above transaction are identified.
- Negotiation: a new resource, *Right2CancelAppointment*, is identified. Additionally, considering the internal value customizability for obtaining a referral to a specialist healthcare clinic of patients’ preference, we derive the resource *SpecialistClinicInformation*, for customers to get first hand information about specialist clinics that they can be referred to.

- Actualization: considering a new resource *InitialTreatmentAtHome4Elders* is identified as an alternative for the resource *InitialTreatment*.

- Post-actualization: considering responsiveness in the sense that the specialist healthcare clinic should respond to the primary care in order for the latter to effectively carry out the post-health examination of the patient, we derive the resource; *Access2PatientTreatmentInformation*.

In Figure A2 below, we model the resource transfers identified considering the different phases as well as internal values. There are three actors involved in this transaction: the Primary care physician, the Healthcare specialist and the Patient. The Primary care physician is responsible for providing initial treatment (*InitialTreatment*) to the patient followed by a referral (*Right2GetAdvanceTreatment*) to get treatment from the Healthcare specialist. At the same time, the Primary care physician provides information regarding the referred patient giving the right for the Healthcare specialist to treat the Patient.

![Figure A2. e³ value model depicting InitialTreatment transaction](image)

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Transactions: AdvanceTreatment, SpecialistRegistration

Application of Guideline 3,a: Identification of resources across planning, identification, negotiation, actualization and post-actualization phases.

Table A3. Resources across different phases of the transactions AdvanceTreatment and SpecialistRegistration

<table>
<thead>
<tr>
<th>Phase</th>
<th>AdvanceTreatment</th>
<th>SpecialistRegistration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Commitment for the treatment has been already established in the PatientRegistration transaction and hence no resources are identified in here.</td>
<td>The Registration Office offers Services catalogue</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Resources: ServicesCatalogue</td>
</tr>
<tr>
<td>Identification</td>
<td>Patients provide Right to get Advance treatment to the Healthcare specialist</td>
<td>Specialist Clinics provide Specialist clinic information to register them to primary care center</td>
</tr>
<tr>
<td></td>
<td>Resources: Right2GetAdvanceTreatment</td>
<td>Resources: SpecialistClinicInformation</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Health care specialist offers Right to time slot to the Patient. Patient provides Right to payment to the Healthcare specialist. Resources: Right2TimeSlot, Right2Payment.</td>
<td>Specialist Clinics get Right to get patients referred. Resources: Right2GetPatientsReferred</td>
</tr>
<tr>
<td>Actualization</td>
<td>Patients get Advance treatment from the Healthcare specialist. Healthcare specialist gets Fee from the Patient. Resources: AdvanceTreatment, Fee</td>
<td>Since this transaction focuses on establishment of commitments (e.g. right to get patients referred), we do not identify transfer of custody of objects in the actualization phase.</td>
</tr>
<tr>
<td>Post-actualization</td>
<td>No resources could be identified in the post-actualization phase of this transaction.</td>
<td>Health services office offers periodic information bulletins to Healthcare specialists. Resources: PeriodicInformationBulletin.</td>
</tr>
</tbody>
</table>

Application of Guideline 3,b: Identification of resources across different phases considering internal values.

Next we re-examine each of the elicited resources, to identify internal values, along all the five phases.

- In the planning phase of both transactions in Table A3, the Specialist Clinics may find it is convenient if the Health services office offers ser-
services catalogues in different formats such as e-catalogues and printed catalogues. Hence, we derive a new resource: \textit{eCatalogue} and \textit{Printed-Catalogue} as two alternatives that replace the previously identified resource: \textit{ServiceCatalogue}.

- In the Identification phase, of the transaction \textit{AdvanceTreatment}, the referral information provided by the patient will be checked against the information Healthcare specialist received from the Primary care physician. As such we do not identify any new resources for the transaction \textit{AdvanceTreatment}. Assuming that the information from the Healthcare specialist will be checked internally by the Health services office, we do not derive new resources considering the internal values in this phase for the \textit{SpecialistRegistration} transaction.

- In the negotiation phase of the transaction \textit{AdvanceTreatment}, considering the internal values we derive the resource \textit{Right2CancelAppointment} so that a Patient may have chance to cancel an existing appointment within a reasonable time period.

- Since there are no custody transfers involved in the registration of the Healthcare specialist by the Health services office, we do not derive any new resources for the transaction \textit{SpecialistRegistration}. Also, in the \textit{AdvanceTreatment} transaction, we do not derive any new resources considering the internal values in this phase.

- In the post-actualization of the transaction \textit{SpecialistRegistration}, the Primary care physician may find it useful if they receive information updates regarding health services from the Health services office. Thereby, we identify \textit{PeriodicInformationBulletin} as a resource that could be received by the Primary care physician from the Health services office. For the transaction \textit{AdvanceTreatment}, we do not derive any new resources in the post-actualization phase.

The above identified resource transfers are modeled in Figure A3 below which models three actors: Health services office, Healthcare specialist and Patient. The figure below models two transactions, the \textit{AdvanceTreatment} transaction between the Healthcare specialist and the Patient (①) and the transaction \textit{SpecialistRegistration} between the Healthcare specialist and the Health services office(②).
Figure A3. $e^3$ value business model depicting AdvanceTreatment and SpecialistRegistration transactions.
Appendix B

Exploring the Use of Business Models for Designing E-Services Using the MMOG Case

Application of Step 1: Generating a CIM/Business Model for the MMOG case
Considering the MMOG case presented in Section 2.7.1, we identify the following business transactions. We utilize the guidelines presented in Section 7.2.1 to identify the transactions below. However, here we do not develop a complete business model for the MMOG case as the primary goal of this appendix is to explore the services designing method presented in Chapter 7. We use the REA business modeling method in this section to design the business model.

- For providing access to the games by the Game Provider to the Game Player, we introduce a transaction, GamesProvisioning. For the provisioning of the hosting service by the ISP to the Game Provider, we introduce one transaction HostingProvisioning. Furthermore, we introduce one transaction InternetAccessProvisioning for providing Internet access by the ISP to the Game Player.
- For player profile creation at the Game Provider, we introduce one transaction PlayerProfileCreation. Concerning the registration of ISPs by the Game Provider, we introduce the ISPRegistration transaction.

Next, the transactions identified above are expanded along the planning, identification, negotiation, actualization and post-actualization phases. In here, we consider only the GamesProvisioning transaction. In Table A1 below, we summarize the economic events identified in this transaction along these phases.
Table B1. Economic events, actors and resources of the transaction GamesProvisioning

<table>
<thead>
<tr>
<th>Phase</th>
<th>Economic Events (EE), Actors (A) and Resources (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>Game Provider (A) offers Catalogue (R) to the Game Player (A). In return the Game Provider (A) obtains the Attention (R) of the Game Player (A). Economic Events (EE) – Publish Games Catalogue (Game Provider), Obtain Attention (Game Player)</td>
</tr>
<tr>
<td>Identification</td>
<td>Game Player (A) provides Accreditation (R) to the Game Provider (A). Game Provider (A) compensates with Games Info. (R) to the Game Player (A). Economic Events (EE) – Obtain Game Selection (Game Player), Offer Games Info. (Game Provider)</td>
</tr>
<tr>
<td>Negotiation</td>
<td>Game Provider (A) offers Right to Play Games (R) to the Game Player (A). Game Player (A) offers Right to Payment (R) to the Game Provider (A). Economic Events (EE) – Offer Right to Play Games (Game Provider), Obtain Right to Payment (Game Player)</td>
</tr>
<tr>
<td>Actualization</td>
<td>Game Player (A) gets the Access to Games (R) Game Provider (A) gets the custody of Money (R) Economic Events (EE) – Deliver Games (Game Provider), Obtain Payment (Game Player).</td>
</tr>
<tr>
<td>Post-actualization</td>
<td>Game Player (A) gets FAQ Info (R). Game Provider (A) gets Status (R). Game Player (A) provides Error Reports (R) to the Game Provider (A) Game Provider (A) offers Solutions (R) to specific problems of the Game Player (A). Economic Events (EE) – Offer FAQ, Offer Solutions (Game Provider), Obtain Error Report, Obtain Player Satisfaction (Game Player)</td>
</tr>
</tbody>
</table>

In the above figure, we present the business model fragment for the GamesProvisioning transaction explored along five phases in the table above. In Figure B1 below, the events are created from the MMOG perspective (i.e. provider perspective).
Application of Step 2: Generating CIM/Process Models for the MMOG case.

In Figure B2, we consider the Offer Right to Play Games and Obtain Right to Payment events forming a business service that we name Establish Contract. Following Step 1, a process shall be created from the perspective of the MMOG provider.

Considering the organizational perspective, the business modeler will create two UML partitions: Game Player and Game Provider. The modeler will then explore the two major tasks (functional perspective) in this service:

a. offering right to play games, which will be realized by obtaining a selection of games from the player; and

b. obtaining a right to payment by providing the player a contract.

By creating a composition of the outlined activities (behavioral aspect), refining them to the level of atomic business activities and including the internal rules, the modeler will create a process model as depicted in Figure B2. Considering the informational aspect, the modeler will identify the messages/documents that have to be exchanged by the activities identified in the behavioral aspect, and model those using UML objects (see Figure B2).
obtained service process will begin when the Game Provider receives a player selection from the Game Player. The Game Provider then checks the information to examine if the player has a subscription with a payment due or not. Based on this information, the provider will either offer a contract to the Game Player, or decide on an acceptance of the player.

Figure B2. UML activity diagram exploring the details of the Establish Contract service

Application of CIM to PIM Transformation Rules

The table below summarizes elements that are directly mapped from the CIM-activity diagram to the PIM Service Profile model, after application of transformation rules in Section 7.2.2.
Table B2. Summary of CIM-level elements and corresponding PIM/Service Profile elements

<table>
<thead>
<tr>
<th>Rule</th>
<th>Element types</th>
<th>Elements</th>
<th>PIM Service Profile</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIM-activity diagram</td>
<td>PIM Service Profile</td>
<td></td>
</tr>
<tr>
<td>1, a</td>
<td>Partition</td>
<td>Partition</td>
<td>gamePlayerManagement</td>
</tr>
<tr>
<td>1, b</td>
<td></td>
<td></td>
<td>Game Provider</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>subscriptionManagement</td>
</tr>
<tr>
<td>2,a</td>
<td>Activity</td>
<td>Operation</td>
<td>receivePlayerSelection</td>
</tr>
<tr>
<td>2,b</td>
<td></td>
<td></td>
<td>Get payment details</td>
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<td></td>
<td></td>
<td>sendContractTerms</td>
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<td></td>
<td></td>
<td></td>
<td>Provide acceptance/rejection</td>
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<td></td>
<td></td>
<td></td>
<td>notification</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>receivePlayerDecision</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Get contract/termination</td>
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<td></td>
<td></td>
<td></td>
<td>sendContract</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>sendPaymentDueNotice</td>
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<td></td>
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<td></td>
<td>sendPlayerInformation</td>
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<td></td>
<td>receiveGamesCost</td>
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<td></td>
<td>receiveContractInformation</td>
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<td></td>
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<td></td>
<td>receivePaymentDueAmount</td>
</tr>
<tr>
<td>3,a</td>
<td>Resource</td>
<td>Message</td>
<td>playerSelection</td>
</tr>
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<td></td>
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<td></td>
<td>Cost/Terms</td>
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<td></td>
<td></td>
<td></td>
<td>playerDecision</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>contract</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>paymentDueInformation</td>
</tr>
</tbody>
</table>

- Considering Rule 1,(a), the `gamePlayerManagement` partition (see Table B2) is responsible for the interactions of the Game Provider to the Game Player. For this partition, a Service Provider, Service Consumer, Service, Service Specification and Service Gateway elements are created and named `gamePlayerManager`, `subscriptionAssessor gameContract`, `gameContractInterface` and
The Gateway element is added to define that the service specification is accessible outside its hosting partition.

- Considering Rule 1, (b) subscriptionManagement partition (see Table B2) is added to host the information retrieval activities of the Game Provider, such as to Check if the player has a subscription in the CIM-level activity diagram in Figure B2. Additionally a Service Provider, Service Consumer, Service, Service Specification and Gateway elements are added, for the created partition (see Figure B3). These elements are named subscriptionAssessor, gamePlayerManager, subscription, subscriptionInterface and subscriptionManagementGateway.

- The table above shows the elements that are directly identified considering Rule 2, (a).

- (Rule 2, b): the Operation elements receivePlayerStatus, sendGamesInformation within subscriptionInterface are added (Figure B3).

- (Rule 2, c): the activity element Get contract/notification in the CIM is decomposed to Operation elements “sendContract” and “sendPaymentDueNotice” within the gameContractInterface (Figure B3). Additionally, Provide contract/termination notification in the CIM Game Provider partition is decomposed to receiveContractInformation and receivePaymentDueAmount Operation element within the subscriptionInterface.

The “Check if the player has a subscription” and “check if the player has a payment due” in the CIM-level are the assignment-type of activities, and as such, are mapped to “selectPlayerInformation” and “selectPayment-DueInformation” in the PIM/Service Behavior (Figure B4). Considering selecting games information, preparing contract terms, selecting player decision information and preparing the final contract, and the preparing payment due notice, assignment-type activities selectGamesInformation, prepareContractTerms, prepareContract, preparePaymentDueInformation are added to the PIM Service Behavior. Additionally, considering the fact that the player information and contract information is already available with the process itself, we decompose the activity, Get player notification and perform its function within the assignment-type activity prepareContract.

- (Rule 3, a) The information resource such as “Player selection” from the CIM (see Figure B2) are mapped to the Message elements in the PIM Service Profile (see Table B2 and Figure B3).

- (Rule 3, b) Considering the decomposition of the activity Get contract/termination notification in the functional aspects in Rules 2(c), the information resource “Contract/termination notice” from the CIM-
level activity diagram is decomposed to the Message elements “contract” and “paymentDueNotice” in PIM/Service Profile. Additionally, considering the decomposition of the CIM-level activity Provide contract/termination notification new Message elements decisionInformation and contractInformation is added to the PIM Service Profile (see Figure B3).
Figure B3. PIM/Service Profile for gameContract and subscription Services
Figure B4 below depicts the behavioral part of the PIM service model obtained when applying the transformation rules on the CIM service *Establish Contract*.

![Figure B4. PIM service behavior model gameContract and subscription Services](image-url)
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