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A method to support the alignment of business models and goal models

Halleux, Pierre; Mathieu, Ludovic

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Pierre HALLEUX and Ludovic MATHIEU

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A Method to Support the Alignment of Business Models and Goal Models

Pierre HALLEUX and Ludovic MATHIEU

Abstract

The activity of modelling has become a substantial mean to produce models used by managers to take important decisions regarding the organization. Usually, a business model is closely linked to the achievement of the organization's goals. These goals can be expressed in a goal model. Most of the time, changes in the environment will lead to a redefinition of the goal model which will also modify the business model.

This thesis relates to the issue of the alignment between goal models and business models during the (re)definition of business and its environment. For solving this issue, a method that builds on a previous templates and rules approach from [4] is proposed. The goal of this approach is to reflect the new strategic changes from a goal model to an associated business model. The method takes as input a goal model and a business model, and outputs a business model that is aligned with the explicit goals of a business actor.

The results are an improvement of the previous templates and rules syntax (while keeping the original semantic), a better methodological support for the goal and business modelers and a decrease of implicit constructions for the production of the output. All of these improvements contribute to reduce the possible mistakes and ambiguities during the application of the method, and add more precision to the model produced in output. The validity of the results is illustrated by applying the improved method on a case study.

Keywords:

goal model, i^*, business model, value model, e^{3}value, model alignment, redefinition of business.

Résumé

L'activité de modélisation est désormais devenue un outil important pour l'organisation. En effet, elle permet la production de modèles utilisés par les managers lors de prises de décisions cruciales concernant l'organisation. Habituellement, un modèle de la valeur est lié aux buts d'une organisation; ces derniers peuvent être exprimés à l'aide d'un modèle de but. La plupart du temps, des changements dans l'environnement de l'organisation induiront une redéfinition de ce modèle de buts qui se répercuteront également sur le modèle de valeur.

Ce mémoire examine le problème de l'alignement entre ces deux canevas de modélisation lors d'une (re)définition de l'organisation et son environnement. Afin de résoudre ce problème, cette étude propose une amélioration d'une méthode déjà existante issue de [4], basée sur un ensemble de gabarits (templates) et règles de transformations associées.

Le résultat produit par cette méthode est un modèle de valeur qui est conforme aux objectifs stratégiques de l'entreprise exprimés dans un modèle de buts de l'organisation. Ce travail contribue principalement à une amélioration de la syntaxe des gabarits et règles précédemment établies (tout en gardant un lien avec la sémantique originale), un meilleur support méthodologique pour les modélisateurs de buts et business, ainsi qu'une réduction des constructions implicites dans la production des résultats. Chacune des améliorations suggérées permet une réduction des erreurs possibles lors de l'application de la méthode ainsi qu'une plus grande précision du modèle de valeur obtenu. La validité de nos résultats est illustrée par l'application de la méthode sur une étude de cas.

Mots-clés:
modèle de but, i^*, modèle de valeur, e^{3}value, alignement de modèles, redéfinition d'une organisation.

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Chapter 1

Introduction

1.1 Context

In today's business world, the relationship between an organization and its environment appear more complex than ever before. One reason is maybe that the environment becomes more and more economically unpredictable, is extremely competitive often subject to frequent and fast changes. That makes management decisions for an organization more complex and more difficult. Moreover, the organization can face technological choices, from growing competition, and a life cycle of its products which becoming shorter and shorter. On one hand, the organization should be able to manage various distribution channels, elaborate supply chains, expensive technological implementations and strategic partnerships. On the other hand, it should ensure an essential flexibility and a good reactivity regarding to market changes. E-business is an illustrative example of this situation, in which the organization continually increases the number of involved actors, in order to stay competitive and innovative.

To be able to face this growing complexity, one solution is to use models that focus on different aspects. Therefore, models are designed at different levels to represent the organization in a structured way within its environment. With these models, it becomes possible to catch, communicate, analyze, scale, simulate and modify the environment of a particular organization. These models can be classified according to a layered view (with five layers).

The first one is the *strategic layer*. This layer can be represented by a goal model. Roughly, the goal model expresses the "why" of the organization. It clarifies the interests, the goals and the strategies of the different actors situated in its environment. Many frameworks can be used at this level to represent the strategic objectives, the needs, the goals, etc. to be achieved by the organization. For instance, at the strategic level there are different frameworks such as Tropos [7], KAOS [26], the Business Motivation Model (BMM) [30], $i^\star$ [31], and the SWOT Analysis [19].

The second layer is the *value model layer*. It can be represented by a business model (or value model). The business model describes the "what" of the organization. This kind of model represents the value propositions, the goods and services, the values exchanges, etc. between the actors. Some of the possible frameworks used to describe this level are Resource-Event-Agent (REA) [8], e^{3}value [12], e-Business Model Ontology (eBMO) [22], Weil-vitale [28].

The third layer is the *business process layer*. The models which take part in this layer represent the processus of an organization in a more detailed way than its upper layer. At this level some frameworks as Business Process Modelling Notation (BPMN) [29], and Business Process Modelling Languages (BPML) [6] can be used as frameworks to model the processes of the organization.

The layer below the business process layer represents the *IT needs layer*. This layer aims at representing the IT projects of the organization. Some modelling languages as the Unified Modeling Language (UML) [2] which allows software engineers to focus on the architecture and the design are used at this level.

The last layer of this layered view is the *IT structure* represented by the physical implementation of IT projects.

It is therefore possible to imagine how these five layers are linked. Each layer depends on its upper layer and is sensitive to its evolution. The problem is that changes often occur in the models due to modifications within the organization and its environment (e.g. some new strategic objectives, some new value exchanges, etc.).

Figure 1.1 depicts a relevant top-down view of the different layers. It represents how the organization deals with its environment (competitors, partners and clients) through the different views offered by different layers (strategic, value model, business process, IT needs, and IT structure). This figure shows how a modification in an upper layer will impact the layer situated below.

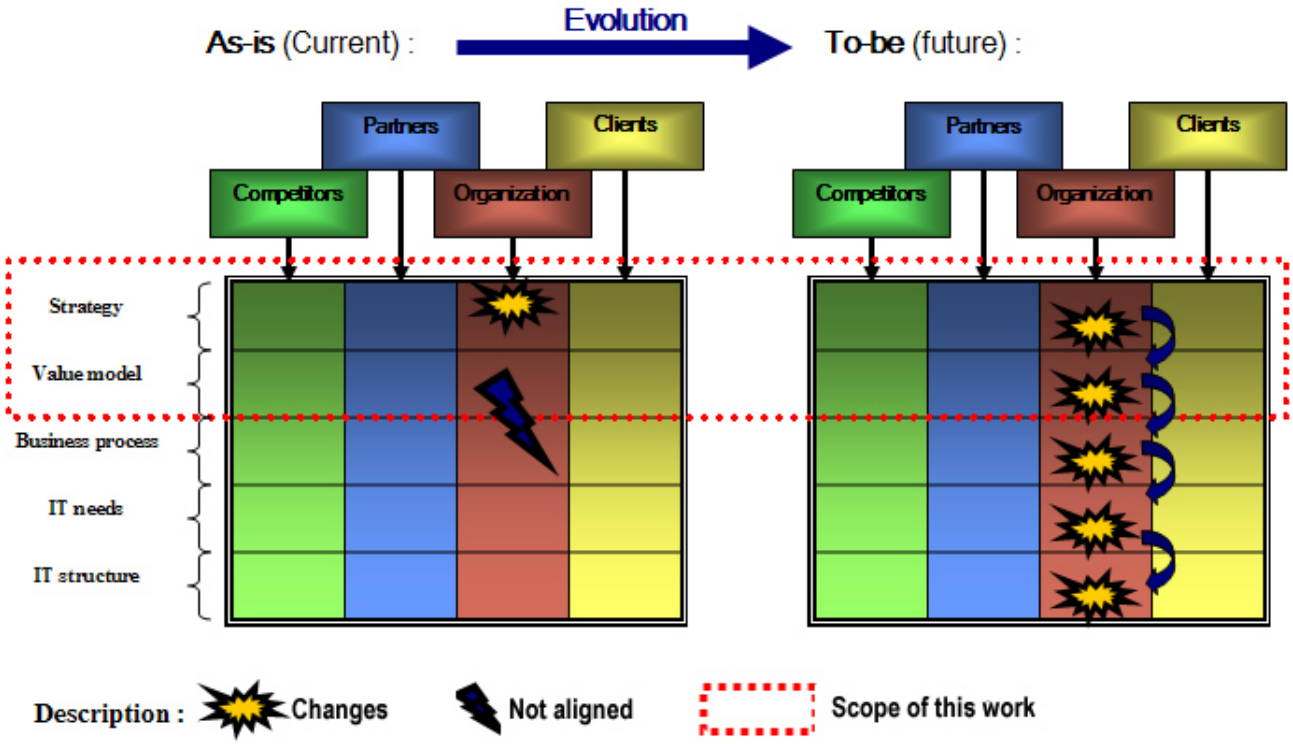


Figure 1.1: *Overview of the problematic (adapted from [17])*

Generally, IT-systems situated in the lowest layer are the materialization of the goals of the organization. Therefore, the issue is to reflect the changes which occur from a model situated in an upper layer to the different lower layers.

The amount of research and literature pointing out the importance of business and IT alignment is vast. Notable examples of approaches for alignment through model use can be found in [13], [23], and [25].

1.2 Purpose

The purpose of this thesis is to present a method for addressing the first part of the alignment problem between the goals of an organization and the IT-resources — *the alignment of a goal model with a value model*. This alignment problem of the two first layers is relevant because it is important that the value models match with the strategic objectives of the organization.

Generally, in the literature goal and business models are studied separately (e.g. i^* [31], e^3value [12], etc.). However, it seems important to make the link between both in order to be able to align them. It means that from a goal model, it should be possible to derive one business model which conforms to the strategic goals introduced in the goal model. It is therefore necessary to have a method to cope with changes which occur in the environment of the organization to keep these two models aligned.

The method suggested in this thesis relies on one of the approaches of the literature [4]. It consists of templates and rules based approach. Roughly, a template expresses a particular goal model component in terms of business model notions. A transformation rule is associated to a template and applies a particular transformation on the business model. Thus, to make the bridge between the strategic level and business level, a list of templates and their associated transformation rules have been created by [4]. Figure 1.2 gives an overview of this thesis purpose.

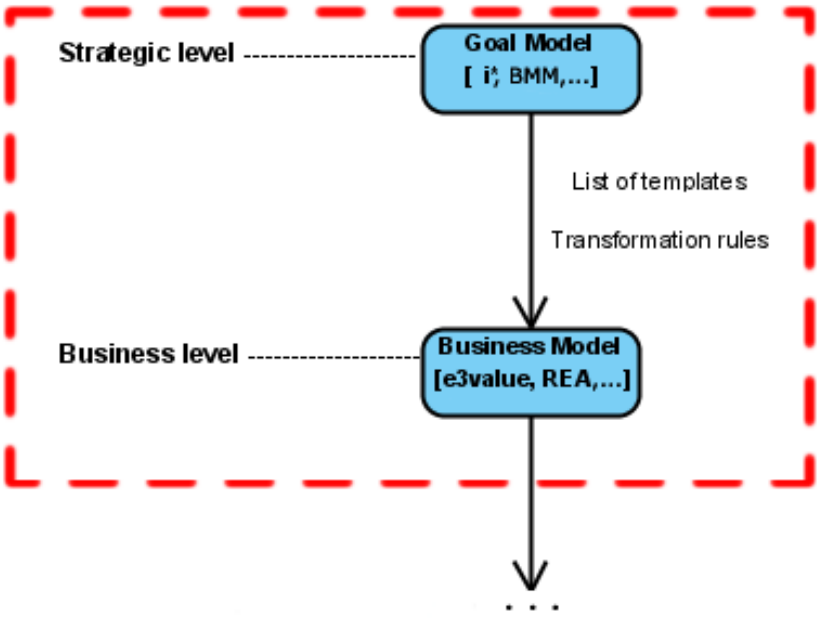


Figure 1.2: *Overview : goal model to business model*

1.3 Thesis Goals

Our theoretical investigations focus on the completeness of the method of [4]. In other words, we analyze the definition of each step, the formalism used in the templates and the rules (uniform and well founded syntax), the correctness of the results proposed as output of the method. The usability of the previous approach of [4] is also analyzed through a case study.

The different goals we will carry on in this thesis are the followings.

- Our first goal will be to analyze the method presented in [4] by highlighting the syntactical and non-syntactical issues in the templates and rules approach.
- Our second goal will be to propose several improvements and extensions on templates and rules to correct these issues.
- Our third goal will be to test the new method on a case study. In order to make a comparison of both methods application, the same case study as the one used in the previous work of [4] will be chosen.
- Our last goal will be to compare the different results and argue if the changes done in the method represent a real improvement and lead to more efficiency than in the old method.

The results we hope to produce through this work will not be limited only to education and scientific research. They could be used in the world of industry, with more templates and the development of tools in future work.

1.4 Scope

The scope of this work concerns the method we will propose. Further in this work, we will choose two modelling frameworks among those available at the first and second layer.

The first one is $i^\star$. It will be used for goal modelling. This decision has been made because this framework is widespread in the academic world. Another reason is that $i^\star$ has wealthier concepts than other frameworks (e.g. BMM).

The second one is e^3value. It will be used for the business modelling. This framework has been chosen because its concepts are more appropriate for business modelers. This is justified by the fact that some other frameworks (e.g. REA) are a subset of this one and do not allow to represent so many relevant concepts (e.g. value ports, interfaces, etc.). e3value seems also more appropriate for the application of a more formal transformation rules approach.

The use of these two particular frameworks will directly have an impact on the syntax of the templates and the rules. Following this idea, we will improve the templates and rules based approach by keeping it easy to understand and leaving it easy to complete in future work (or even to develop similar methods for other frameworks situated at the same level).

Figure 1.2 illustrates this idea. The dotted line shows the scope of this work. This figure has been adapted from [17] by showing the scope of our work (the two first layers), and by highlighting in bold the two frameworks used in our method.

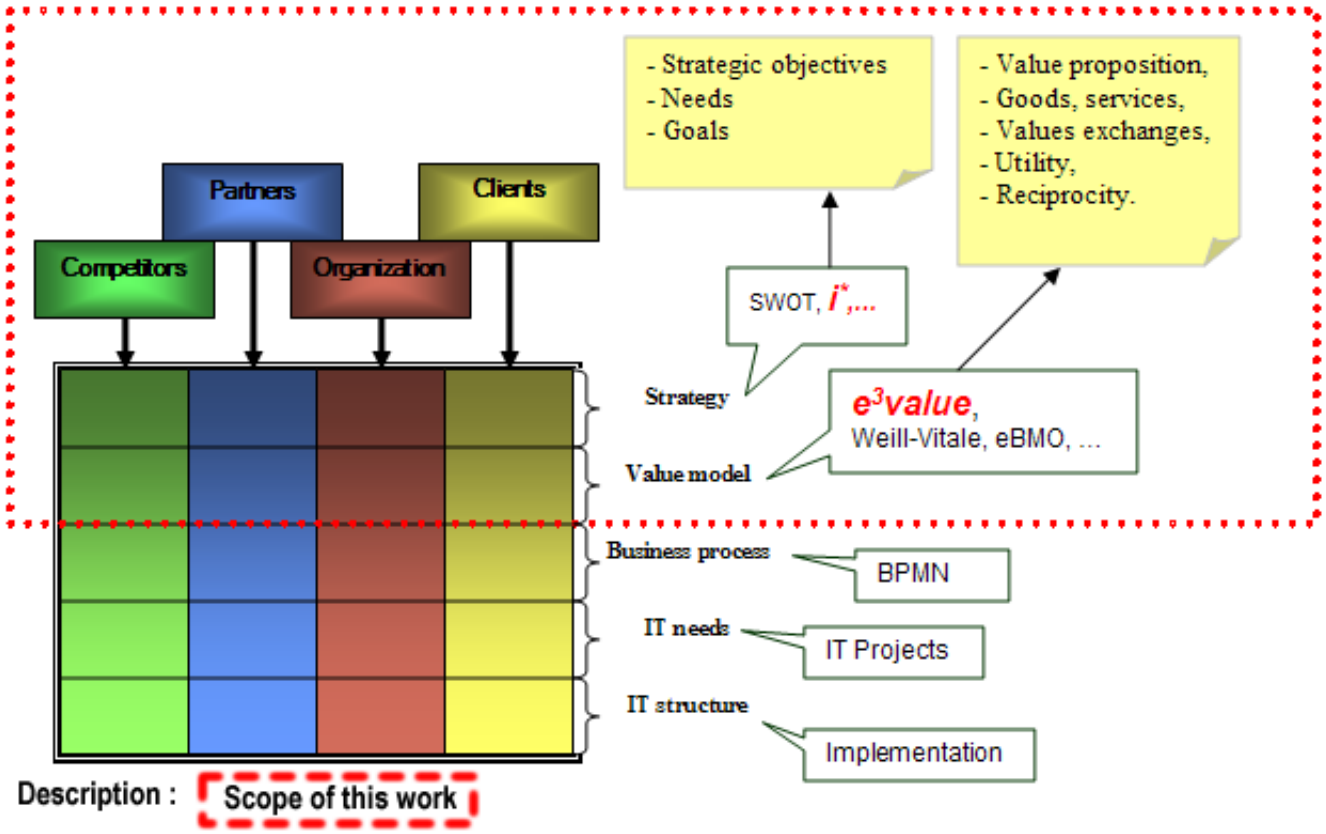


Figure 1.3: *Scope of our work (adapted from [17])*

1.5 Structure

The rest of this thesis is structured as follows:

Chapter 2 provides an overview of the frameworks used in a previous method of [4] by first introducing the frameworks used at the strategic level (BMM for the goal model representation) and at the value level (REA for business model representation). Then, it presents the frameworks used for the improvement in this thesis (i^* and e^3value). Finally, the method of [4] proposed for aligning goal and business models is detailed.

Chapter 3 analyzes and highlights issues in the method based on templates and rules [4]. From these issues, it suggests some solutions to improve the templates and the rules approach. Then, this chapter gives a summary of the improved method, its inputs and outputs. Finally, a discussion about the approach followed to improve the templates and the rules is made in this chapter.

Chapter 4 illustrates and validates the method proposed in this thesis by using the same real life business case study of a Massive Multiplayer Online Gaming (MMOG) company as in [4]. This chapter concludes with a comparison between the results produced by the improved method and the original method. This comparison shows that the improvements made in Chapter 3 are effective and give a better alignment between the goal and the business models.

Chapter 5 concludes this thesis by summarizing the results, indicating our contributions, and identifying future work for this research.

Chapter 2

Background

As expressed previously (see Fig. 1.3), the organization can be represented throughout different layers. For each layer, a kind of model can be associated (e.g. goal model, value model, etc.). For each kind of model, different frameworks can be used (e.g. i^*, e^{3}value, REA, BMM, etc.). Usually, the IT-systems of an organization (situated at the bottom of the Figure 1.3) are the materialization of the organization's business goals (situated at the top of the Figure 1.3). This is why, in a top-down approach, a huge number of organizations are clarifying their goals to make possible the alignment between their strategic objectives and their IT-systems.

In this thesis we address a part of the problem of alignment. This problem is the alignment between the two first layers: the strategic model and the business model. Therefore, it is only necessary to focus on them.

Usually, the goal models are used in the earliest phases of business and information systems design. Their utility is to make more comprehensible the interests and the strategic objectives of the different actors involved in the environment of the organization. Thus, this first layer is expressing the *"why ?"* of an organization.

Situated on the level just below, the business models are created to identify the actors and the values transferred between them. A business model focuses therefore on the *"what ?"* of the organization.

The purpose of this chapter is to present the state of the art in this domain. It aims to give the necessary information to get good basis of documentation related to our topic. Notice, that it do not aim to invent or create new things, but it only gives information about the concepts on which our method bases on.

The purpose of this thesis is the improvement of an existing method [4]. This method bases on two frameworks : Business Motivation Model (BMM) [30] and Resources-Events-Agent (REA) [15]. These two frameworks are necessary for the good comprehension of the approach. Therefore, they are explained respectively in the Sections 2.1 and 2.2.

This thesis improves and extends [4] in several ways (in Chapter 3), most notably in the amount of formalism used. These extensions are making use of two well known modelling techniques. For the goal model, i^* is used, and for the business model e^{3}value is used. Therefore, the Sections 2.3 and 2.4 are respectively introducing the essential notions of goal model and business model with their respective frameworks. Each framework is followed by an example and its meta-model.

Finally, Section 2.5 introduces the existing approach of [4]. In this section, the essential notions of "templates" and "rules" are explained. This section also shows how [4] aims to solve the problem of alignment.

2.1 Goal Modelling: Business Motivation Model (BMM)

2.1.1 Main Concepts

The Business Motivation Model is defined in [30] as providing *"a scheme or structure for developing, communicating, and managing business plans in an organized manner"*. Thus, BMM focuses on the business states and organization wishes to achieve, but also on the actions allowing the achievement of those states.
The BMM framework is build on three major concepts:

- **Ends**: An End is something the organization seeks to accomplish. However, it does not include any indications on how it will be achieved. This End expressed in terms of desired result is represented by a goal that the organization (or some part of it) intends to achieve. A goal is thus a qualitative general condition of the business that needs to be achieved or sustained. For instance, in an e-business company, a typical goal could be "get more customers than any other e-business".

- **Means**: *"A Means represents any device, capability, regime, technique, restriction, agency, instrument, or method that may be called upon, activated, or enforced to achieve Ends"* [30]. A Means indicates only the capabilities that can be exploited to achieve the desired Ends. For attaining the goal "have more customers than any other e-business", a Means could be "buy other e-business mailing lists". When a goal is highly abstract, it is a common practice to divide it into subgoals so that the Means stand at the bottom of the hierarchy.

- **Influencer**: An Influencer is anything that may produce an effect on the achievement of Means, and by extension, its related goal. Two kinds of Influencer can be distinguished. The Internal Influencers related to resources or infrastructure within the organization and the External Influencers related to customers, competitors, technology, etc. outside the organization. The impact of an Influencer on a Means (or goal) is considered as neutral until it has been assessed.

Notice that no meta-model is presented for BMM. The main reason is that the constructions of BMM will not directly be used. Instead of giving this meta-model, the constructions are explained by an example below. This example is extracted from [4].

Figure 2.1 depicts an excerpt of a goal model for a Massively Multiplayer Online Game scenario. This goal model represents the game provider point of view. The top goal is broken up into a hierarchy of subgoals and means. The means is a leaf node in the hierarchy. The means "Procure Innovative game stories from Customer" supports the fulfilling of the goal "Game shall be attractive". The influencer "Increase interest in playing Computer games" is assessed to provide an opportunity to obtain ideas of good games stories from players.

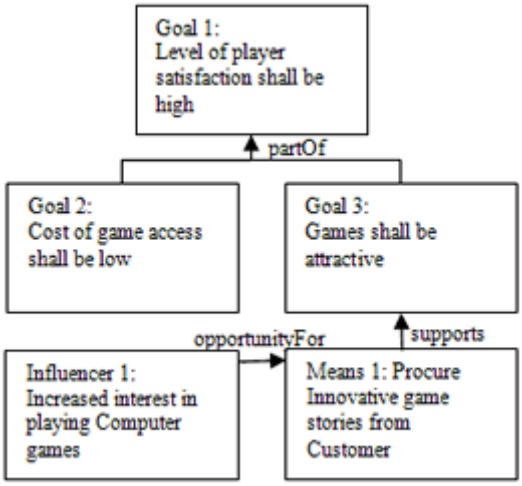


Figure 2.1: *Illustration of a goal model in BMM framework (Source : [4])*

2.2 Business Modelling: Resource-Event-Agent (REA)

2.2.1 Main Concepts

Originally proposed in 1982 by William E. McCarthy, the Resource-Event-Agent (REA) framework consists of a stereotypical representation of an exchange.

The REA framework uses a kind of accounting system to represent the actual business. For this reason, exchanges can be considered similarly as economic phenomenons: *"In a sense, the economic activities of an entity are a sequence of exchanges of resources - the process of giving up some resources to obtain others. Therefore, we have to not only keep track of increases and decreases in the resources that are under the control of the entity but also identify and record which resources were exchanged for which others."* [8].

The core concept of this framework is based on three primitives : the requited events (e.g. business transactions, agreements that affect the resources), the resources that are subject of the exchanges (e.g. goods, time, cash, services, etc.), and the participating agents (e.g. people, companies, etc.).

Normally, a pair of events are linked by a relation (duality). This relation represents an "exchange". Two kinds of duality exchanges which lead to two types of duality are distinguished : the transformation and the transfer. The difference between them is that the transformation duality is creating value between agents, while the the transfer duality is creating value trough the change of a resource.

Usually, a REA exchanges pattern is expressed as objects and relationships with Unified Modeling Language (UML) notation. Figure 2.2 illustrates a REA exchange.

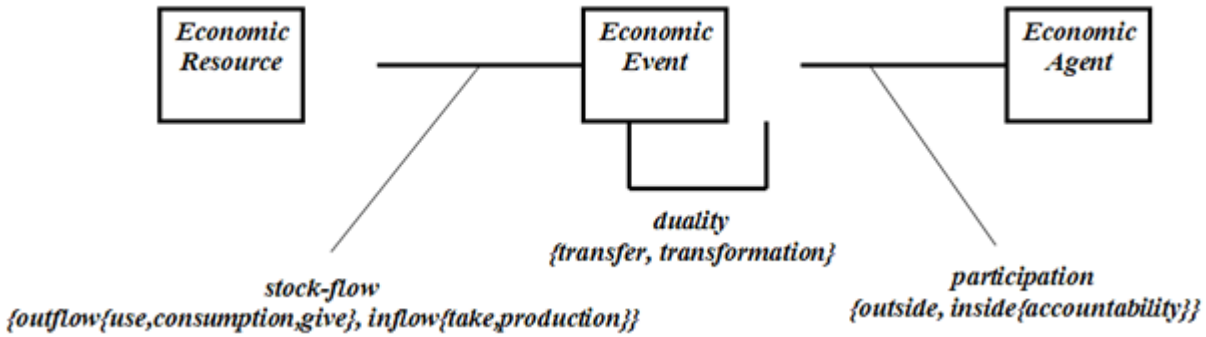


Figure 2.2: *UML illustration of a REA exchange (Source: [8])*

In [8], the authors give the following meaning to this example: "... **Stock-flow relationships** describe the connection between Economic Resources and Economic Events. Figure 1 [here Figure 2.2] differentiates among five different types of stock-flow relationships: *use, consumption, give, take* and *production*. An economic event results in either an inflow or an outflow of resources. Inflows and outflows are further specialized depending on the nature of the duality relationship. For an exchange relationship we *give* up a resource (finished good) to *take* another resource (cash). During a transformation we either *use* or *consume* a resource to *produce* another resource. When resources are used, they often completely disappear in the transformation process and lose their form so as to be unrecognizable. When resources are consumed, they are decremented in chunks that leave the original form discernible (Black and Black 1929, p. 30). It is important to note that the same resource can participate in many different types of stock-flow relationships. For example, a machine is first acquired (take), then employed in production (consumed), and finally sold (give)...

The **participation relationship** describes the agents involved in an Economic Event. Inside and outside are two different subtypes of this relationship representing the two roles of Agents in the participation relationship. The same agent (person) can be an inside agent (employee) for one event and an outside agent (customer) for another event. We consider accountability as a specific subtype of the inside relationship. An accountability relationship records the (inside) agent responsible for the event..."[8].

The Figure 2.3 is an example of business model in the REA framework. Note that this figure is extract from [4]. This figure will be used later in thesis in the case study (see Chapter 4). In this model, the syntactical elements must be read like this :

- Economic agents: rectangles
- Economic resources: ovals
- Economic events (Exchanges): diamonds with "E" inside
- Economic events (Conversions): diamonds with "C" inside (this relation is reflexive on an agent)

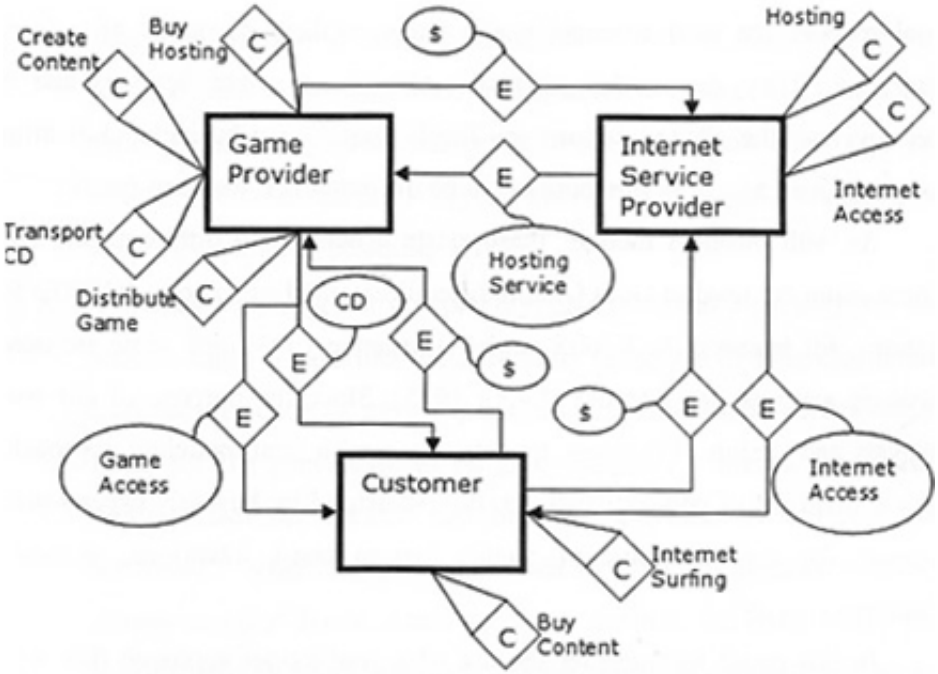


Figure 2.3: *Example of business model with REA (Source: [4]).*

The business model of Figure 2.3 contains three actors : a game provider, a customer, and an Internet Service Provider (ISP). This figure can be interpreted as follows :

Game provider:

- **Buy hosting:** this actor needs to host the game on a web server.
- **Create content:** this actor needs to create the content for the game (maps, characters,. . .)
- **Distribute game**: this actor needs to distribute the content (game software and game access) to customer.
- **Transport CD:** this actor needs to give the CD client-side application to his customer.
- **CD (good):** this CD contains the client-side application for the customer.
- **Game access (service):** the game access is required to access to game server (usually for one month).
- **Money (good):** the payment for the CD and the game access.

Customer: this is the actor who wants to play to the MMOG game.

- **Buy content:** the customer needs to buy content for his character.
- **Buy game subscription:** the customer buys a period of time for accessing the game server.
- **Internet surfing:** the customer has to get an internet connection to communicate with other players and be able to connect to the game server.

ISP: this is the Internet service provider who provides hosting service to the game provider and internet access to the customer.

- **Hosting:** the internet provider sells service which allow company to store online data.
- **Internet access (service):** the ISP sells internet access.
- **Internet access (good):** the internet access allows the customer to get an internet connection and surf on the web.

2.2.2 Meta-model

Figure 2.4 is the meta-model of the REA framework suggested in [20].

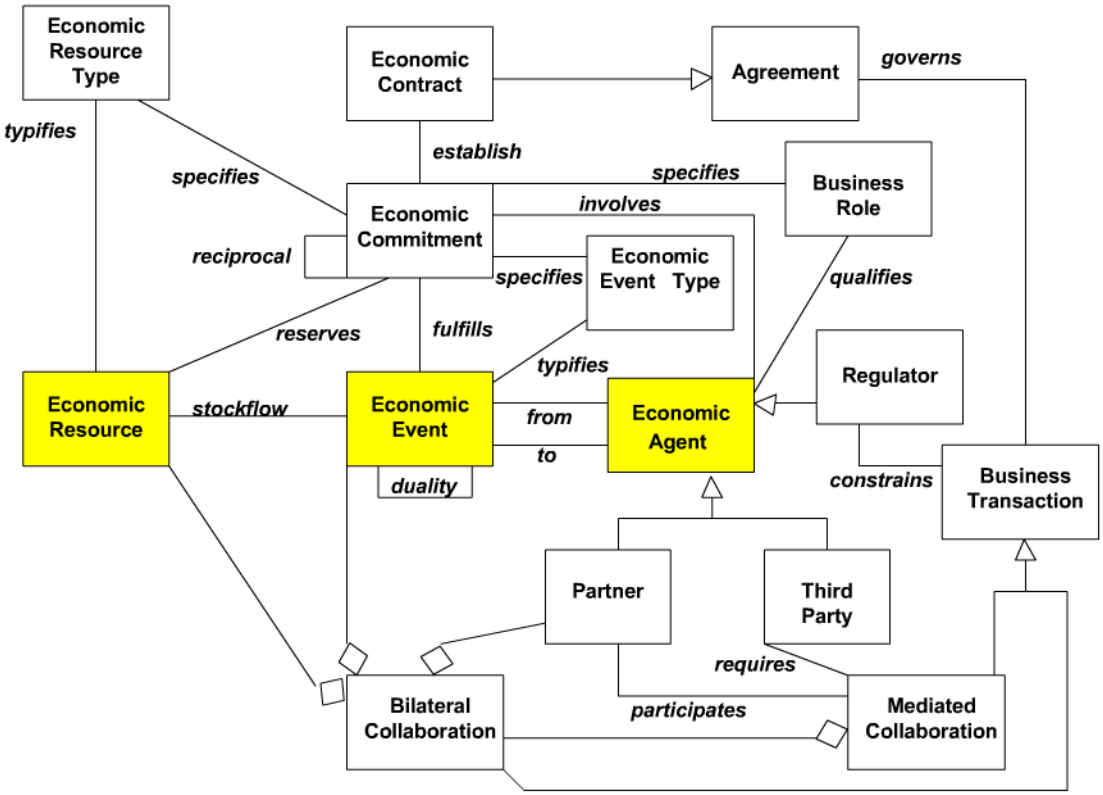


Figure 2.4: *The REA meta-model (Source: [20])*

2.3 Goal Modelling: *i**

2.3.1 Main Concepts

$i^\star$ is an actor and goal oriented modelling framework used at the strategic layer. This framework do not answer to the ”what” but rather to the “who” and “why” questions of a business. This framework expresses the strategic interests of an organization, and the actors situated in its environment. It is also used to describe the strategic dependencies between the actors.

The main purpose of this framework is to define the “goals” of different actors. By goal, we means a “*condition or state of affair which should be achieved by an actor*” [14]. In this framework,

the actors are "strategic" they depend on each other to obtain some resources and perform some tasks to achieve their goals.

$i^\star$ allows the creation of two types of models: the Strategic Dependency Model (SDM) and the Rational Dependency Model (RDM). The first one focuses on the main dependencies between actors, while the second describes the reasoning of the actor about achievement of its goals.

Thus, the main concepts of this framework are "goals", "tasks", "resources", "soft-goals". The different types of dependencies are dependencies such as "goal dependencies", "task dependencies", "resource dependencies", "soft-goal dependencies", or "actor association link".

Further in this work, $i^\star$ is used as ontology to represent the goal models. In the previous method [4], the BMM framework is applied instead of this one. The motivation for using $i^\star$ is based on two arguments. On one hand, $i^\star$ is widely spread at academic level. The advantages links to this fact are : well build tools available, help support etc. On the other hand, $i^\star$ has a lot of wealthy concepts which allow to get a better overall view on actors environment and relations. These elements let many possibilities to extend the method suggested in this thesis in the future work. These arguments explain why $i^\star$ is more relevant in this thesis for modelling the strategic layer.

The rest of this section gives an interesting example to associate the concepts of this framework with elements of an organization.

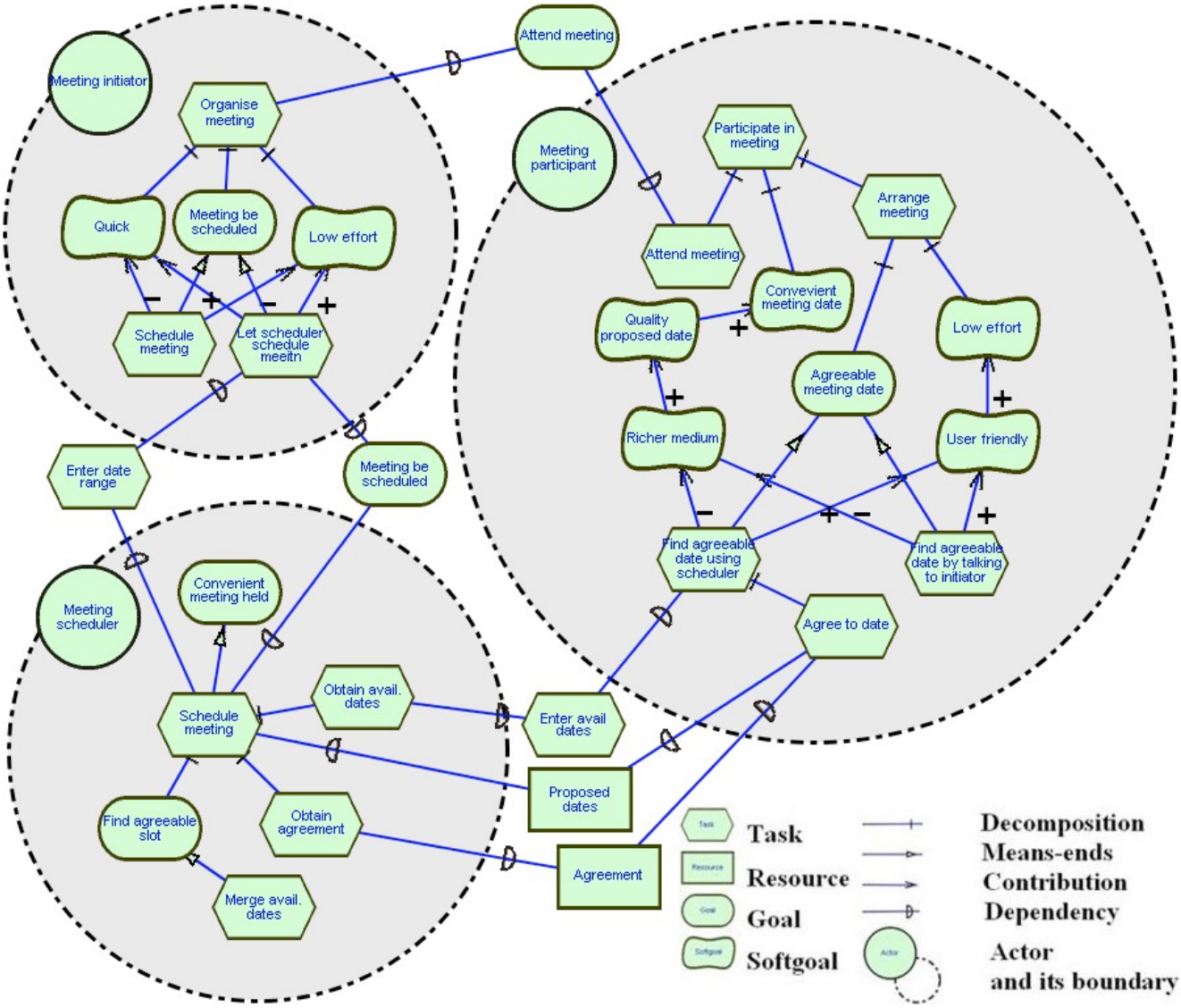


Figure 2.5: *Example of $i^\star$ concepts (Source: [31])*

Figure 2.5 is a meeting scheduling example. On it, we can find most of the concepts listed previously. We can see that the task of the meeting scheduler (actor) is to schedule meeting (task). This task is a way to achieve that a convenient meeting be held (goal). Therefore, the link from the task to the goal is a means-ends link. Scheduling a meeting is decomposed in three different mandatory elements (find an agreeable slot, obtain agreement, obtain available dates) by decomposition links.

It also appears on the figure that the meeting scheduler (as depender) depends on the meeting initiator (as dependee) to enter a date range for the meeting (dependum). In the limits of its boundary, the fact that the meeting initiator lets the schedule of the meeting to another actor (meeting scheduler) helps at the same time to organize quicker and with low effort the meeting. These are two quality goals (or soft-goals). We can also find two resources between the meeting scheduler and a meeting participant: a list of proposed dates (physical or informational entity) and an agreement (informational entity).

All of the concepts proposed by $i^\star$ are not present in this example (e.g. beliefs, role, position,

etc.). It is explained by the fact that these are less used in $i^\star$ modeling and it is hard to find a fully detailed example containing all the concepts at once. Moreover, these other concepts are not relevant in the method of alignment. You can refer to [31] and [32] for more examples. Appendix B also presents a summary of the syntax and the semantic of the constructions illustrated by examples.

2.3.2 Meta-models

These meta-models are introduced in [31]. Figures 2.6 and 2.7 respectively represent the Strategic Dependency Model (SDM) and the Rational Dependency Model (RDM) suggested in [31].

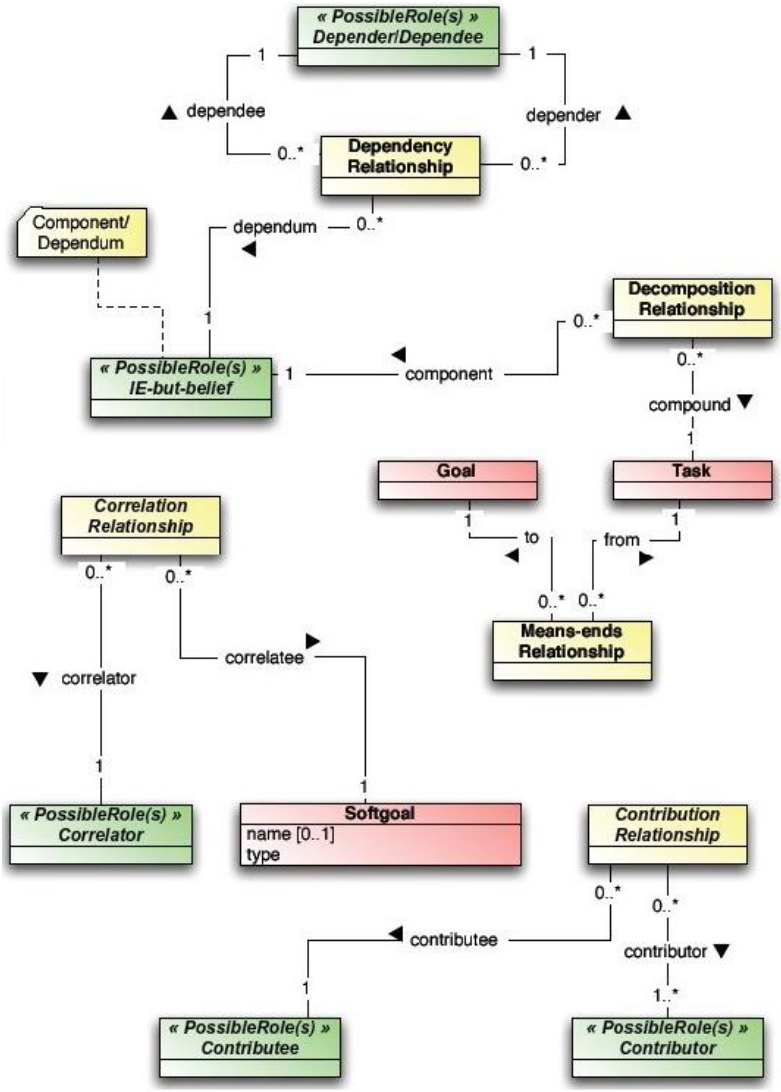


Figure 2.6: *The i* Strategic Dependency Model (SDM) meta-model (Source: [31])*

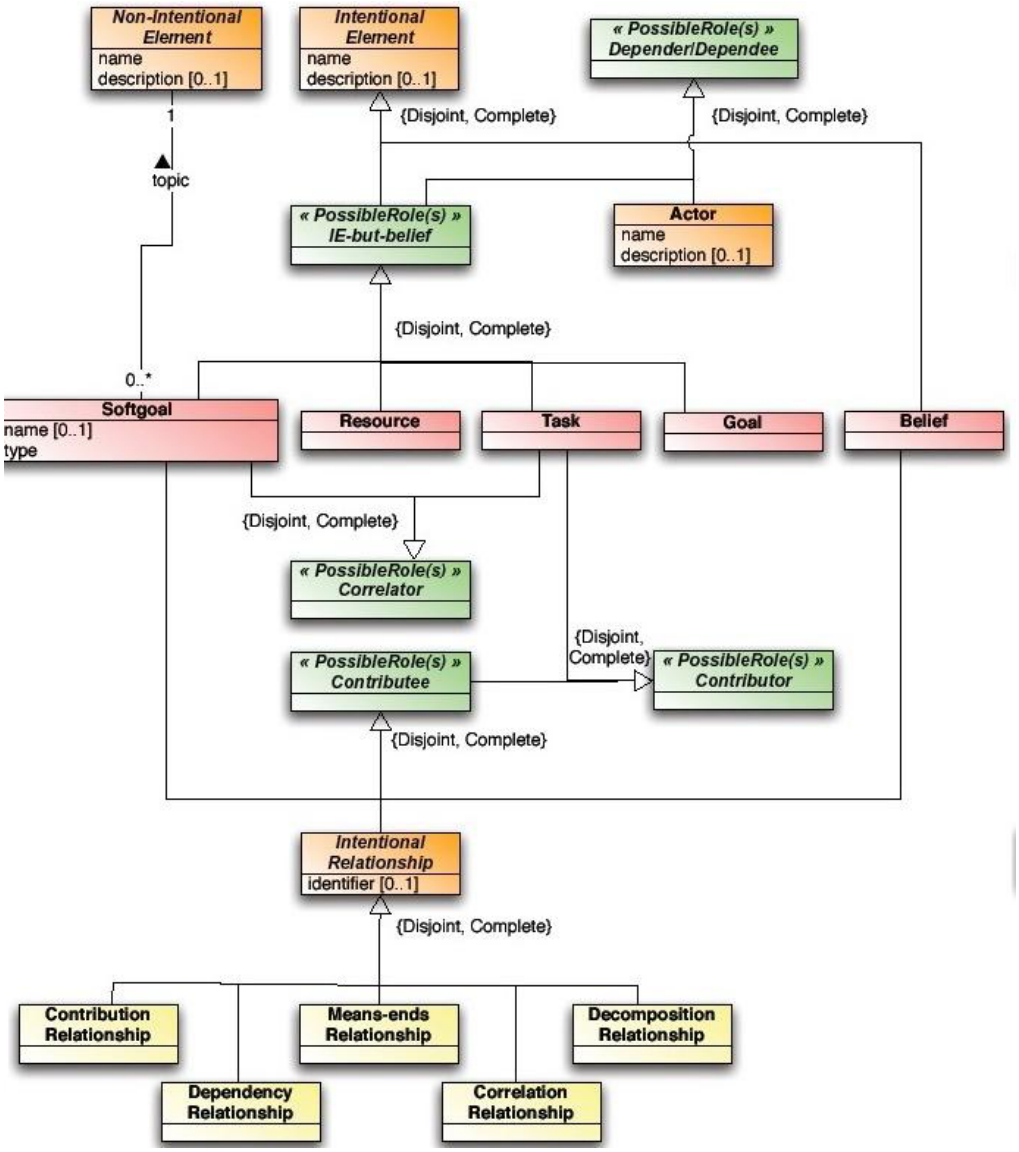


Figure 2.7: *The i* Strategic Rationale Model (SRM) meta-model (Source: [31])*

2.4 Business Modelling: e^{3}value

2.4.1 Main Concepts

Attracted by the potential of recent technologies (as well as the new communication links) many projects located in the field of the e-business were started during this last decade. A general observation is that an original idea is not always enough to make its economic activity profitable. One consequence of this observation is that the number of startups which badly developed (or did not survive) is rather consequent [10].

Regarding to these startups, the principal reason of this bad development is that the leaders probably do not have a good vision of their organization. Therefore, they had no ideas about how to develop effectively. This lack of information could become risky when there is a huge number

of participants involved in various value exchanged. Actually, without this good comprehension of their business, it was nearly impossible for them to reach a profitability (and this perhaps even before they put their ideas in action...).

It is mainly to fill this lack of information (or an erroneous vision) that the "e^3value" methodology has been designed. With "e^3value" the managers become able to explore, to analyze, and to evaluate the current organization or its possible perspectives some innovative ideas [10].

This methodology introduces the concept of "value object" and allows to count the expenses and the incomes. In this way, it can be estimated (among other things) the future profits of the organization by holding account of the inflation of the prices and the competition growth. Many advantages of this method have contributed to use it widely for the modeling of business situated in the e-commerce field [10].

The main concepts of this framework is the concept of "actor". An actor is an independent economic entity which wants to increase profit and/or utility. Each actor can exchanges "value objects". These objects are goods or services which represent a value for one of the actors. Inside each actor there are some "value activities". These activities are modelling "what an actor offers to (or requests from) his environment". The connections between a value activity and actor are done thanks to "interfaces" which are groups of ingoing and outgoing value offering. Inside an interface there are some "in-ports" or "out-ports". These ports represent an abstraction of the business processes in order to focus on the direction of the value object exchanged. Inside an actor, it is also possible to have a "path" between the interfaces. This path can use XOR, AND, OR, JOIN and FORK connections.

The rest of this subsection is a short example which helps to understand the main concepts enounced above. Notice that, more details about the syntax and the semantic of e^3value are given with more illustrated examples in Appendix C. You can also refer to [12] for more information about this framework.

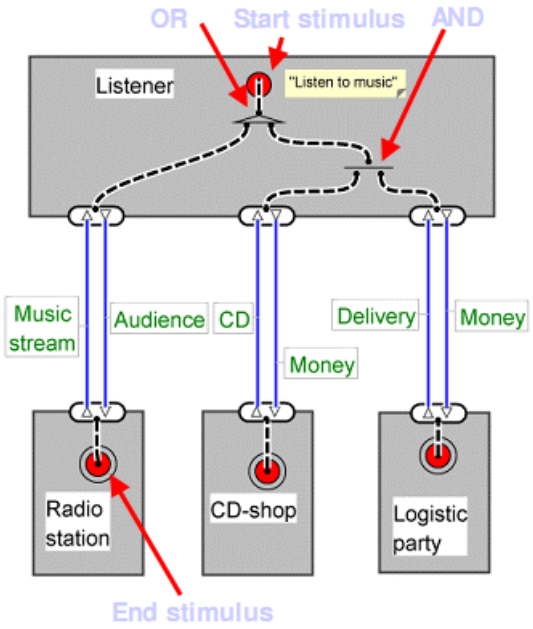


Figure 2.8: *Example of e^3value concepts (Source: [9])*

There are four actors on Figure 2.8 : the listener, radio station, cd-shop, and logistic party.

The listener can be considered as the main actor. There are several value objects on this figure: music stream, audience, CD, money and delivery. A post-it (which is an informal notation) expresses what the actor "listener" is looking for: "listen to music". A path is visible inside this actor listener. This path shows the possible ways for the listener to get value objects from the two others actors. There are different ways to get some music.

- From the radio station : the listener gets a music stream and gives audience in exchange of the value received.
- From the CD-shop and the logistic party :
  1. the listener gives some money to the CD-shop and get a CD in exchange.
  2. the listener gives some money to the logistic party which provides the service of delivery.

The reader should notice that a business model is different from the process model [12]. The process model is situated on the layer below the value layer (see Fig. 1.1). In [5], the authors explain this distinction as follows : *"A business model is different from a process model, as a process model captures other kinds of relations between actors than those of a business model. For instance, a process model may contain information about time ordering between activities or flows of goods between actors".*

2.4.2 Meta-model

Figure 2.9 is the UML meta-model for this framework. This figure is extracted from [11]. In [11], the figure is commented as follows : *"Concepts and relations of the e3-value ontology for value models in e-commerce. Rectangles are concepts, related by associations (lines). Concepts play a role in an association. Also, cardinality constraints are expressed. For instance, the association between actor and value interfaces reads: a value interface is assigned to zero or one actor, and, an actor has one or more value interfaces"* [11].

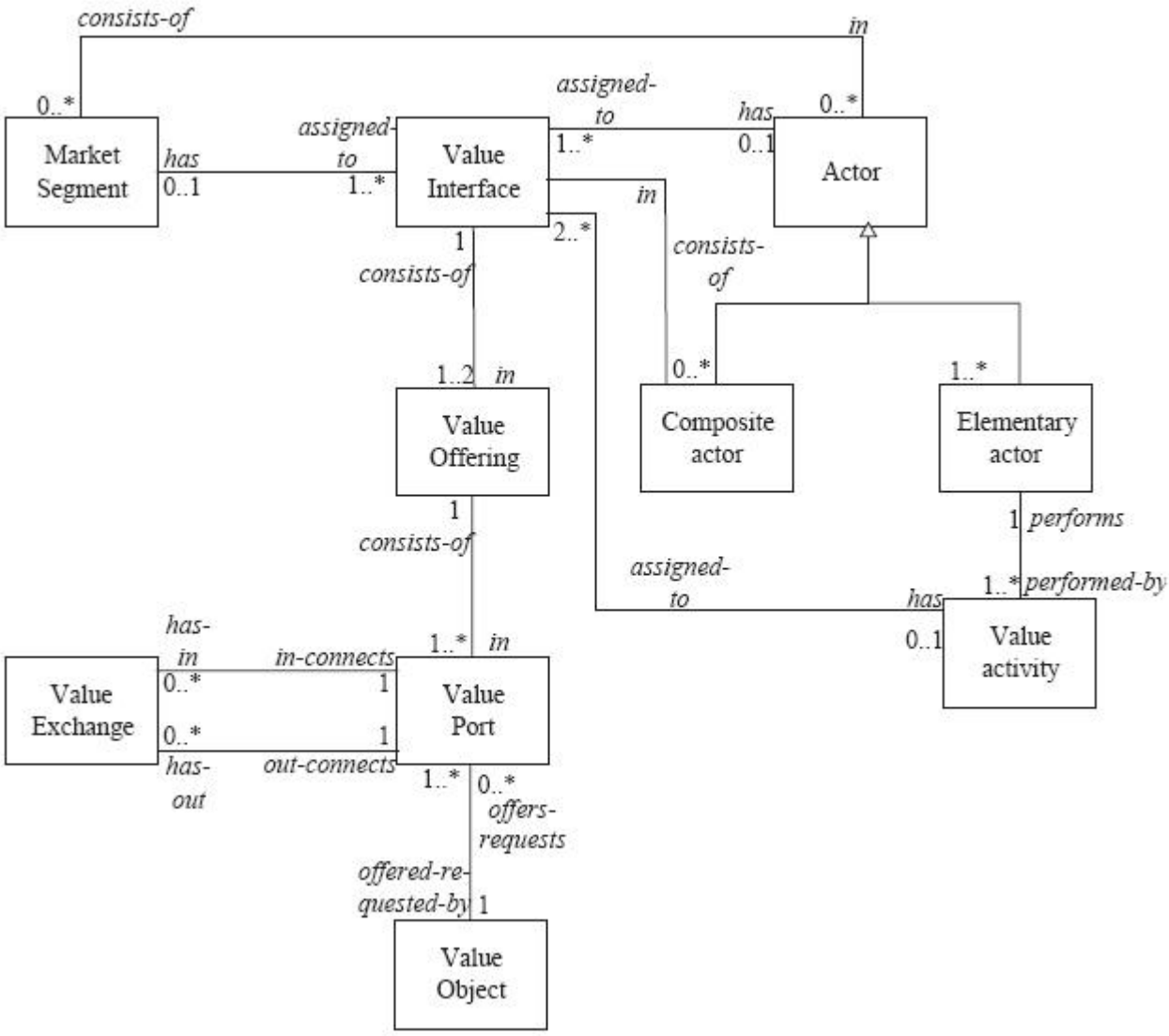


Figure 2.9: *The e^3-value meta-model (Source: [11])*

2.5 A Templates and Rules Approach for Goal and Value Models Alignment

There are few existing papers related to the problem of alignment between the goal and the value models. One interesting method is the approach of [4]. The main idea of this paper is that the core of the business model can be found in the objectives of its organization. These objectives can be written explicitly in the goal model.

The purpose of this paper is to construct a business model taking in account the explicit goals of an organization stated in its goal model. When all of the goal stated in the goal model of an organization are taken in account in its business model, we can say that the two models are aligned. Considering the fact that the method should base on some notions such as actors, resources, exchanges, etc., the authors propose to use concepts which are close from the established Resource-Event-Agent (REA) ontology.

At the opposite, usually, it could exist an unalignment between the goal and the business models. It means that the business model is not taking in account the strategic objectives. This could append when the organization decides to change some objectives (for example : outsourcing the production of a resource, start procuring a resource from an other agent, etc.). Most of the time, this problem of unalignment appears because of misunderstandings between the business modeler and goal modeler. Moreover, it is not always easy to produce aligned models because it exists a gap between the goal model and the business model notations.

For reducing this gap between goal and business models, [4] proposes to use some business model notions for expressing goal models components through "templates". As written in [4], a template is composed of an event, a resource, and an agent forming a triplet with the syntax: <`Event, Resource, Agent`>. Hence, the templates help to know how to produce an aligned business model by taking them as input.

The term "means template" is also used in [4]. It relates to the notion of "means" which can be associated to a capacity (often a task) for achieving a goal in a goal model. The idea is that, most of the time, a relation *"help to satisfy"* will be present between a means and a goal in the goal model. In [4], a set of nine templates is proposed to express those means in terms of business model notions.

Some syntactical elements are used to structure the templates: *italic terms* are used to show which terms can be instantiate, the "and" has the same interpretation as in logic, and the "vertical bar" shows the exclusive alternatives. The parenthesis are used for grouping alternatives, and the square brackets are used to separate two parts within the template called : "compulsory part" and "optional part". These elements are summarized in Figure 2.10.

"`[ ... ]`" delimitates the optional part of the template.

"`( ... )`" is used for grouping alternatives.

"`|`" represents a logical XOR interpretation.

"`AND`" represents a combination of parts that must all be present in the means.

italic words are goal model terms when formulating the means.

Figure 2.10: *Semantic of the syntactical elements in the existing method [4]*

Each template is divided in one "compulsory part" and one "optional part". The first part of a template (the compulsory) expresses what this template aims to do. Some examples of compulsory parts are "`offer resource to agent`", "`stop producing resource in conversion event`[1]". The compulsory part of this first example means that an organization wants to offer a resource to another agent. The secondary example expresses the fact that the organization stops the production of a resource in one of its conversion event.

The second part (the optional) expresses the different possibilities to satisfy the compulsory part. This part is denoted as "optional" because the way to solve the compulsory part is not always known by the goal modeler. Actually, this information is not always evinced in the goal model. The reason is that the goal modeler do not always know how to fill in this part. In this case, it is the business modeler who will complement this part. Figure 2.11 is an illustration of an optional part associated to a template where the compulsory part is "`offer resource to`

[1] A "`conversion event`" in REA ontology can be considered as a synonym of "value activity"

agent"[2]. This compulsory part leads to three different possibilities to offer a resource to an agent:

1. The organization can produce this resource in a new conversion event
2. The organization can produce it in an existing conversion event
3. The organization can procure it from another organization

These possibilities are situated in the optional part of this template, and are expressed as in Figure 2.11.

```
[AND (start using conversion event | start producing resource
| start procuring resource from agent)] [ AND receive resource from agent]
```

Figure 2.11: *Example of a template optional part (offer resource to agent)*

Another concept of this approach is the notion of "rules". The rule is the term used to denote the part of the method to construct the aligned business model based on the goal model and the templates. Thus, the transformation rules are applied to transform an "as-is" business model into a "to-be" business model. There is a "one-to-one relation" between a means template and its transformation rule. A rule explains how the associated template will influence the business model. Notice that the optional part associated to the compulsory part of each template must be filled in by the business modeler before applying the associated transformation rule. The elements contained in the rules can be sorted in three groups. From each group, some effects can be introduced in the business model:

- the *introduction* of new business model component
  (e.g. if the organization produces a resource x)
- the *deletion* of business model component
  (e.g. if the organization stops producing a resource y)
- the *change* at the process level. However, this is not visible on the to-be business[3] model
  (e.g. if the organization increases production of resource z)

A transformation rule is divided in two parts: a primary action and a secondary action. There is no explanation about the choice of the term "action" in [4]. However, we can assume that the authors have chosen this term to describe that these parts of the rule will make some actions in order to transform the business model.

The first one (primary action) is directly related to the compulsory part of the associated template. It introduces on the business model the purpose of the means template. For instance, the primary action associated to the compulsory part : `procure resource from agent` will draw on the business model the value exchange between two actors which are exchanging a resource.

The second part (secondary action) is related to the optional part of the associated template. It introduces on the business model the consequences of the compulsory part. By "consequences",

[2]Notice that, in this thesis, the compulsory part of a template is use as key term for identifying a template.
[3]Notice that this approach do not takes in account the quantification part of e[3]value.

we mean the changes that must appear on the business model to satisfy the purpose of the template. For example, the consequence stated in the optional part of the template `procure` *`resource`* `from` *`agent`* is the introduction of either the elements for using the resource the organization has procured in a value activity, or the elements for offering the resource the organization has procured. Another consequence is that it will also add some elements on the business model in order to offer a compensation for the resource the organization has just received. Figure 2.12 is the complete rule of [4] for the template `procure` *`resource`* `from` *`agent`*.

(Compulsory part)
`procure resource from agent`
(Optional part)
[AND (start using *resource* in *conversion event* | offer *resource* to *agent*) AND provide *resource* to *agent*]
(Associated rule)
Primary action:

a. Add a new exchange event for the resource from the agent to the principal agent.

Secondary action:

a. Connect a new exchange event to an existing or new conversion event.

b. Add a new exchange event from the principal agent to a new or existing agent to whom the resource is offered;

Figure 2.12: *Example of a rule associated to a template (procure* resource *from* agent*)*

This approach also introduces two important notions: the "as-is business model" and the "to-be business model". The first one (as-is business model) presents the current situation of the organization at the business level. The second one (to-be business model) relates to the business model produced in output of the method which is aligned with the goals situated in the goal model of the organization.

Figure 2.13 summarizes the relations between the different elements mentioned before in this section. It also gives an overview of the method of [4]. The idea proposed by [4] is to take as input an as-is business model (in the REA framework) and a goal model (in the BMM framework), and produce (by templates an transformation rules) a to-be business model (in the REA framework) conforming to the goal model.

The method is divided in two steps. At first, it is the goal modeler's responsibility to formulate the means according to the means templates. Then, he constructs a goal model with the means templates. In the second step, it is the business modeler's responsibility to complement each means by filling in the optional parts of its templates if needed. Then, for each means, he has to apply the transformation rules on the as-is business model. Hence, the method ensures that the to-be business model produced as output is aligned with the goal model.

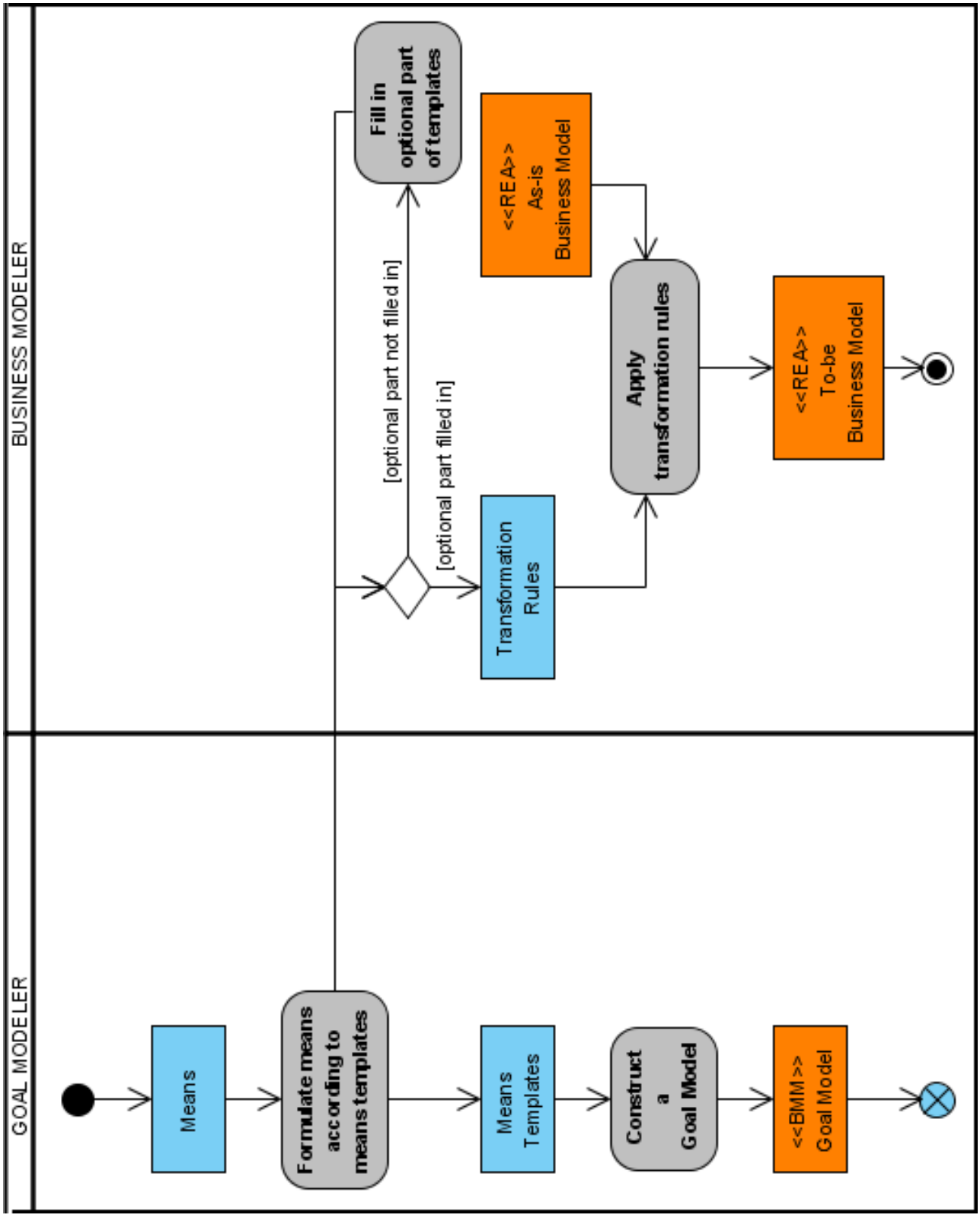


Figure 2.13: *How [4] aligns a goal model with a business model.*

The rest of this section presents the set of templates introduced in [4]. The nine templates are attended with their respective semantic. The transformation rules are also given. Notice that only five transformation rules corresponding to the templates 1, 2, 3, 4 and 9 have been defined in [4]. This was due to space restriction in their paper.

List of templates and corresponding transformation rules in [4]:

1. `offer` *`resource`* `to` *`agent`*
   [AND (start using *conversion event* | start producing *resource* | start procuring *resource* from *agent*)] [AND receive *resource* from *agent*]

   a) Semantic: *"This template addresses the business activity of exchanging economic resources between agents. The compulsory part deals with the exchange event providing an economic resource to an agent. The first optional part addresses the origin of the resource and offers three alternatives: through an existing conversion event, through the initiation of a new conversion event in the principal agent to produce the resource, or through an exchange event that involves another agent. The second optional part specifies what economic resource is exchanged as a compensation for the resource provided by the principal agent."*

   b) Primary action: Add one exchange event for the resource from the principal agent to an existing or new agent in an existing or new duality.

   c) Secondary action:

   a. Connect the new exchange event to a new conversion event, or

   b. Connect the new exchange event to an existing conversion event, or

   c. Add a new exchange event from the principal agent to a new or existing agent from whom the resource is procured; and

   d. Add a new exchange event for receiving a resource from agent to the principal agent as a compensation for the resource offered by the principal agent.

2. `stop offering` *`resource`* `to` *`agent`*
   [AND (stop procuring *resource* from *agent* | stop producing *resource*)]

   a) Semantic:*"This template addresses the issue of ceasing to provide a certain resource. The optional part of the template has an effect only if the principal agent stops offering the resource to every agent. 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 agent."*

   b) Primary action: Delete the exchange event that concerns the transfer of the resource from the principal agent.

   c) Secondary action:

   a. Delete the exchange events related to the procurement of the resource, or

   b. Delete the conversion events producing the resource.

3. `procure` *`resource`* `from` *`agent`*
   [AND (start using *resource* in *conversion event* | offer *resource* to *agent*) AND provide *resource* to *agent*]

   a) Semantic:*"The compulsory part in this template is related to the procurement of a resource by the principal agent from another agent. The optional part describes the possible effects of the procurement of the resource. The resource procured may be used as an input for the production of a certain resource or it may be offered directly to the principal agent's customers."*

b) Primary action: Add a new exchange event for the resource from the agent to the principal agent.
c) Secondary action:
a. Connect a new exchange event to an existing or new conversion event.
b. Add a new exchange event from the principal agent to a new or existing agent to whom the resource is offered.

4. `stop procuring resource from agent`
[AND (stop offering *resource* to *agent* | start producing *resource* in *conversion event*)]

a) Semantic:*"This template addresses the issue of stopping the procurement of a resource from another agent. The possible effects of this is that the principal agent may have to start the production of the resource himself in order to be able to continue providing the resource to his customers or he may have to stop offering that resource. However , the optional part depends on whether the principal agent stops procuring the resource from all possible supplying agents or not. Depending on that, one of the alternatives in the optional part is chosen."*
b) Primary action: Delete the duality with the exchange event that concerns the transfer of the resource from agent to the principal agent.
c) Secondary action:
a. Delete the exchange event related to providing the resource to agent (in case of discontinuing the provisioning), or
b. Add a new conversion event in the principal agent to produce the resource (in case the provisioning of the resource continues).

5. `start producing` *`resource`* `in` *`conversion event`*
[AND start offering *resource* to *agent*]

a) Semantic: *"This template states that if the production of a resource is started then it must be offered to some agent."*
b) Transformation rules: not defined in [4].

6. `stop producing` *`resource`* `in` *`conversion event`*
[AND (start procuring *resource* from *agent* | stop offering *resource*)]

a) Semantic: *"The compulsory part in this template deals with the issue of stopping the product ion of a resource. The optional part describes possible consequences of this. The first option is to start procuring the resource in order to offer it to other agents. The other option is to stop offering the resource altogether."*
b) Transformation rules: not defined in [4].

7. `(increase | decrease) production of` *`resource`* `in` *`conversion event`*

a) Semantic:*"This template deals with the increment or decrement of the production of a resource. This is usually a percentage difference in production capacity. Means of this kind has normally no structural effect on the business model."*
b) Transformation rules: not defined in [4].

8. `insource production of` *`resource`* `in` *`conversion event`*
[AND (start | increase) producing *resource* AND stop procuring *resource* from *agent*]

a) Semantic:*"The compulsory part of this template takes care of the situation where the*

production of a resource is being insourced. If the production is insourced, then it will lead either to an increase of the production in an existing conversion event or to the introduction of a new conversion event to produce the resource."

b) Transformation rules: not defined in [4].

9. `outsource [fraction of] production of` *`resource`* `in` *`conversion event`*
[AND (stop | decrease fraction of) production of *resource* AND start procuring *resource* from *agent* AND start providing *resource* to *agent*]

a) Semantic:*"The compulsory part of 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 of the resource in the principal agent. In addition to that the principal agent must also start procuring the resource, whose production has been outsourced, and start providing a resource as compensation."*

b) Primary action: Add a new agent if necessary.

c) Secondary action:

a. Delete the conversion event that produces the resource, and/or

b. Add a new exchange event for receiving a resource from agent to the principal agent as a compensation for resource offered by the principal agent.

c. Add a new exchange event for providing a resource from agent to the principal agent as a compensation for resource procured by the principal agent.

Chapter 3

Detailled Analysis and Improvement of the Approach

Now that some interesting ideas from the literature in relation with the topic of this thesis - *the alignment between goal models and business models* - have been introduced, it is possible to analyze the method of [4] and go into the details.

Actually, it is obvious that this existing method introduced in the previous chapter suffers from some limitations (for example, a badly defined syntax). However, the templates and rules approach seems to be a structured way for solving the problem of alignment. Therefore, this chapter consists of the analyze, the improvement, and the extension of [4]. This analyze, improvement, and extension is done through this chapter. It is divided in four sections.

The first section (see Sect. 3.1) analyzes in details the first component of the method : the set of templates. Actually, the templates mentioned in [4] are suffering from different issues (e.g. a badly defined syntax, implicit links, etc.). These issues could make the method ambiguous or less understandable at some levels. Therefore, the main goal of this section is clearly to highlight issues in (and between) the different templates of [4]. This analyze is done on basis of some illustrations from [4]. For each kind of issue, a general solution is proposed. At the end of this section, the output is an improved list of templates.

As the templates are not self-sufficient to align the goal and the business models, the authors of [4] have introduced the notion of "rules". This notion constitutes the second component of their method. At first sight, it is not obvious to see that some rules can be source of ambiguities, and can introduce some inconsistencies within the output of the method. Therefore, the main goal of the second section of this chapter (see Sect. 3.2) is to find and fix the issues situated within the rules of [4]. The improvements and extensions provides by this section are situated at two levels : a higher level of formalism, and a better alignment between the goal model and the business model. At the end of this section, the output is an improved list of rules associated to the improved templates.

As it is noticeable, [4] is suffering of a poor methodological support. Therefore, the third section of this chapter (see Sect. 3.3) intends to give a clear summary of the method. Going further than the discussion of the links between the inputs and the output, this section clarifies the necessity of one of the inputs.

The last section of this chapter (see Sect. 3.4) aims to summarize and justify the validity of the approach followed within this chapter. This section also justify some choices done in Sections 3.1 and 3.2. Finally, it concludes with a discussion about the completeness and the consistency of the method.

3.1 The Templates

It is obvious that the templates mentioned in [4] are suffering from different issues (e.g. a badly defined syntax). As these issues could make the output of the method inconsistent, this section focuses on the improvement of this set of templates. These issues are classified into two categories. For each issue, an illustration based on a template of [4] is given to show it clearly.

Then, a global suggestion for solving each issue is also proposed.

The first category intends to solve the syntactical issues situated inside the templates (see Sect. 3.1.1). The issues which belong to this category are based on inconsistencies between the defined syntax and its application (e.g. formulation of the compulsory part, logical problems, etc.). Most of these problems are due to a badly defined syntax and lead to formulate a "Backus Naur Form" (BNF) grammar to express the templates.

At the opposite, the issues classified in the other category (see Sect. 3.1.2) are not at all due to the bad syntax used to express the templates. Actually, these issues are contributing to make the method more difficult to understand (e.g. ambiguous names, unnecessary event situated within the templates).

In Section 3.1.3, the global suggestions for solving the issues are applied on the set of templates of [4]. These improvements contributes to make possible the definition of a BNF grammar (see Sect. 3.1.4).

Once the templates are corrected, a graphical notation is introduced (see Sect. 3.1.5) to represent the semantic of the templates in a more understandable way for the final user of the method. From a decisional point of view, this graphical notation seems a more evident way to understand the templates by associating some decisional workflows to the textual templates.

In order to make the templates more understandable and prevent to construct inconsistent business model, Section 3.1.6 introduces some instantiations and specializations inside the templates.

The Section 3.1.7 aims to provide a clearer method than in [4] to link the templates with the goal model of an organization. To achieve this goal, this section introduces a new distinction between an "as-is goal model" and a "to-be goal model".

Finally, in order to ensure the consistency between the templates, the Section 3.1.8 introduces a notion of "scheduling conditions".

3.1.1 Syntactical Issues inside the Templates

3.1.1.1 Formulation of the Logical Operators

Intended for the usage by the goal and business modelers, the templates have to be designed following a similar logic. This is necessary due to the fact that these people will have most of the time a few knowledge in programming. One of the first elements on which these people will raise question is the signification of syntactical elements included into the templates.
In [4], the authors use the keyword "AND" to express the "logical and" but they use the vertical bar "|" to express the "logical xor". Figure 3.1 illustrates this on the sixth template.

Template 6: `stop producing resource in conversion event`
[AND ($start\ procuring\ resource\ from\ agent \mid stop\ offering\ resource$)]

Figure 3.1: *Illustration of syntactical issue (formulation of logical operators)*

Normally, from a cognitive point of view, it is better in a language (or in a method) when related concepts are expressed with related forms. Therefore, a solution to make the syntax of the templates more consistent would be to express the logical operators in the same way :

- Logical and : AND

- Logical xor : XOR

Figure 3.2 is the illustration of the solution for solving this issue in the sixth template.

Template 6: `stop producing resource in conversion event`
[`AND (start procuring resource from agent XOR stop offering resource)`]

Figure 3.2: *Correction of syntactical issue of Fig. 3.1*

3.1.1.2 Normal Rules of the Logic

As explained previously (in Sect. 2.5) the templates are composed of a compulsory and an optional part. While the compulsory part is expressing what the template aims to do, the optional part is expressing the different alternatives to satisfy its compulsory part. Therefore, some logical operators have been introduced in the syntax of the template by the authors of [4] in order to express these different possibilities. However, the normal rules of the logic does not seem to have been employed.
This issue can be illustrated with the second template (see Fig. 3.3). Among the ideas of [4], this template expresses the fact that *if the organization would like to see on the business model what are the impacts of stopping the offering of a resource to an agent, the organization must stop producing a resource or must stop producing a resource.*

Template 2: `stop offering resource to agent`
[`AND` (*stop procuring resource from agent* | *stop producing resource*)]

Figure 3.3: *Illustration of syntactical issue (normal rules of the logic (1))*

From this template, it is possible to highlight an issue at a logical level. Usually, the logical operators (the "OR" and the "AND") are used to make the exclusion or the association between some terms. However, in this template (see Fig. 3.3), it is visible that an "AND" is situated at the beginning of the optional part. This "AND" makes the template more difficult to understand.

The next figure represents the third template. It introduces the possible sources of ambiguities and misunderstanding within a template (see Fig. 3.4). This template expresses the fact that: *if the organization wants to procure a resource from an agent, the organization must either to start using a resource (in order to use it as input for the production of a resource) or must provide a resource to an agent (as intermediary). Then the organization must provide a resource to an agent (which represents the financial compensation for the resource procured).*

Template 3: `procure resource from agent`
[*AND* (*start using resource in conversion event* | *offer resource to agent*)
AND provide resource to agent]

Figure 3.4: *Illustration of syntactical issue (normal rules of the logic (2))*

One other issue is also that in each template of [4], the optional part starts with an "AND" (even if there is only one item in the optional part). However, this "AND" is also used to separate the terms inside the optional part. Usually, the logical operators are only used to separate two logical expressions. For this reason, we suggest as solution to remove the "AND" at the beginning of the optional part in each template. This would make the templates more understandable and less complex.

For example, after this correction, the templates 2 and 3 will be represented respectively as in Figures 3.5 and 3.6.

Template 2: `stop offering resource to agent`
[(*stop procuring resource from agent* | *stop producing resource*)]

Figure 3.5: *Correction of syntactical issue of Fig. 3.3*

Template 3: `procure resource from agent`
[(*start using resource in conversion event* | *offer resource to agent*)
AND provide resource to agent]

Figure 3.6: *Correction of syntactical issue of Fig. 3.4*

3.1.1.3 Formulation of the Compulsory Part

In [4], the authors describe the syntax of the compulsory part as : *"... The general form of a template is a triplet:* $< Event, Resource, Agent >$*..."*. But further in the paper, neither "<" nor ">" notations appear in the list of templates proposed. This issue is visible on Figure 3.7.

Template 2: `stop offering resource to agent`
[(*stop procuring resource from agent* | *stop producing resource*)]

Figure 3.7: *Illustration of syntactical issue (formulation of the compulsory part)*

While looking at the compulsory part of this template some elements can be linked with the suggested syntax :

- `stop offering` is the "Event"
- `resource` is the "Resource"
- `agent` is the "Agent"

By linking the elements in this way, a part is omitted: the preposition "to". Thus, the question is raised to know to which part (Event?, Resource? or Agent?) this preposition should be linked ? If we look carefully at the templates introduced by the authors (in Sect. 2.5), prepositions (from, to, in) are always situated at the same place in the compulsory parts. Indeed, the preposition is always situated between the resource and the agent.

Actually, this preposition is present in each template and is useful to determine its semantic. With this preposition, it becomes possible to know in which direction the resource will be directed (e.g. distinguishing "**from** an agent" and "**to** an agent"). Therefore, it is proposed as solution to describe the compulsory part as a 4-tuple in this way: *<Event, Resource, Direction, Agent>* instead of "*<Event, Resource, Agent>*". Figure 3.8 shows the correction of this issue.

Template 2: <stop offering, resource, to, agent>
[(*stop procuring resource from agent* | *stop producing resource*)]

Figure 3.8: *Correction of the syntactical issue of Fig.3.7*

3.1.1.4 Formulation of the Optional Part

In [4] the authors describe a template like this: *"...each template has two parts, one compulsory and one optional, the optional is written within square brackets ..."*. One syntactical issue is located in the first template (see Fig. 3.9). The issue is that this template seems to have more than one optional part because there are many pairs of square brackets ("[". . . "]").

Template 1: offer resource to agent
[*AND* (*start using conversion event* | *start producing resource* |
start procuring resource from agent)] [*AND receive resource from agent*]

Figure 3.9: *Illustration of syntactical issue (formulation of the optional part)*

Normally, according the authors, it should only have one pair of square brackets. This template means that *if an organization wants to offer something to an agent, then the organization has either to produce what needs to be offered in an existing activity (or in a new activity) or to procure this resource from another agent. At the end of this process, a financial compensation will be received from the agent to which the organization offered the resource.* It seems thus that the usage of normal brackets ("(. . .)") could help to solve this syntactical ambiguity inside this template. Figure 3.10 shows the application of this solution on the first template.

Template 1: offer resource to agent
[*AND* (*start using conversion event* | *start producing resource* |
start procuring resource from agent) *AND receive resource from agent*]

Figure 3.10: *Correction of syntactical issue of Fig. 3.9*

3.1.1.5 Informal Links between the Templates

Another syntactical issue can be found out in the expression of the optional part of some templates. Sometimes, this part makes an explicit reference to a compulsory part of another

template. For example, Figure 3.11 shows that the template 6 has two exclusive elements in its optional part : "`start procuring resource from agent`" and "`stop offering resource`".

The first one is the name of the compulsory part of the template 4 ("`Start procuring resource from agent`"). However, the second part seems to make a link to the template 2 ("`Stop offering resource to agent`") but the syntax is not exactly the same. The difference is that the end is missing in the template 6 ("to agent").

Template 6: `stop producing resource in conversion event`
$[AND\ (start\ procuring\ resource\ from\ agent \mid stop\ offering\ resource)]$

Figure 3.11: *Illustration of syntactical issue (informal link between the templates)*

Considering the set of templates, it comes very often that some terms appearing in the optional part of a particular template, are synonyms to compulsory part name of another template. We guess, in an informal way, the authors of [4] referred to this idea of link between the optional part of a template and the compulsory part of another. Consequently, it is suggested to use the name of a compulsory part instead of a synonym term.

3.1.2 Non-syntactical Issues inside the Templates

3.1.2.1 Name of Event in the Compulsory Part

As enounced before (see Sect. 3.1.1.3), the compulsory part of each template could be written in the form of a 4-tuple ($< Event,\ Resource,\ Direction,\ Agent >$). By looking carefully at the list of templates suggested in [4] (see Sect. 2.5), it is possible to imagine the idea of the authors : introduce a duality between different templates. The notion of "dual templates" can be assimilated to a template that have an opposite effect to another template on the business model. The Figure 3.12 is a first attempt to group the templates by pairs. Notice that, only the compulsory part of each template is represented in this figure.

$$
\begin{cases} Template\ 1 : Offer\ resource\ to\ agent \\ Template\ 2 : Stop\ offering\ resource\ to\ agent \end{cases}
\begin{cases} Template\ 3 :\ Procure\ resource\ from\ agent \\ Template\ 4 :\ Stop\ procuring\ resource\ from\ agent \end{cases}
\begin{cases} Template\ 5 :\ Start\ producing\ resource\ in\ conversion\ event \\ Template\ 6 :\ Stop\ producing\ resource\ in\ conversion\ event \end{cases}
\{\ Template\ 7 :\ (Increase|Decrease)\ production\ of\ resource\ in\ conversion\ event
\begin{cases} Template\ 8 :\ Insource\ production\ of\ resource\ in\ conversion\ event \\ Template\ 9 :\ Outsource\ [fraction\ of]\ production\ of\ resource\ in\ conversion\ event \end{cases}
$$

Figure 3.12: *Illustration of non-syntactical issue (duality between the templates)*

One of the issues for future work addressed in [4] is the question of completeness of the templates. In order to match the templates with the cognitive representation of the final user and make possible the study of their completeness, it is important to express the templates in an uniform syntax.

By looking at the previous figure (see Fig. 3.12), it is visible that some events begin with a "stop" (e.g. : *stop offering resource to agent*) or a "start" (e.g. *start producing resource in conversion event*). However, we can not always find a duality in each pair of templates. For example, there is no *start offering resource to agent*. The dual template of *stop offering resource to agent* one is played by *offer resource to agent*.
Despite that the templates 1 and 2 can be considered as dual templates, it is not explicit. Therefore, it could be useful to link the start and stop templates to introduce a formal duality between them.

In order to introduce the idea that each template must have a dual template, it is necessary to split the 7^{th} template (see Fig. 3.13) into two different (but dual) templates. The result of the splitting of the 7^{th}template is the creation of two new templates : the 7ath and the 7bth templates. This result is visible on Figure 3.14.

Template 7: (*increase* | *decrease*) *production of resource in conversion event*

Figure 3.13: *Illustration of non-syntactical issue (no duality for the 7^{th}template)*

Template 7a: *Increase production of resource in conversion event* Template 7b: *Decrease production of resource in conversion event*

Figure 3.14: *Correction of non-syntactical issue of Fig. 3.13*

By proceeding in this way, each template will have a dual template. The effect is that each template beginning with a "Start event" (resp. Insource or Increase) will have a dual template beginning with a "Stop event" (resp. Outsource or Decrease). The motivation for the introduction of these formal dualities between templates is to make the method easier to understand for the business and goal modelers. These dualities will also help to analyze the completeness of the templates list. Figure 3.15 represents the correction of duality issues in the templates.

Following the same idea, it is necessary to introduce the notion of "[fraction of]" into the template of the insourcing to keep the duality with the template of the outsourcing (see Fig. 3.12).

$$\begin{cases} Template\ 1 : Offer\ resource\ to\ agent \\ Template\ 2 : Stop\ offering\ resource\ to\ agent \end{cases}$$
$$\begin{cases} Template\ 3 :\ Start\ procuring\ resource\ from\ agent \\ Template\ 4 :\ Stop\ procuring\ resource\ from\ agent \end{cases}$$
$$\begin{cases} Template\ 5 :\ Start\ producing\ resource\ in\ conversion\ event \\ Template\ 6 :\ Stop\ producing\ resource\ in\ conversion\ event \end{cases}$$
$$\begin{cases} Template\ 7a :\ Increase\ production\ of\ resource\ in\ conversion\ event \\ Template\ 7b :\ Decrease\ production\ of\ resource\ in\ conversion\ event \end{cases}$$
$$\begin{cases} Template\ 8 :\ Insource\ [fraction\ of]\ production\ of\ resource\ in\ conversion\ event \\ Template\ 9 :\ Outsource\ [fraction\ of]\ production\ of\ resource\ in\ conversion\ event \end{cases}$$

Figure 3.15: *Correction of the non-syntactical issue of Fig. 3.12*

3.1.2.2 Consequences of Change of Ontology

As explained in section 2.5, at the origin, in the approach of [4] the templates and the rules of the method were not written for making use of them in other frameworks than REA or BMM for the goal model and the business model.

However, in this thesis $i^\star$ and e^{3}value are used to express the goal model and the business model. For this reason, the terms of the previous ontology located in the templates must be replaced by the appropriate terms. For example, the name "conversion event" is used in [4] should be replaced by the corresponding term : "value activity". Thus, to make the switch of ontology, all terms situated into the templates must be replaced as the Table 3.1 suggests.

REA terms	Equivalent in e^{3}value
Exchange event	Value exchange
Resource	Resource
Principal agent	Main actor
Agent	Actor
Conversion event	Value activity

Table 3.1: *Table for the conversion from REA to e^{3}value*

The Figure 3.16 represents the switch of ontology for the template 6.

Template 6: `stop producing resource in value activity`
[`AND start procuring resource from agent | stop offering resource)`]

Figure 3.16: *Illustration of ontology switching (template 6)*

3.1.2.3 Scheduling between the Templates

As we have explained before (in Sect. 2.5), a rule is associated to each template. In an automated process, the goal modeler should declare templates to get a business model. Then, each rule should modify the business model by adding (or removing) elements. From this point, we can

find another issue related to the templates. The issue is that, as described in [4] the templates do not offer any way to check the consistency. However, it seems logic that some templates must not be applied before (or after) some other templates.

For example, there is not any mentions in [4] which restricts a business modeler to use the template *stop offering resource to agent* without having applied the template *offer resource, to, agent* before. This constitutes an issue because it does not enable a part of checking for the consistency of the model produced in output. To address a part of the consistency, it must not be allowed to apply the rule associated to the template `stop offering resource to agent` if the organization is not offering this resource to this agent. In this case, this is equivalent to forbid to use the template `stop offering resource to agent`.

An intuitive solution could be the usage of preconditions or scheduling conditions for the templates of [4]. This solution for solving this issue of relations between the templates will be investigated in details further in this thesis (in Sect. 3.1.8).

3.1.2.4 Ambiguous Name for "*Agent*" and "*Resource*"

We can see that some elements in the templates (in the compulsory part as well as in the optional part) are abstract entities : "resource" and "agent". For example, in the template 3, there are three occurrences of "resource" and three occurrences of "agent" (see Fig. 3.17). Although these concepts are understandable, these names can address respectively good, service, or compensation (for a resource) and provider, outsourcer, or customer (for an agent).

The template 3 is illustrated in Figure 3.17. By looking at the semantic of this template, it is obvious that the first agent is a provider, the second plays the role of a customer, and the last one is the same as the first one. However, these generic names of *agent* and *resource* could be a source of misunderstanding for the business modeler.

Template 3: `procure` resource `from` agent
[*AND* (*start using* resource *in conversion event* | *offer* resource *to* agent)
AND provide resource *to* agent]

Figure 3.17: *Illustration of non syntactical issue (ambiguous name for agent and resource)*

For this reason, it is proposed as solution to specialize these terms by using the roles played by the agent. Therefore, "provider", "customer" and "outsourcer" will be used instead of "agent". It is also proposed to make a distinction between the "compensation" and the "other resources" instead of using the generic term "resource". Notice that most of the time, this compensation will be financial, but not necessary. Therefore, the term compensation is used instead of financial compensation (or money). Specializing these terms by giving them a particular role in the templates is a good way to reduce the possible mistakes and remove all ambiguous names.

This problem of specialization is discussed in details further in this thesis once that all of (non)syntactical issues have been resolved (in Sect. 3.1.6).

3.1.2.5 Unnecessary Event in Template 9

This problem is specific to the template 9 illustrated in Figure 3.18.

Template 9 : `outsource [fraction of] production of resource in conversion event`
[*AND* (*stop* | *decrease fraction of*) *production of resource*
AND *start procuring resource from agent*
AND `start providing resource to agent`]

Figure 3.18: *Illustration of non syntactical issue (unessential event template 9)(1)*

In the template 9, the two last actions are "***`start procuring resource from agent`***" and "***`start providing resource to agent`***". As we have explained before (in Sect. 3.1.1.5), it can happen that a term situated in the optional part of a template is a link to another template by mentioning the name of the compulsory part.

In Figure 3.18, the first element represents the procurement of the resource which is outsourced (with the template 3 as expressed in Figure 3.19). The last term represents the providing of the financial compensation to the outsourcer.

Template 3: `procure resource from agent`
[*AND* (*start using resource in conversion event* | *offer resource to agent*)
AND *provide resource to agent*]

Figure 3.19: *Illustration of non syntactical issue (unessential event template 9)(2)*

The problem is that within the template 3, there is also a compensation which is offered to the provider of the resource with the element `provide resource to agent`. It is thus necessary to remove the financial compensation from the template 9, because as in the template 9 the link with the template 3 is not a choice, we are sure that the template 9 will always make a link to the template 3. Therefore, the compensation will always be provided to the outsourcer in the template 3.

3.1.3 Improved List of Templates

This section aims to correct the issues highlighted in the two previous sections (syntactical issues in Sect. 3.1.1 and non-syntactical issues in Sect. 3.1.2). For each problem described previously, the associated suggestion(s) will be applied on each template. We have chosen to make several improvements at the same time for each template. This is due to the fact that, highlighting every issue in each templates would be too long and maybe annoying for the reader.

Two adjectives are used to distinguish two kinds of templates. The first kind of templates is the templates of [4] containing some issues. Each of these templates is called "original template". Notice that each original template has been presented with its semantic in the Chapter 2. The other kind of templates is the corrected version of original templates from the global solutions suggested in this thesis. This kind of templates is called "improved template".

Template 1:

Original template: **offer resource to agent**
[AND (start using conversion event | start producing resource | start procuring resource from agent)] [AND receive resource from agent]

Improved template: <**start offering, resource, to, agent**>
[(start using value activity XOR start producing resource XOR start procuring resource from agent) AND receive resource from agent]

Template 2:

Original template: **stop offering resource to agent**
[**AND** (stop procuring resource from agent | stop producing resource)]

Improved template: <**stop offering, resource, to, agent**>
[(stop procuring resource from agent XOR stop producing resource)]

Template 3:

Original template: **procure resource from agent**
[AND (start using resource in conversion event | offer resource to agent) AND provide resource to agent]

Improved template: <**start procuring, resource, from, agent**>
[(start using resource in value activity XOR start offering resource to agent) AND start providing resource to agent]

Template 4:

Original template: **stop procuring resource from agent**
[AND (stop offering resource to agent | start producing resource in conversion event)]

Improved template: <**stop procuring, resource, from, agent**>
[(stop offering resource to agent XOR start producing resource in value activity)]

Template 5:

Original template: **start producing resource in conversion event**
[AND start offering resource to agent]

Improved template: <**start producing, resource, in, value activity**>
[start offering resource to agent]

Template 6:

Original template: **stop producing resource in conversion event**
[AND (start procuring resource from agent | stop offering resource)]

Improved template: <**stop producing, resource, in, value activity**>
[(start procuring resource from agent XOR stop offering resource)]

Template 7:

Original template: **(increase | decrease) production of resource in conversion event**

Improved template (a): <**increase production of, resource, in, value activity**>

Improved template (b): <**decrease production of, resource, in, value activity**>

Template 8:

Original template: **insource production of resource in conversion event**
[AND (start | increase) producing resource AND stop procuring resource from agent]

Improved template: <**insource production of, resource, in, value activity**>
[(start producing of resource XOR increase production of resource) AND stop procuring resource from agent]

Template 9:

Original template: **outsource** [**fraction of**] **production of resource in conversion event**
[AND (stop | decrease fraction of) production of resource AND start procuring resource from agent AND start providing resource to agent]

Improved template:
<**outsource** [**fraction of**] **production of, resource, in, value activity**>
[(stop producing resource XOR decrease fraction of production of resource) AND start procuring resource from agent]

3.1.4 Backus-Naur-Form Grammar for the Templates

By making a generalization of the solutions suggested in the Sections 3.1.1 and 3.1.2, it is possible to produce a Backus-Naur-Form grammar (BNF grammar). This grammar allows to solve most of the issues situated into the templates of [4].
Figure 3.20 is the BNF grammar for expressing the templates.

```
MEAN_TEMPLATE    ::=    COMPULSORY_PART [ '[' OPTIONAL_PART ']']
COMPULSORY_PART  ::=    '<' event ',' resource ',' DIRECTION ',' A_OR_VA '>'
DIRECTION        ::=    'from' | 'to' | 'in'
A_OR_VA          ::=    agent | value activity
OPTIONAL_PART    ::=    E
E                ::=    E 'AND' T | T | COMPULSORY_PART
T                ::=    T 'XOR' F | F | COMPULSORY_PART
F                ::=    '('E')' | COMPULSORY_PART | other_event
```

Figure 3.20: *A BNF grammar for the templates*

As it is visible, this grammar allows to design templates which contain a compulsory part and an optional part. The compulsory part is expressed between '<' and '>'. The node "other_event" stated in the grammar is a terminal node. Therefore, this node is not a reference to template and should be distinguished from it. These "other events" can be replaced by one of the events situated in Table 3.2. The elements situated inside this table can be considered has "basic pieces" inside the templates.

Other event
Start using existing value activity
Receive resource from agent (compensation)
Start using resource in value activity
Start providing resource to agent (compensation)

Table 3.2: *Identifier of the other events inside the templates*

For example, the grammar of the figure 3.20 matches with the first template :

<start offering, resource, to, agent>
[(start using value activity XOR start producing resource XOR start procuring resource from agent) AND receive resource from agent]

Figure 3.21: *Example: template 1 matches with the BNF*

In the BNF grammar, the part containing the 'E','T' and 'F' seems quite complex. However, it is necessary in order to avoid ambiguities in the grammar. This part as been constructed using the example of [24]. For example, if we had used a grammar similar to Figure 3.22 it would be an ambiguous grammar.

```
E    ::=    E XOR E | E AND E | (E) | other_event
```

Figure 3.22: *Example of an ambiguous BNF grammar*

This first ambiguity is called *associative ambiguity*. For example, *"x AND y AND z"* has up to two trees of analysis, and could be interpreted either as *"(x AND y) AND z"* or *"x AND (y AND z)"*. This ambiguity is solved by choosing the recursive side (left-recursive).
The second ambiguity is the same as *"(x XOR y) AND z"* vs *"x XOR (y AND z)"*, it is called

precedence ambiguity. This ambiguity is solved by adding another non-terminal node (here the term "T" and the factor "F"). Actually, these kinds of ambiguities are solved by expressing the grammar as in Figure 3.23.

```
E      ::=    E XOR E | T
F      ::=    T AND F | F
T      ::=    id | (E)
```

Figure 3.23: *Solving the ambiguous grammar of Fig. 3.22*

This is for this reason that instead of writing the `XOR`, `AND`, the link to the `COMPULSORY_PART` and the `other_event` on one line, it has been distributed on three lines named 'E','T' and 'F'.

This grammar can be seen as a tool for adding new templates. Although it allows to represent all of the existing templates, it is a little too permissive. This is due to the fact that the natural language is rich. Therefore a valid template has to match with the grammar, but it has also to be semantically consistent. The notion of consistency of a template is delegated to the goal modeler who will use the template.

3.1.5 Graphical Representation

Generally, for an important number of people, a graphical notation seems easier than complicated textual ideas. Therefore, this section focuses on the introduction of a graphical notation for expressing the templates. This graphical view aims to give a more intuitive way for expressing the ideas situated in the templates. An interesting idea to represent a template graphically is to present it as a kind of network. With this kind of presentation, the different alternatives and conjunctions (respectively expressed by an "AND" and a "XOR") are well presented.

Actually, the usage of a graphical notation has been used before the correction of the templates and has helped to detect issues situated inside the templates and the rules. With this kind of notation, it is possible to check the "completeness" and the "consistency" of the templates. Here, by "completeness" we mean : checking if the template contains all of the actions it should (according to its semantic). By "consistency" we mean : checking the relevance of the templates, the logical links between events, the consistency of the recursion in the templates, the non-existence of redundant terms inside a template, and the succession of the actions between the templates (e.g. "Producing" before "Offering"...).

The Section 3.1.5.1 concerns the choice of an appropriate notation. Then, in the Section 3.1.5.2, this notation is used for representing the improved templates of Section 3.1.3.

3.1.5.1 Usage of UML for Representing the Templates

The UML activity diagrams [2] seem ideal to represent the templates. With the "choice" and the "merge" it is possible to represent the different alternatives situated inside the templates optional part. Moreover, the activity diagrams allow to represent operational step-by-step workflows of components in a system.

In this section, there is one activity diagram per template. Each graphical notation begins with an entry point and contains the different parts of a template. Each part of a template (compulsory and optional) is represented within the activity diagram. For each template, all of the elements situated inside the optional part are visible and divided in action nodes. Moreover, there is also an action node for expressing the compulsory part.

In the activity diagrams used in this thesis, different background colors are used to distinguish the different action nodes. This distinction is linked to the templates. The different action nodes are the following:

- The action node with a **white background called $\mathbf{T}_i$**
  - It represents an element situated in the optional part of the template
  - This element is a reference to another template
  - It can be seen as a "sub value activity" or a call
  - *e.g. A call to* <`start offering, resource, to,agent`>
- The action node with a **white background called with only a letter**
  - It represents an element situated in the optional part of the template
  - This element is an "other_event" node as stated in the BNF grammar (in Section 3.1.4)
  - It does not make a link to another template
  - *e.g. Receive resource from agent (compensation)*
- The action node with a **grey background called "C.P."**
  - It represents the main action of the template
  - It matches with the compulsory part (C.P.) of the template
  - *e.g. The moment when the resource is given in "Start offering resource to agent"*

Notice that the differentiation between the "link to a template" and the "other_event" is necessary. It can help to distinguish the call to another template from a basic piece of a template.

Due to space restriction, it is not possible to write the full templates names inside the action nodes. Thus, in the actions with a grey background and these with a white background, identifiers are used to refer respectively to the "other_event" or to another template. Tables 3.3 and 3.4 present these identifiers.

Identifier	**Compulsory part of the template**
T1	<start offering, resource, to,agent>
T2	<stop offering, resource, to,agent>
T3	<start procuring, resource, from, agent>
T4	<stop procuring, resource, from, agent>
T5	<start producing, resource, in, value activity >
T6	<stop producing, resource, in, value activity >
T7a	<increase production of, resource, in, value activity>
T7b	<decrease production of, resource, in, value activity >
T8	<insource production of, resource, in, value activity >
T9	<outsource [fraction of] production of, resource, in, value activity>

Table 3.3: *Identifiers of the templates*

Identifier	Other event
(a)	Start using existing value activity
(c)	Receive resource from agent (compensation)
(e)	Start using resource in value activity
(f)	Start providing resource to agent (compensation)

Table 3.4: *Identifier of the other events*

It is very important for the reader to see how to understand this notation. Therefore, the rest of this section explains how to understand the graphical notation associated to the first template. The Figure 3.24 remember the improved template 1.

Template 1 : <**start offering, resource, to, agent**>
[(start using value activity XOR start producing resource XOR start procuring resource from agent) AND receive resource from agent]

Figure 3.24: *Improved template 1*

This template can be interpreted such as : what happens if... the organization wants to ***start offering a resource to an agent*** ? "Start offering resource to agent" matches with the first template : <**start offering, resource, to, agent**>.
The optional part of this template makes possible different alternatives for the organization. This choice is linked to the way to dispose of the resource to offer, and is expressed in the first bullet.

- (a) Start using existing value activity (to produce the resource to offer)
  (T5) Start producing resource (in an existing value activity)
  (T3) Start procuring resource from agent (from another organization)
- Then, the resource is offered (in the grey action node called C.P)
- Then, the organization receives a compensation from the agent (customer) in c

This template is represented in Figure 3.25.

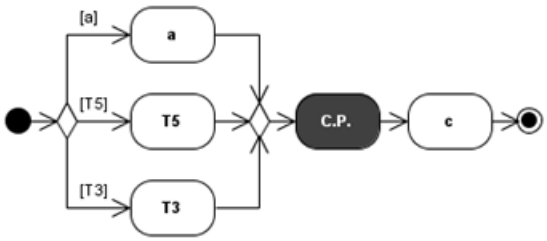


Figure 3.25: *Graphical notation for the template 1*

In this thesis, the elements situated in the first bullet are called "precursors". It means that these elements have to be executed before the main action (the offering of the resource). In the template 1, these precursors express the way to get the resource the company will offer.

As there is a notion of temporal precedence between the actions, it is visible in this template that the payment (in c. in Fig. 3.25) will always occur after the offering of the resource (grey action node). This has been decided according to the semantic of the templates (as expressed in [4]. Therefore, at a semantic level, an organization that needs to express a "pre payment" could add a new template to consider that.

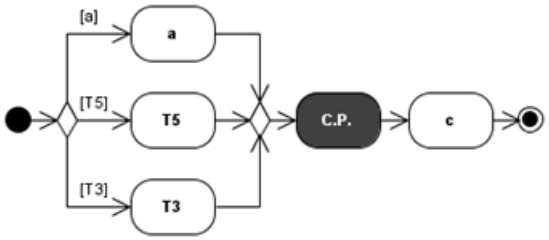
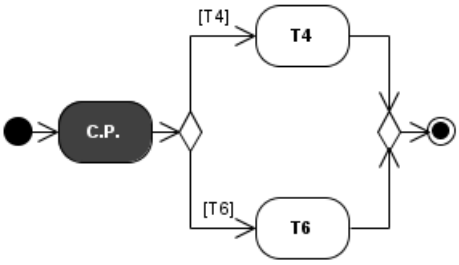
However, this choice does not impact the quality of the output. Actually, this template will be implemented in the framework used at the business level (e^3value). Therefore, there will have no precedence visible between the paiement and the resource offered.

The graphical notation suggested in this section will help the goal and business modelers from a decisional point of view. Moreover, this notation will help them to understand the semantic of the templates. Thus, this notation should be used to reflect decisional processes of the templates and nothing else.

Notice that this section concerns the templates and not yet the rules of the method. However, the graphical notation can also be used for the construction of the rules. But, as the templates are situated on a higher level than the rules, it has sense to introduce the graphical notation here.

3.1.5.2 Application of the Graphical Notation on the Improved Templates

The Table 3.5 presents each templates on a graphical form. These templates have been arranged so that the dual templates (left-right column) can be easily linked with the associated "stop" template.

Template	**Dual template**
T1<Start offering, resource, to, agent>	*T2<Stop offering, resource, to, agent>*
	

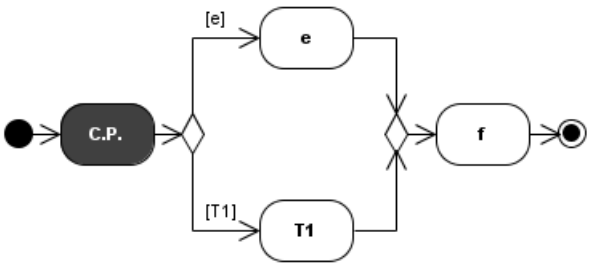
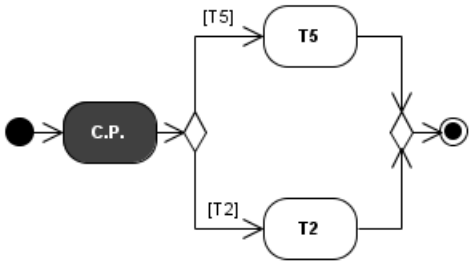
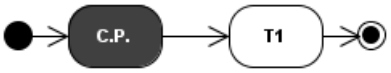
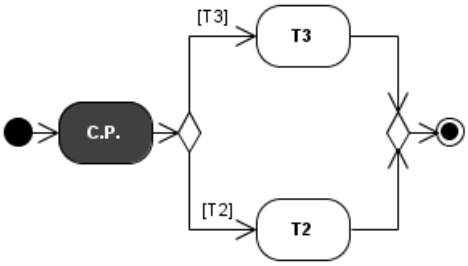
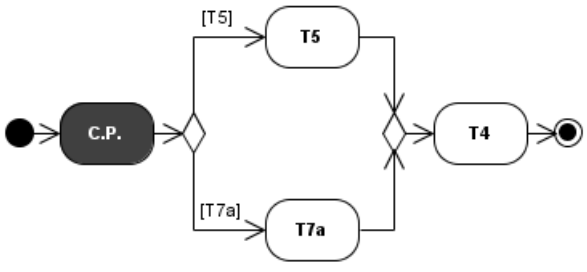
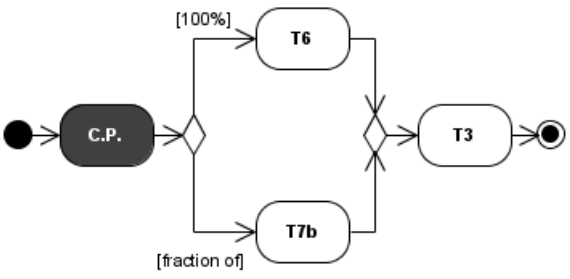
T3<Start procuring, resource, from, agent> 	*T4<Stop procuring, resource, from, agent>* 
T5<Start producing, resource, in, value activity> 	*T6<Stop producing, resource, in, value activity>* 
T7a<Increase production of, resource, in, value activity> 	*T7b<Decrease production of, resource, in, value activity>* 
T8<Insource production of, resource, in, value activity> 	*T9<Outsource [fraction of] production, of resource, in, value activity>* 

Table 3.5: *Graphical notation and dualities between the templates*

As it is visible on the graphical notations, there is no strict duality between each template. It means that in two opposite templates, the same opposite constructions (action nodes, choice and merge) can not always be found. For example, there is no strict duality between the

first template ("<`start offering resource to agent`>") and the second template ("<`stop offering resource to agent`>"). This could sound disturbing but there is a reason to that.

Indeed, the templates represented by a graphical notation situated in the left column of the Table 3.5 are only "start..." templates. At the opposite, the templates situated in the right column are "stop..." templates. One major difference between these two columns is that there are not any elements called "other_event" (see Table 3.4) within templates situated in the right column. This comes from the fact that, at business level, the rules associated to each template will modify the business model by basing only on the templates. Therefore, it is necessary to add some elements with extra information in the templates to let possible some constructions.

These information are

- the name of an existing activity *(a)*
- the kind of compensation to receive *(b)*
- the value activity in which a resource will be used *(e)*
- the kind of compensation to provide *(f)*

These elements are not links to other templates but basic information called "other event" as mentioned in Table 3.4.

In contrast with the "start" templates, the templates beginning with a "stop" do not care about these extra information. This can be explained easily. Indeed, later at business level, the rules associated to the templates will not need so many choices or information. For example, the rule associated to the stop template `stop offering resource to agent`, will first deleted the value exchange between the main organization and its customer. Then, if the offered resource was produced in a value activity, the value activity will be deleted only if it is no more used inside the main actor. Moreover, it is necessary to understand that the templates are context dependant. It means that they are constructed for a kind of organization. Therefore, in this thesis we have kept the original semantic of [4] as the organizational context.

The distinction made between the main part and the other actions on the graphical notation allows to distinguish the precursors and the successors of the main action. The precursors are actions situated before the action node with a grey background, and the successors are the actions situated after. Therefore, some readers could have the impression, by looking at the graphical notation, that the first template is making a kind of "backward call" (by calling a template in an activity situated before the main action), while all other templates only have actions after the main action. However, it is not. This distinction is necessary and will be used later to avoid redundant changes in the output.

For example, the first template ("`Start offering resource to agent`") shows that to become able to offer something, the organization has first to get the resource to offer. Therefore, these different alternatives to get the resource must be situated before the main part (which represents the offering) on the graphical notation.

At the opposite, the second template ("`Stop offering resource to agent`") do not have any precursors. This template means that if the organization wants to "`stop offering a resource to an agent`", then it has to stop procuring the resource from an agent (template 4), or it has to stop producing the resource in a value activity (template 6). But the organization do not have to do things before stopping the offering.

3.1.5.3 Global Network

As some templates can call other templates, it becomes relevant to draw a global network. This network shows the different possible execution flows regarding to the calls between the templates.

The implication array in Table 3.6 helped us to construct the global network. In this table, the templates identifiers are situated on the vertical and horizontal axes. The implication dependencies are indicated by putting a mark in the intersecting cell of a template column and row. This table has been constructed by looking at each graphical notation of each template. For example, for the template 4, if the organization wants to `stop procuring resource from agent` (T4), then it is needed to `start producing the resource in a value activity` (T5) or `stop offering the resource`(T2). Notice that, as the only purpose is to focus on calls between the templates, the "other_events" have been omitted from this implication array.

FROM	TO									
	T1	T2	T3	T4	T5	T6	T7a	T7b	T8	T9
T1			1		1					
T2				1		1				
T3	1									
T4		1			1					
T5	1									
T6		1	1							
T7a										
T7b			1							
T8				1			1			
T9						1				

Table 3.6: *Implication array for drawing global network*

This implication array could be understood as follows :

- If the template 1 (T1) is executed, then template 3 (T3) or template 5 (T5) will be executed,
- If the template 2 (T2) is executed, then template 4 (T4) or template 6 (T6) will be executed,
- ...

Figure 3.26 is coming from this implication array. This network will be a useful tool to avoid redundant changes in the rules while making calls between the templates.

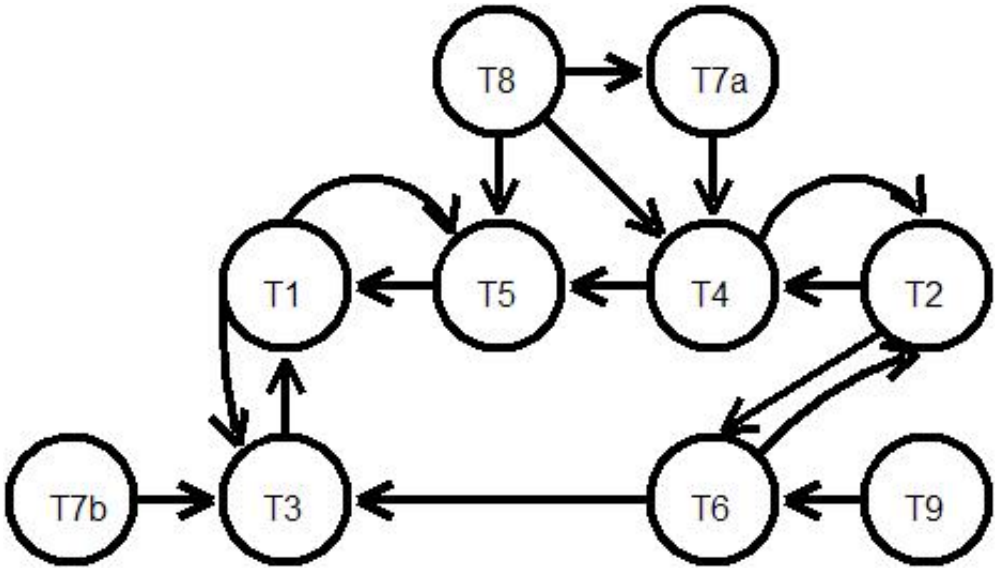


Figure 3.26: *Global network*

3.1.6 Instantiation and Specialization

In this section, two improvements are realized on the templates. The first one is the specialization of some templates elements. The second one is the instantiation of some terms situated into the templates.

As [4] suggests, the templates will be associated to means situated into the $i^\star$ goal model. Therefore, the templates must be clear and understandable. It means that, when the goal modeler will have to chose between some templates, no matching issues or misunderstanding within the templates can occur. However, for the moment, the goal modeler may encountered some problems. These problems are caused by the fact that in the goal model, the actors are attached to names and concrete roles. Unfortunately, in the templates of [4], only the abstract mention of "agent" can be found. For instance, instead of looking for the highly abstract notion of "agent", the goal modeler will more likely look for the notion of "customer", "provider",etc. Following the same logic, the goal modeler will think in terms of concrete resource instead of using the generic notion of "resource". However, only the generic term "resource" is used in the templates of [4] *(e.g.* `start offering resource to agent`*).*

Therefore, in order to reduce the possible misunderstanding (or ambiguities) which can lead to some errors, it is better to specialize the notion of *agent* and *resource*. Thus, we have made a specialization in the templates for the concepts of "*agent*" into "customer", "outsourcer" or "provider", and the concept of "*resource*" into "compensation" when necessary. Following this idea it will become easier for the goal modeler to distinguish the role of an agent and see if the role of a resource is a compensation or not. In this way, the method will be composed of templates which are more understandable for the goal modeler.

Figure 3.27 represents the first template before and after specialization of its terms.

Template 1:

Before specialization: <**start offering, resource, to, agent**>
[`(start using existing value activity XOR start producing resource XOR start procuring resource from agent) AND receive resource from agent`]

After specialization: <**start offering, resource, to, customer**>
[`(start using existing value activity XOR start producing resource XOR start procuring resource from provider) AND receive compensation from customer`]

Figure 3.27: *Example of specialization for template 1*

Another problem which could make the method of [4] more complex to use is that a same template will probably be selected many times to match with the goal model of an organization. For example, an organization can have many times in its goal model a means "`start offering resource to customer`" if the organization is offering various resources to different customers (e.g. offering a "resource a" to "customer x" , and a "resource b" to "customer y"). This implies that the same template will match many times with different means. As stated in [4], it is not possible to remember which template is matching with which means. Thus, the templates, as stated in [4], could implies confusions between the resources offered. Currently, the method do not provide any information to distinguish two identical templates which have two different goals. Following this idea, that could lead to some errors or misunderstandings.

To be more specific and able to distinguish the different terms, a subscript will be added to "customer", "provider", "outsourcer", "resource", "value activity", and "compensation" situated inside the templates. For example, it will be possible to write customer$_{\mathbf{1}}$, customer$_{\mathbf{2}}$, etc. provider$_{\mathbf{1}}$, provider$_{\mathbf{2}}$... Thus, by instantiating these variables into the templates, it becomes possible to handle a set of providers and customers, and know exactly on which agent we are talking about in the templates application. Notice that, by introducing this new notation, it may occur (but it is absolutely not a problem) that in some organization, the customer$_i$ and provider$_j$ may be the same agents, (e.g. customer$_i$ in one template may refer to the same entity as customer$_j$ in another template).

Therefore, by using this instantiation and specialization, it will be easier for the goal modeler to understand the concepts of the templates. With this elements it will be also possible to make a distinction between two instantiations of a same template for expressing two different means. Consequently, the ambiguities introduced by the highly abstract and not instantiated terms in the templates of [4] will be reduced. At a deeper level, as the rules are associated to the templates, this specialization and instantiation of the terms will also be present inside the rules.

According to these ideas, the compulsory part of the improved templates will be replaced by a specialized and instantiated compulsory part as in Table 3.7. The specialization and the add of subscripts will, obviously, also be done in the optional part of the templates. Given that, in both parts, the notion of "customer", "provider", "outsourcer" (used previously) can make implicit references to a same person by using the same subscript.

In order to avoid the repetition of the templates, the list of the improved templates with the instantiated and specialized agents and resources will be presented in the same time as the instantiation and specialization in the improved rules in Section 3.2.

Compulsory parts (before improvement)	**Compulsory parts (improved)**
<start offering, resource, to, agent>	<start offering, resource$_{\mathbf{j}}$, to, **customer$_{\mathbf{i}}$**>
<stop offering, resource, to, agent>	<stop offering, resource$_{\mathbf{j}}$, to, **customer$_{\mathbf{i}}$**>
<start procuring, resource, from, agent>	<start procuring, resource$_{\mathbf{j}}$, from, **provider$_{\mathbf{i}}$**>
<stop procuring, resource, from, agent>	<stop procuring, resource$_{\mathbf{j}}$, from, **provider$_{\mathbf{i}}$**>
<start producing, resource, in, value activity>	<start producing, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >
<stop producing, resource, in, value activity>	<stop producing, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >
<increase production of, resource, in, value activity>	<increase production of, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >
<decrease production of, resource, in, value activity>	<decrease production of, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >
<insource production of, resource, in, value activity>	<insource production of, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >
<outsource [fraction of] production of, resource, in, value activity>	<outsource [fraction of] production of, resource$_{\mathbf{j}}$, in, value activity$_{\mathbf{k}}$ >

Table 3.7: *Instantiation and specialization in the compulsory parts*

The instantiation and specialization of the concepts of "other events" situated into the optional parts give the following results (see Table 3.8).

Other event (before this improvement)	**Event (improved)**
(a) Start using existing value activity	Start using existing value activity$_{\mathbf{k}}$
(c) Receive resource from agent	Receive **compensation$_{\mathbf{c}}$** from **customer$_{\mathbf{i}}$**
(e) Start using resource in value activity	Start using resource$_{\mathbf{j}}$ in value activity$_{\mathbf{k}}$
(f) Start providing resource to agent	Start providing **compensation$_{\mathbf{c}}$** to **provider$_{\mathbf{p}}$**

Table 3.8: *Instantiation and specialization of the other events*

Figure 3.28 is an example of specialized and instantiable template 9.

9. <outsource *fraction* of production of, $resource_j$, in, $value\_activity_k$>
[stop producing $resource_j$ in $value\_activity_k$ AND start procuring $resource_j$ from $outsourcer_o$]

Figure 3.28: *Example of specialized and instantiable (template 9)*

Furthermore, in [4] there is no mention of variables situated into the templates. Therefore, an idea has emerged to associated names coming from the goal model to the variables of the templates. In this way, the rules associated to the templates will be closer from the goal model, by having some variables containing the value of the elements situated into the goal model. So, instead of introducing generic names into the business model (e.g. agent, resource, value activity, etc.) as in [4], it is now possible to use formally the same names in the goal model and into the to be business model (e.g. shipper, CD delivery, transport CD, etc.).

Although every programming language allows to instantiate variables, the choice of Prolog is more adequate in a templates and rules context. Hence, the idea of instantiation of subscripted variables will be explained by basing on some ideas similar to Prolog [21]. Actually, a template can call other templates. That implies working with a kind of substitution chain. For this

reason, it is better to use a similar approach as Prolog because it deals with this problem. Below stands a list of Prolog concepts and their relations adapted from [21] with the templates and rules notions:

1. ***Variable***: each element contained in the set ν.
   e.g. : <start procuring, resource$_j$, from, provider$_i$> where resource$_j$, provider$_i$ $\in \nu$
2. ***Term*** : variable or constant. τ represents the set of the possible terms.
   e.g. : <start procuring, BOOK, from, LUDOVIC> where BOOK, LUDOVIC $\in \tau$
3. ***Substitution*** : a substitution is represented by σ and it is a set $\{X_1/t_1, \ldots, X_n/t_n\}$ where
   - $X_1, \ldots, X_n \in \nu$
   - $t_1, \ldots, t_n \in \tau$
   - $X_i \neq X_j \forall i, j \in 1, \ldots, n$ and $i \neq j$
   - $X_i \neq t_i \forall i \in 1, \ldots, n$

   The result of a composition is the replacement of each occurrence of a X_i variable by the corresponding term t_i (i=1,...,n).

   e.g.: σ={resource$_1$/BOOK, customer$_1$/LUDOVIC, resource$_2$/COMPUTER, provider$_1$/PIERRE}
4. ***Domain(σ)*** = {X_1,...,X_n}
   e.g. Domain(σ) = {resource$_1$,resource$_2$,customer$_1$,provider$_1$}
5. ***Codomain(σ)***= var(t_1,...,t_n)
   e.g. Codomain(σ) = {BOOK, COMPUTER, LUDOVIC, PIERRE}

3.1.7 Formal Link between the Goal Model and the Templates

The previous sections aimed to improve the templates. However, in order to focus mainly on the templates and their improvements, an accurate view of how to link the elements situated into the $i^\star$ goal model with the set of templates still needs to be given. This matching between the templates and the goal model constitutes the first part of the method. Thus, this section gives a formal way to start the method.

As introduced in the section 2.5, [4] is considering one goal model for an organization. This goal model has to be constructed with the templates. Later, the rules associated to these templates (used to construct the goal model) will be used to transform the existing business model of the same organization (the as-is business model) into an aligned business model (to-be business model). However in this thesis we introduce a distinction within the goal model. The rest of this section clarifies and justifies this distinction.

Actually, the origin of the non-alignment between the goal model and the business model comes from the fact that, one day, this current goal model of the organization (as-is goal model) will no more reflect the real goals of the organization in a right way. This can be due to changes in the environment (new actors, new techniques, new strategic goals, etc.).

Thus, to make the goal model more realistic, the goal modeler will modify the as-is goal model and introduce some new goals, actors, etc. These goals will most than probably require to add some new tasks into the to-be goal model to be achieved[1]. It is assumed that, after adding these

[1]Note that the term "task" situated into the goal model, is assimilated to the term "means". It is considered as a more relevant term because we only consider the tasks which are means to satisfy some new goals.

tasks, the goal modeler will select in the set of templates, the templates which are matching with the new means. After all of these modifications in the goal model, the goal modeler will obtain a new goal model. This goal model will reflect the organization at a strategic layer at the current time. In this thesis, this goal model is called: to-be goal model.

The main reason to make a distinction between a to-be and an as-is goal model is that most of the organizations already have a goal model and a business model. They rarely start from a clean slate. Therefore, in the thesis, these existing models are called as-is goal model and as-is business model.

In this thesis, it is assumed that the set of templates used to construct the as-is goal model previously is known. This history of the application will be used later to avoid illegal changes into the model (in Sect. 3.1.8). For example, to prevent from applying a "stop offering..." template if a "start offering..." template has not been applied before to create the as-is business model.

By making a distinction between an as-is goal model and a to-be business model, this thesis corrects a missing view in the method of [4]. "Missing view" means that there is not in [4] any explicit solutions to know which means from their goal model have already been taken in account into their as-is business model. The reason is that in [4], there is a mention of an as-is business model but not any distinction within the goal model. Moreover, there is no distinction between the as-is goal model and the to-be goal model. Consequently, in [4], the method is supposed to modify an as-is business model with the rules associated with the templates, but, as the goal model is completely rebuild from the templates, it is no more possible to highlight the new means in it. Therefore, it is not possible to know which elements are already taken in account in the as-is business model.

Figure 3.29 represents a generic to-be goal model. In this picture, new goals, new means, new resources, and new actors are visible and highlighted.

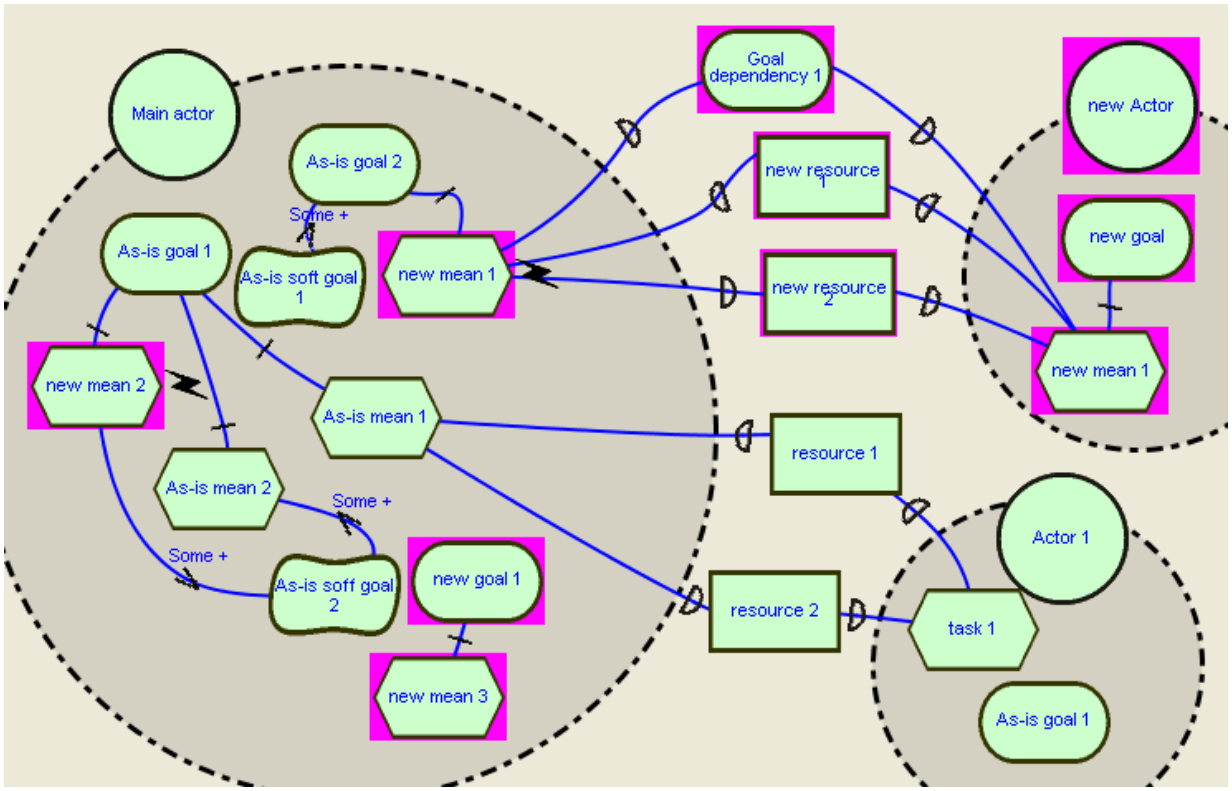


Figure 3.29: *A generic to-be goal model*

As the as-is goal model is transformed and becomes the to-be goal model (as in Fig. 3.29), the as-is business model becomes no more aligned with the to-be goal model. In order to solve this problem, the templates and rules based approach can be applied to align the to-be goal model with the as-is business model.

The first part of this approach is based on the templates introduced and improved previously. Each new means situated in the to-be goal model should find a matching thanks to the goal modeler with a template coming from the set of templates. For example, on Figure 3.29, the "new means 1" could match with the template 1: <`Start offering, resource`$_j$`, to, customer`$_j$>. The "new means 2" could match with the template 7a: <`Increase, production of resource`$_j$`, in, value activity`$_k$>, etc.

Due to the subscripts associated to the variables introduced in Section 3.1.6, it is possible to avoid the confusion between the templates by instantiating the variables. Actually, in [4], as a template can be used more than once (to match with two different means), a confusion occurs because, without instantiation, it is no more possible to know which template refers to which means. For example, if the organization offers a resource A to a customer X, and offers a resource B to a customer Y, then [4] will only write "offer resource to agent" twice.

At the opposite in this thesis, we have suggested an instantiations of the variables situated into the templates to help the means of the goal model to match with the templates. Each substitution applied to do the matching between an highlighted means and a template is called a γ_i substitution. A substitution contains variables (e.g. `customer`$_i$`, value activity`$_k$`, provider`$_p$`, outsourcer`$_o$, etc.) which can be substituted with a real name of an actor, resource, etc.

For example, in Figure 3.29, the "new means 1" can be matched with the first template by

the substitution γ_1={`resource`$_j$`/computer, customer`$_j$`/client a`}. The "new means 2" can be matched with the template 7a by the substitution γ_2 = {`resource`$_j$`/hard disk`}, etc. It is assumed that a template is matching with each means. However, it is obvious that the list of templates suggested in [4] restricts the possible usage of the method on a limited number of organizations. This problem of adding new templates will be discussed as a basis for future works.

We also suggest to add another kind of substitution: the σ_i substitution. This other substitution appears from the calls between the templates. Indeed, this σ_i substitution is needed to instantiate the variables of a called template by using it into the caller templates.

For example, the first template (<`start offering, resource`$_j$`, to, customer`$_j$>) matching with the "new means 1" can call the template 5 (<`start producing, resource`$_j$`, in, value activity`$_k$>). This call is possible because the first template has the template 5 in its optional part. It expresses the fact that one of the possibilities[2] to get the resource to offer to its customer, is to produce it. Therefore, the substitution σ_1 ={`T5.resource`$_j$`/T1.resource`$_j$`, T5.value activity`$_k$`/computer factory`} is used to pass the variables from the template 1 to the template 5. Then, as the template 1 has already been instantiated, the template 5 will be instantiated as follows : <`start producing, computer, in, computer factory`>. This instantiation can be done with the σ_1 substitution.

Notice that some choices depends on the business modeler and not the goal modeler. For instance, it could happen that a variable situated into the called template is not present into the caller. Consequently, this variable can not be instantiated by the caller template automatically. This is for example the case for the variable `T5.value activity`$_k$ which is instantiated with the value "computer factory" which do not come from a variable of T1. This lack of information in the caller template is due to the fact that the templates are situated between the goal model and the business model level. Therefore, some information (as the name of a value activity) can be unknown by the goal modeler.

As it is suggested in Prolog, it is possible to represent the chaining substitutions by a tree. Thus, to get a proper view of the substitutions and the templates, we can represent it by a tree. Figure 3.30 shows an example of substitution tree for the examples given before in this section.

[2]The different possibilities are obvious by looking at the graphical notation in the table 3.5.

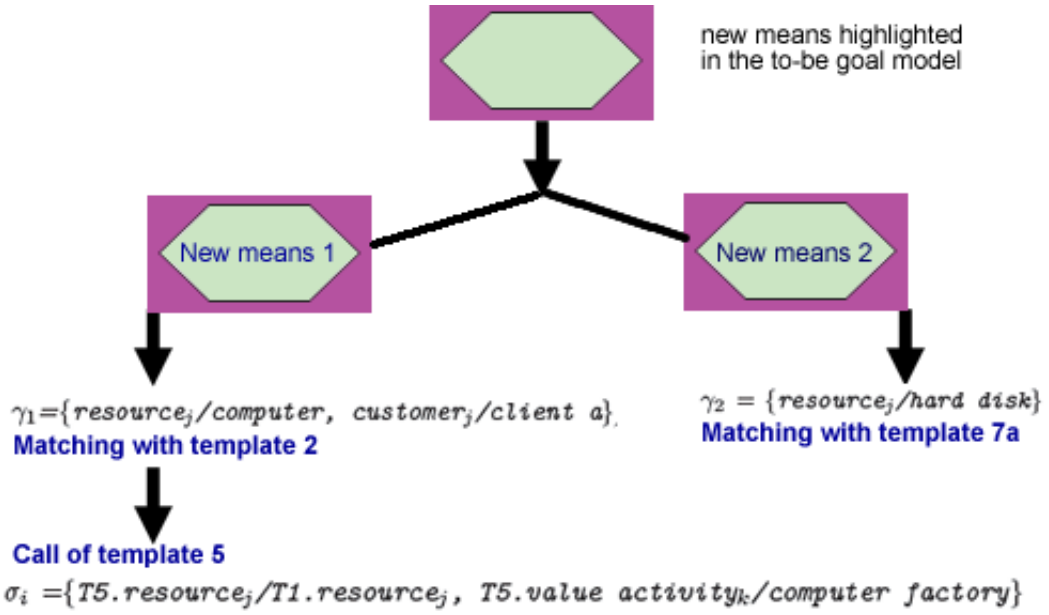


Figure 3.30: *Through the goal model to the templates with a substitution tree*

It is now quite clear that the first part of the method must have an as-is goal model as input. However, in some cases, it is possible that there exists not any as-is goal model for the organization. This is for example the case in the definition of a startup company. However, if there is no as-is goal model, the method can also be applied with an artifice. This artifice is just to take an empty goal model as input for the as-is goal model. By "empty", we mean a model which only contains the main actor. Figure 3.31 represents an empty goal model. For this reason, even if we do not have an as-is goal model, we can assume that the as-is goal model is always there. In this case, all of the elements inserted by the goal modeler (new goals, new means, etc.) will be highlighted. Consequently in this case, there is no problem for applying the method.

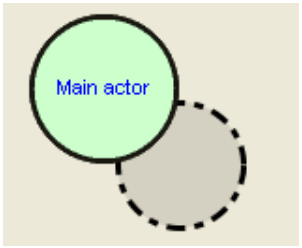


Figure 3.31: *An empty as-is goal model in* i* *framework.*

3.1.8 Scheduling Conditions between the Templates

As described previously, a goal modeler will match different means from the to-be goal model with some templates. But, from the consistency point of view, it seems logical that some templates could not be applied at anytime. For instance, a goal modeler must not declare a <stop offering, resource$_j$, to, customer$_i$> without a previous <start offering, resource$_j$, to, customer$_i$>.

Therefore, a consistency checking of the templates combinations is important and is addressed in this subsection with the notion of "scheduling conditions".

A scheduling condition is an expression of a particular combination of templates on which precondition must be checked to ensure its legality. A scheduling condition has two parts. The first part is the "combination part". This part is represented by the identifiers of two templates (which are the same as previously used for the graphical notation, see Table 3.3) separated by an infix composition operator "∘". This operator is used to express that a particular template can be combined with another with some conditions. These conditions for the combination are situated in the second part or "conditional part" which contains a guarded expression. Consequently, a scheduling condition is expressed such as : $\mathtt{T}_i \circ \mathtt{T}_j$ `where precondition`.

The aim of adding such conditions on the templates is to allow the automated check of the consistency in the to-be model goal model. This will ensure a part of the production of a valid business model as output. Actually, the business modeler needs to check if these conditions are respected during the building of the to-be model from the templates. It seems quite intuitive and logic that before applying a template beginning with a "stop", a dual template with a "start" has to be used previously.

The list of scheduling conditions for the dual templates has been build from the set of templates and is expressed in Table 3.9.

$\mathtt{T}_i \circ T_j$	Precondition
T2∘T1	$\mathtt{T1.resource}_j$=$\mathtt{T2.resource}_j$ and $\mathtt{T1.customer}_i$=$\mathtt{T2.customer}_i$
T4∘T3	$\mathtt{T3.resource}_j$=$\mathtt{T4.resource}_j$ and $\mathtt{T3.provider}_i$=$\mathtt{T4.provider}_i$
T6∘T5	$\mathtt{T5.resource}_j$=$\mathtt{T6.resource}_j$ and T5.value $\mathtt{activity}_k$=T6.value $\mathtt{activity}_k$
T7a	$\mathtt{production(T7a.resource}_j)\leq$100%
T7b	$\mathtt{production(T7b.resource}_j)\geq$0%
T8∘T9	$\mathtt{T9.resource}_j$=$\mathtt{T8.resource}_j$ and T8.value $\mathtt{activity}_k$=value $\mathtt{activity}_k$

Table 3.9: *Scheduling conditions for the set of templates*

For example, the first scheduling condition in Table 3.9 expresses that template 2 (`stop offering resource`$_j$ `to customer`$_i$) can be combined with template 1 (`start offering resource`$_j$ `to customer`$_i$) only if the `resource`$_j$ of the first template is equal to the `resource`$_j$ of the second, and if the `customer`$_i$ of the first template is equal to the `customer`$_i$ of the second.

Regarding the 4^{th} and 5^{th} scheduling condition, it is obvious that before increasing (or decreasing) the production of a resource, it has to be checked that the production is not already over (or under) the limits of the production. Note that, no matter with what template T7a and T7b are combined, the precondition is targeted only on T7a or T7b.

Of course if new templates are added in future work, the scheduling conditions could be extended. That would be needed for some templates to address the consistency. For example, for each stop/start dual template, a new condition will be added. Notice that in some cases, the list of such conditions would by highly context dependent. For instance, it could appear that some combinations may not be allowed in one organization, while other combinations may be forbidden in another organization.

3.2 The Transformation Rules

Until now, only the first component of the method has been introduced : the templates. A template gives an idea of : which means have been introduced into the to-be goal model to achieve the new goals (with the construction of the to-be goal model), what are the different alternatives for achieving the means (with the optional part of the template), what are the names of the new actors, new resources, etc. (with the variables instantiation situated inside the templates that match with the means of the to-be goal model).

However, a template does not explain how to transform the as-business model. That means that there is no accurate explanations within the templates to align the as-is business model with the to-be goal model. Therefore, this section refers to the introduction of the second component of the method: the "transformation rules".

In order to solve the issue of alignment between the goal and the business models, [4] is also using transformation rules. However, in [4], the definition of rule is not very concise and not very easy to understand. Hence, this section starts off with a definition of this concept (see Sect. 3.2.1).

The Section 3.2.2 addresses the correctness of the rules. In the first time, issues are highlighted into the rules of [4]. For each issue, an illustration is given basing on a rule of [4]. As each rule could not be treated in details, a general solution is suggested for solving the problems situated in each rule.

Once all issues are found out, the general solutions are applied on the rules of [4] (see Sect. 3.2.3). In this section, the σ_i substitutions introduced previously in the templates (in the Section 3.1.6) are also brought in the rules. This substitutions will allow to make the calls between the templates explicit and pass the instantiated variables to other called templates.

3.2.1 Understanding the Rules

The goal of a rule is to transform and align the as-is business model (given as input) with the to-be goal model of an organization. For each template, there is an associated transformation rule. For example, a rule is associated to the first template (<`start offering, resource`$_k$`, to, customer`$_j$>), another rule is associated to the second template <`stop offering, resource`$_k$`, to, customer`$_j$>), etc. The rules remove (or add) elements from (or into) the as-business model according to the templates which have been selected and instantiated from the to-be goal model (as explained in Sect. 3.1.7).

A rule has two parts: the primary and the secondary action. The first one is based on the compulsory part of the associated template. It draws on the model what the template aims to do. The second part represents the information contained in the optional part. The elements of the optional part are either the possible precursors of the main action meaning what to do before the execution of the main action (e.g. to get a resource in order to be able to offer), or the possible successors (consequences) meaning what is next to the main action (i.e. in a post-payment, the provider gets a financial compensation for the offered resource). For each element situated into the optional part of a template, a matching fragment (piece of the rule) is present inside the rule to apply these changes on the as-is business model.

When all rules have been applied on the as-is business model, then all the consequences (and the possible precursors) situated into the templates have been applied on the model [3]. Hence,

[3]By "all" we means, the fragment of the rules related to the compulsory part, and all the elements situated in the optional part excepted these which do not have been choose by the business or goal modeler. It is obvious

by transition, as the templates match with the new means of the organization situated into the goal model, and as these means are achieving the new goals of the organization, the to-be business model produced as output is aligned with the new goals of the to-be goal model.

As explained for the templates, in the section 3.1.2.2, different frameworks are used as in [4]. Indeed, $i^\star$ and e^{3}value are used instead of REA and BMM. Consequently, to make the rules easier to understand and analyze, it is presumed in this section that the rules of [4] have already been translated into the correct ontology.

Notice that, if some templates are used as illustration for highlighting issues in the associated rules, the improved version of the templates will be used.

3.2.2 Issues in the Rules

The rules of [4] have already been presented in the Section 2.5. In this section, several issues in these rules are highlighted. When necessary, an illustration is given to avoid ambiguities or make the ideas clearer. Then, as the same issues can occur in more than one rule, a general solution is suggested. In the same way, as for the templates, the ten corrected rules will be presented at the end of the Section 3.2.3.

3.2.2.1 Lack of Information for Transformation

From an operational point of view, the rules have to add (or remove) some "value exchanges" between "value activities" when they are (or not anymore) necessary in the business model. However, in the rules of [4], every rule is not always doing that correctly. For instance, Figure 3.32 illustrates the rule associated to the template 4. This rule is used for highlighting the fact that a rule of [4] can produce an inconsistent business model. This rule should modify the business model in a consistent way, to show the effects of a stop in the procurement of a resource from a provider.

Template 4: <*stop procuring,* resource$_j$*, from,* provider$_p$>
[(stop offering *resource$_l$* to *customer$_i$*) XOR (start producing *resource$_j$* in *value activity$_k$*)]
Associated rule:
Primary action:
Delete the duality with the value exchange that concerns the transfer of the resource from agent to the principal agent.
Secondary action:
a. Delete the value exchange related to providing the resource to agent (in case of discontinuing the provisioning), or
b. Add a new value activity in the principal agent to produce the resource (in case the provisioning of the resource continues).

Figure 3.32: *Illustration of the lack of information for transformation in the rules (rule 4)*

that some choices have to be done in the optional part. Therefore, the rule will only apply the elements related to the choice(s) in the business model.

Actually, this rule can lead to some troubles. At first, it is not explicitly indicated to which agent the rule is referring to. Then, there is no explanation about the notion "delete the duality" in [4] as well. All these elements constitute a lack of information. But other information are missing in this rule and could contribute to produce an inconsistent to-be business model. Figure 3.33 is used to illustrate these inconsistencies created by the template 4 (see Fig. 3.32).

The primary action in the rule is the deletion of the value exchange between the provider and the main actor. The effect of this operation is visible in (1) on the business model in Figure 3.33. Then, in the secondary action, there are two possibilities proposed by the templates. If the main actor wants to *stop offering the resource to its customer*, then the value exchange in (a) will be deleted. Otherwise, if the main actor wants to *start producing the resource in a value activity* (to compensate the stop of the procurement) the rule will create a value activity in (b).

The purpose of this example was to show the two possible issues in the output produced by this rule. The first issue is that the rule do not disconnect the value exchange inside the actor. It is visible from the output that it remains some unnecessary parts of value exchange within the model. These parts are located on the right of (a) and at the bottom of (1).
The second possible issue is that there is not any information about how (and to what) we have to link the new created value activity in (b).

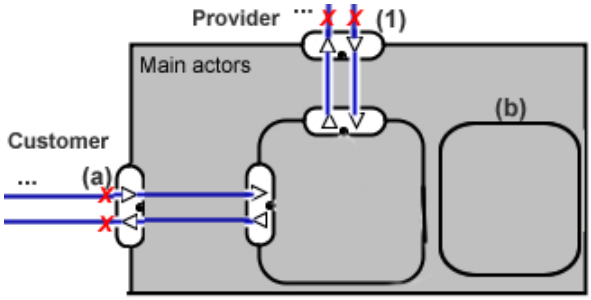


Figure 3.33: *Consequences of lack of information for transformation in the rule 4*

These issues come from some lack of information in the rule of [4] associated to the template 4. Another reason is maybe that these information have been considered as implicit. Anyway, this lack of information could lead to invalid constructions within the business model. That is why, it is suggested to add enough information within the rules to take this in account. Thus, after solving this problem, it will be mandatory for each rule to contain all the explicit information to modify a business model in a right and consistent way.

3.2.2.2 Lack of Rules for Templates 5 to 8

In [4], the rules associated to the template 5 to 8 are not defined due to a lack of space in the paper. However, these rules must be defined to develop a complete method. Thereby, these rules must be implemented in this thesis.

3.2.2.3 Avoid Redundant Changes on the Model

This section addresses the possible issues of redundant changes in the business model. The different issues are solved by (a) adding restricting conditions for the choice within the optional part , and (b) restrictions within the rules.

a) Restricting Conditions for the Choice of the Optional Part

In order to correct the problem concerning the mix of the precursors and successors in the optional part, a new restriction is suggested.

Actually, there are two different cases for the templates :

- case 1: when a template is called by another template (from the optional part of another template),
- case 2: when a template comes from the matching of an highlighted means in the to-be goal model.

The first case is the most complicated. The issue is illustrated with the first template (see Fig. 3.34). This template relates to the offering of a resource to a customer (T1 : "`start offering` resource$_i$ `to customer`$_j$"). In its optional part, this template allows to choose between one of the three elements to get the resource that the organization wants to offer to its customer. These mutually exclusive elements are precursors to the compulsory part (C.P.). This notion of precedence within the template is derived from the semantic suggested in [4]. The semantic describes that some actions must be realized before offering the resource. It is visible that two of these alternatives are calls to other templates (T5 and T3). The three possibilities are :

- (Other event a) `start using resource`$_j$ `in existing value activity`$_k$,
- (Template 5) `start producing resource`$_j$ `in value activity`$_k$,
- (Template 3) `start procuring resource`$_j$ `from provider`$_p$.

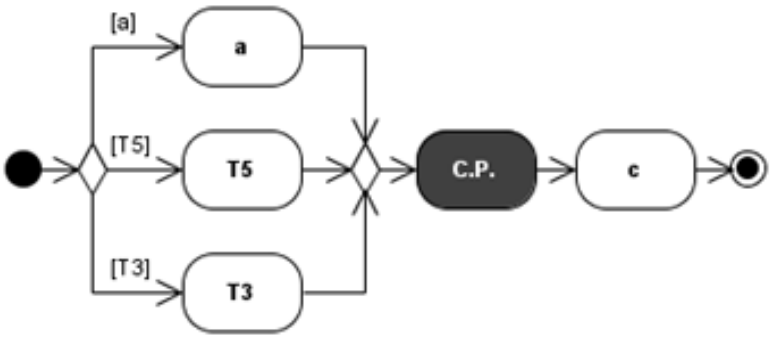


Figure 3.34: *Graphical notation for template 1*

However, by looking at the global network indicated previously (see Fig. 3.26), it is visible that some other templates may also call the first template. For example, the third template (T3: "`Start procuring resource from provider`"), or the fifth template (T5: "`Start producing resource in value activity`") can also make a call to the first template to offer the resource which is procured or produced. This call to T1 from T5 means that the main actor has the means "`Start producing resource`$_j$ `in value activity`$_k$" highlighted in its to-be goal model (which matches with the template 5). The consequence of this template 5 (stated in its optional part) is that the resource$_j$ has to be offered to a customer. So, a call to the first template also needs to be done to introduce some changes related to the offering inside the business model. A call to the first template from the fifth template is illustrated in the Figure 3.35.

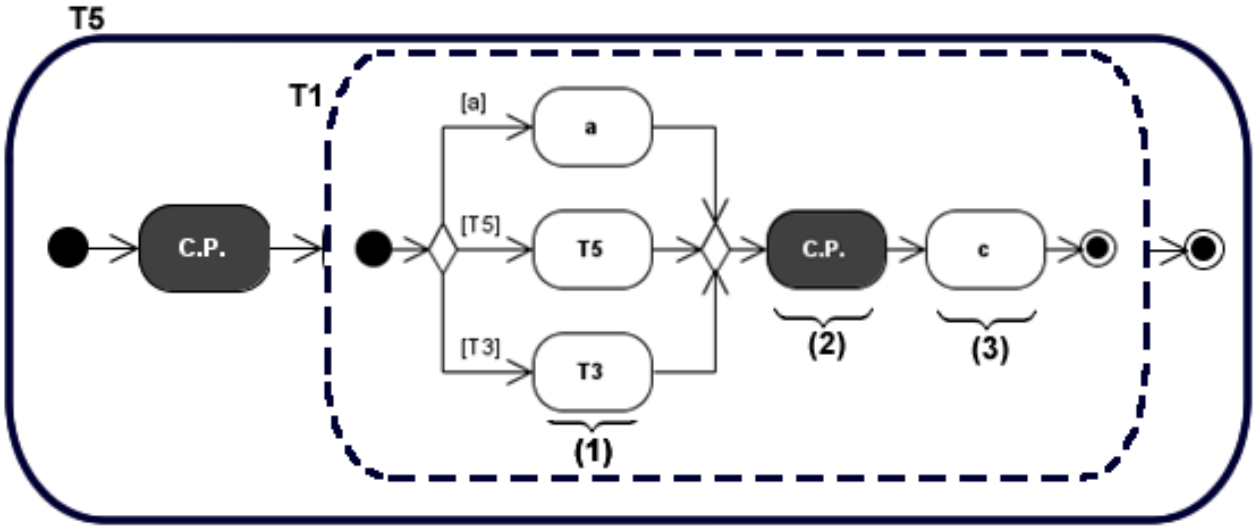


Figure 3.35: *Case 1 : when a template is called from another template (T5 to T1)*

More generally, each action node situated into the graphical notation (which illustrates the template) matches with a fragment of the rule that introduces changes on the business model. [4]

Hence, it is visible in the Figure 3.35 that a problem can happen. The issue is that the first template was called (by the template 5), with the unique idea to offer the resource produced in the fifth template. Thus, the template 5 has called the template 1 to introduce the changes related to the offering of the resource produced. If the rules do not care, when coming into the first template, it would still be possible to go into the template 5 (because the precursors of T1 are [a], [T5], and [T3]). Hence, that would introduce many times the value activity for the production of a resource on the business model.

The problem comes from the precursors in the template T1. Actually, in the case where T1 is called by T5, it is not relevant to chose a precursor for T1. Indeed the resource to offer to the customer has already been gotten with T5. Therefore, the production of the resource has already been drawn on the future to-be business model, by the associated rule of the template which has called T1 (in this case T5).

As a result, to avoid introducing redundant changes on the model, it is forbidden to choose

[4] However, notice that the scheduling of the transformations within a rule can be different from the scheduling of elements situated in graphical form. This is explained by the fact that the rules and the graphical notation are both linked to a template. However, in the graphical notation the elements have been disposed with temporal precedences to help the goal and business modelers to represent in a graphical form a template.

the execution of an optional part when it is situated before the main action (on the graphical representation before C.P), once the template was called from another template.

The second case is easier to understand. It occurs when a template directly matches with a means of the to-be goal model. For example, the modeler can match a means situated into the goal model with the template 1 : "*start offering resource$_j$ to customer$_k$*". This can be interpreted as: what will happen on my business model, if I want to start offering this resource$_j$ to this customer$_k$?. The answer is given by the graph below in Figure 3.36.

- (1) At first, the organization must choose a way to get the resource : transform a resource in a existing value activity (a), start producing (T5) or start procuring (T3) the resource to offer.
- (2) Then, the organization can give the resource to its customer.
- (3) Finally, the organization will receive a compensation from the customer.

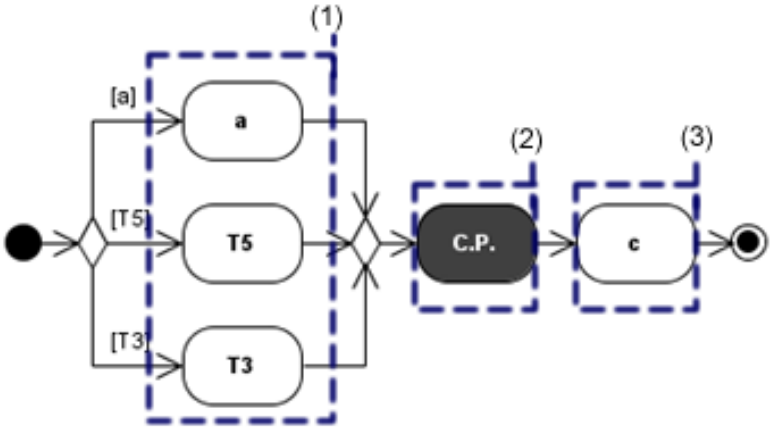


Figure 3.36: *Case 2 : when a template is not called from another template*

In this second case, it is normal to follow the graph and choose a precursor to the main action among the elements shown in (1) in Figure 3.36. This first choice in the template is necessary and will be associated to a part of the rules in order to introduce the correct elements in the model (in order to add the necessary constructions on the model to be able to offer the resource to the customer).

The Figure 3.37 represents an overall solution to this problem. Regarding to the case 1 (when a template is called from another), it is forbidden to choose and execute a part of a rule for an action situated in (1) (the precursors). Thus, it is necessary to jump directly to the part of the rule describing the main action (C.P). This is represented by an arrow on the graphical notation in (2).
Regarding to the second case, there is not any restriction, no matter what paths is followed on the graphical notation. This idea is applicable to the ten improved templates of this thesis, and

must be in application for all the templates which might be added later in future work to keep the consistency of the business model.

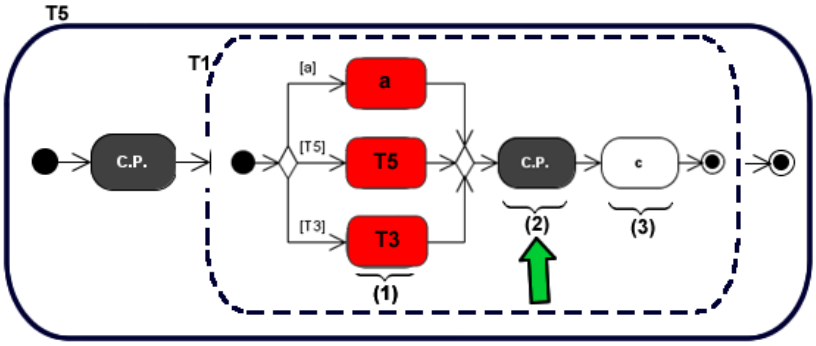


Figure 3.37: *Solving problem : the mix of the precursors and successors in the optional part*

b) Restrictions within the Rules

Another issue may introduces redundant changes into the to-be business model by the calls between templates. The different parts situated within a rules are associated to the different parts of the associated template. Therefore, the graphical notation of the templates can be used to illustrate the problems within the rules because it shows these different parts. In this section, the problem is illustrated with the templates 2 and 4. These templates are reminded on Figure 3.38.

Template 2 (T2):<**stop offering, resource**$_j$**, to, customer**$_i$ >
[(stop procuring resource from provider$_p$ XOR stop producing resource$_j$ in value activity$_k$)]

Template 4 (T4): <**stop procuring, resource**$_j$**, from, provider**$_p$ >
[(`stop offering resource`$_j$ `to customer`$_i$ `XOR start producing resource`$_j$ `in value activity`$_k$)]

Figure 3.38: *Reminder of templates 2 and 4*

T2 expresses the consequences of the stop of the offering to a customer. These consequences are that the organization has to stop procuring or producing the resource that is offered to its customer. These consequences are respectively a call to T4 or T6.

T4 expresses the consequences of the stop of the procurement of a resource from a provider. These consequences are that the organization has to stop offering this resource to its customer, or has to start producing this resource. These consequences are respectively a call to T5 and T2.

By looking at the T2 and T4, in the Figure 3.38 it is visible that T2 can call T4 or T6, and T4 can call T5 or T2. An issue appears here if T2 calls the T4 with the meaning that the organization stops offering a resource (T2) and decides to stop procuring this resource (T4). This issue is that T4 allows in its consequences (situated in the optional part) to call T2. Actually, this is not necessary to come again into T2 and apply the associated rule again, because T4 has already been called by T2. Figure 3.39 illustrates this fact with the graphical notation of T2 and T4.

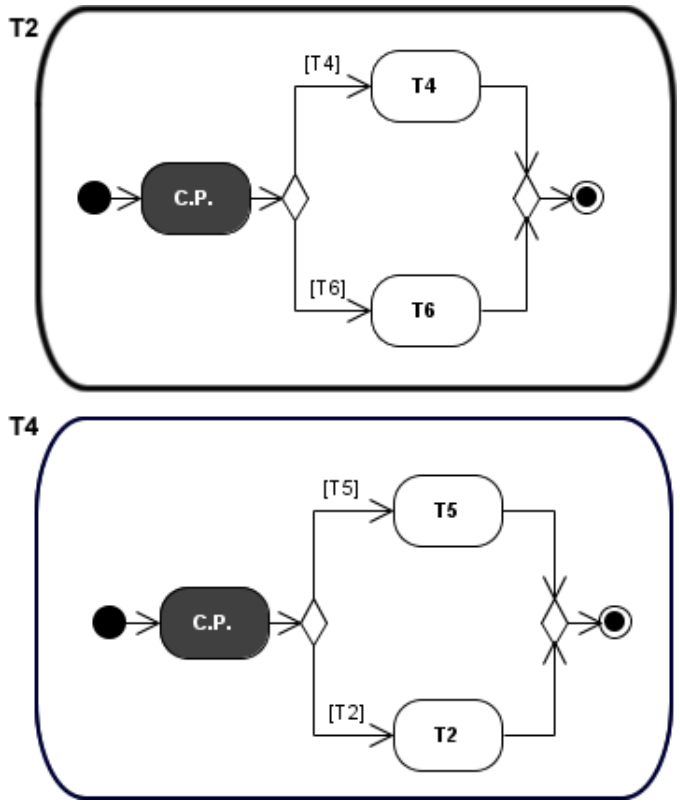


Figure 3.39: *Overview of the links between T2 and T4*

By looking at the global network (presented in the Figure 3.26 of the Section 3.1.5.3), it is possible to generalized this problem to every template which has a cycle in the global network. The Figure 3.40 represents only the cycles of length 2 situated into the global network.

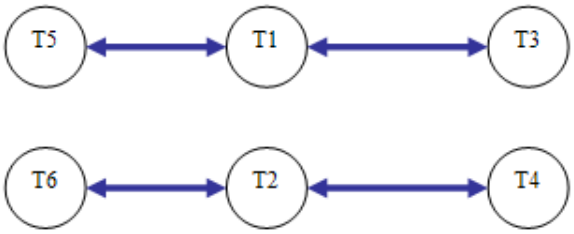


Figure 3.40: *Cycles between the templates*

A solution for preventing the introduction of redundant changes into the rules can be a restriction within the rules. This restriction will narrow down the calls between the templates.

Therefore, a function "`Prev(T`$_i$`)`" is introduced into the rules. This function returns true if the rule associated to the template has been called from the rule associated to the template T_i. Otherwise, it returns false. The function will be used to avoid the introduction of redundant changes in the to-be business model.

Although it sounds very difficult to find out the relations between the templates, it is not. Actually, it is only in the rules, where possible cycles are present, that the function "`Prev(T`$_i$`)`" has to be introduced. This cycles regarding to the set of templates are visible in the Figure 3.40. The function `Prev(T`$_i$`)` has just to check if the precedent template is the same as the

consequence of the current template. If it is, the call to the consequence has to be ignored.

For example, as there is a cycle between the T4 and T2, the rule associated to T4 *(stop procuring)* has to check if the rule was called by T2 *(stop offering)* with `Prev(T2)` before the call to T2. If this function returns true, the call must be disable. Hence, if the goal modeler decides that the consequence of the stop of the procurement (T4) is the stop of the offering (T2):

- if `Prev(T2)`== TRUE : the effects of "stop offering" have already been applied previously in T2,
- if `Prev(T2)`== FALSE : the rule must make changes concerning the stop offering offering on the model.

Maybe that the reader could think that it should be possible to transform the templates in order to remove the cycles between the templates. However it is not because this link to another template is necessary. For example, it could be possible to think that the stop of the offering (T2) is not a consequence of the stop procuring (T4). However it is not. It is easily imaginable that for a strategic reason, a means <`stop procuring, resource`$_j$`, from provider`$_p$> appears in the to-be goal model of an organization. For example, the provider$_p$ can be the only provider of the resource$_j$. If the organization gets bad relationships with this provider, stop procuring may be the only solution. In this case, one of the possible consequences of the stop of the procurement can be the stop of the offering with T2.

3.2.3 Improved Transformation Rules

This section aims to solve the rules of [4] regarding to the issues highlighted before. For solving these issues, the general solutions given previously are applied on each rule. This section begins with a reminder of the difference between the templates and the rules. These information need to be kept in mind to clarify the ideas. The major improvements introduced into the rules of [4] are also described.

A template expresses *what* needs to be done at the business level to be aligned with the strategic level. The rule is associated to a template and describes in details *how* the as-is business model has to be transformed (from an operational point of view). Following this idea, a template and its associated rule can be respectively considered as the header of a function, and its implementation in e^{3}value terms.

One major improvement applied to the rules of [4] is the introduction of explicit calls between the templates. These calls are implemented into the rules by using some substitutions as mentioned previously in the Section 3.1.7.

As a rule implements a template, it is also built on two parts (the primary action and the secondary action). These are related to the two parts of the associated template : the compulsory part and the optional part. As the optional part of the templates contains some choices, only some of the elements situated inside the rule in secondary part need to be applied on as-is business model. For this reason, some "IF, ELSE IF" statements are used into the rules to select the necessary part(s) inside the rules. The part(s) is (are) chosen at the execution according to the element(s) selected in the optional part of the associated template by the business modeler.

For example, Figure 3.41 illustrates a possible instantiation for a template. The substitution used for this, is a γ_1 substitution =`{resource`$_j$`/computer, customer`$_j$`/client a}`. The possible choices proposed to the business modeler are situated inside the optional part. For matching these choices with the elements situated inside the rules, the beginning of each option is written with a conditional statement (e.g. IF start using THEN..., IF start producing THEN..., etc.).

In Figure 3.41, it is visible that some elements are not yet instantiated (e.g. resource$_l$). This

<start offering, *computer*, to, *client a*>
[(start using existing *value activity*$_k$ XOR start producing *computer* in *value activity*$_k$
XOR start procuring *resource*$_l$ from *provider*$_p$) AND receive *compensation* from *client a*]

Figure 3.41: *Example of instantiated template (template 1)*

is because these elements are situated at business level and not at strategic level. Thus, these information are unknown by the goal modeler. As the rules are executed by the business modeler, he will be able to instantiate the necessary parts of the templates by giving extra information at the execution.

Notice that to make the rules shorter to read, the abbreviation "Ti" is used to refer the "template number i". The fact that such abbreviation appears in the rules should not be considered as a weakness. It is just a reference the business modeler needs to follow while applying a rule. The rules must not be used for reasoning because they only contain information about how to transform the model. For reasoning, the business modeler and goal modeler need to have a look at the templates (or their graphical notation). Actually, these latter contain the necessary information to reason (e.g. the variables and the calls between the templates).

Regarding to the level of formalism used, the rules of [4] are written in a natural language. As one of the goals of this thesis is to improve the formalism of the previous method, it is necessary to use a semi-formal or a formal language to write the rules.

It has been decided that the improved rules will be written in a semi-formal language. This choice seems the best way for striking a balance between a complicated language with a high level of formalism (which do not allow ambiguities) and a low level of formalism, which is easy to understand but ambiguous (as the natural language of [4]). The usage of a high level of formalism has been avoid in order to let the method usable by a business manager. This has to be considered because most of the people who will use the method probably do not have a lot of knowledge about formal languages.

However, this formalism should not be seen as a weakness because it reaches one of our goals by introducing more formal notations than the natural language used in [4]. In the same way, the usage of a pseudo-code is very close from a possible implementation without imposing a particular language for the implementation of the rules in future work.

The Sections from 3.2.3.1 to 3.2.3.10 show all of the improved templates and their associated rules. For some rules, some remarks or ideas for future work are proposed. These ideas concern new calls which might be introduced into the optional part of some templates. These new options could be used as basis for complementing the templates and make the method usable in more organizations due to a larger context.

3.2.3.1 Improvement of the Rule Associated to Template 1

Template 1: $<$*start offering,* resource$_j$*, to,* customer$_i$ $>$
[(start using existing *value activity*$_k$ XOR start producing *resource*$_j$ in *value activity*$_k$ XOR start procuring *resource*$_l$ from *provider*$_p$) AND receive *compensation* from *customer*$_i$]

Rules associated to template 1:

Primary action:

a. IF actor customer$_i$ is not present THEN add the actor customer$_i$.

b. Add one value exchange for resource$_j$ (in an existing or new interface) from the principal actor to customer$_i$.

Secondary action:

c. Add a new value exchange from customer$_i$ to the principal actor (as compensation for the resource$_j$ offered by the principal actor).
Connect the new value exchanges to an existing or new value activity of resource$_j$ within the customer$_i$.

d. IF start using THEN connect to the existing value activity$_k$ to the new value exchange.

e. ELSE IF (start producing AND $\neg$ Prev(T5))THEN call T5.

$\sigma = \{T5.resource_j/T1.resourcej, T5.valueactivity_k/T1.valueactivity_k\}$

f. ELSE IF (start procuring AND $\neg$ Prev(T5)) THEN Call T3.

$\sigma = \{T3.resource_j/T1.resource_l, T3.provider_p/T1.provider_p, T3.valueactivity_k/T1.value\_activi y_k\}$

In this rule, there are two subscripts for the resources. The resource$_j$ is offered to the customer$_i$. The resource$_l$ is the resource procured from the provider$_p$. Both resources can be the same but it will not always be the case. For instance, the resource$_j$ can be a raw material for the production of the resource$_j$.

This distinction between the subscripts is used for the substitutions of the names when a call happens. The actor can procure a resource$_l$ from a provider$_p$ to produce the resource$_j$ (with T3). But, in the case where the substitution is σ= {j / l} (which means replacing j by l), then the actor procures directly the resource$_j$ and offers it to its customer. It means that he only serves as intermediary.

In this rule, the function "Prev(T$_i$)" is used to prevent redundant changes (as explained in Section 3.2.2.3).

Note that in this rule, the assumption is made that the customer$_i$ wants to use the resource$_i$ in a new or existing value activity (c.). Therefore, the rule is introducing in each case a new value activity inside the customer.

3.2.3.2 Improvement of the Rule Associated to Template 2

Template 2: <*stop offering,* resource$_j$*, to,* customer$_i$>
[(stop procuring *resource*$_l$ from *provider*$_p$ XOR stop producing *resource*$_j$ in *value activity*$_k$)]

Rules associated to template 2:

Primary action:

a. Delete the duality value exchange concerning the transfer of the resource$_j$ from the principal actor to customer$_i$

b. IF actor customer$_i$ has no more interface with the outside THEN delete it.

Secondary action:

IF $\forall m \neq$ i : $\neg\exists$ value exchange concerning the transfers of the resource$_j$ from the principal actor to the customer$_m$ THEN

c. IF stop procuring THEN $\forall$ provider $_p$ related to the procurement of the resource $_j$ call T4
$\sigma = \{T4.resource_j/T2.resource_l, T4.provider_p/T2.provider_p\}$

d. ELSE IF stop producing THEN call T6
$\sigma = \{T6.resource_j/T2.resource_j, T6.valueactivity_k/T2.valueactivity_k\}$

In [4], the notion of "duality exchange" (in a.) is not defined. In this thesis, it is assumed that it represents a value exchange gathering both the resource$_j$ which is offered and its related compensation.

The condition beginning the secondary action can be considered as a predicate on the as-is business model. This predicate is introduced in order to match with the semantic of this template. This is due to the fact that this rule describes a break in the offering of the resource$_j$ to a particular customer$_i$. But, it is also possible that the organization is offering the same resource to some other customers. Therefore, the organization can only stop procuring the resource$_l$ or stop the production of the resource$_j$ if the customer$_i$ is the only customer for the resource$_j$. In the case where there are many customers, the only impact of this rules on the business model, is to delete the customer$_i$ and the value exchange related to the offering of the resource$_j$ to this customer$_i$.

3.2.3.3 Improvement of the Rule Associated to Template 3

Template3: <*start procuring*, resource$_j$, *from*, provider$_p$>
[((start using *resource*$_j$ in *value activity*$_k$) XOR (start offering *resource*$_j$ to *customer*$_c$)) AND start providing *compensation* to *provider*$_p$]

Rules associated to template 3:

Primary action:

a. IF actor provider$_p$ is not present THEN add the actor provider$_p$.

b. Add a new value exchange for the resource$_j$ from provider$_p$ to the principal actor.

Secondary action:

c. Add a new value exchange from the principal actor to the provider$_p$ (as compensation for the resource$_j$ offered by the provider$_p$).
Connect the new value exchanges to an existing or new value activity (production of resource$_j$) within the provider$_p$.

d. IF start using THEN connect the new value exchanges of the resource$_j$ to an existing or new value activity$_k$.

e. ELSE IF (start offering AND ¬Prev(T1)) THEN call T1.

$\sigma = \{T1.resource_j/T3.resource_j, T1.customer_i/T3.customer_c\}$

In e^{3}value, it is absolutely not compulsory to connect the value exchange of the resource$_j$ (the resource procured from the provider$_p$) with an existing value activity (or a new value activity) "production of resource$_j$" situated inside the provider$_p$ (in c.). However, it is obvious that the provider$_p$ has to produce the resource$_j$ to offer it. Consequently, there are three possible cases which can be treated by the fragment (c.):

- The value activity production of resource$_j$ is already present in the value model. Therefore the connection of the value exchange is done with this latter
- The provider was not present in the as-is value model. Therefore, the provider has just been added, and we can add the value activity for the production of the resource$_j$
- The provider was present but the value activity for the production of resource$_j$ is not present. Therefore, we can add this value activity to add more information on the business model

Consequently, in each case, the to-be business model produced will be more detailed.

3.2.3.4 Improvement of the Rule Associated to Template 4

Template4: <*stop procuring*, resource$_j$, *from*, provider$_p$>
[(stop offering *resource*$_l$ to *customer*$_i$) XOR (start producing *resource*$_j$ in *value activity*$_k$)]

Rule associated to template 4:

Primary action:

a. Delete the duality with the value exchange concerning the transfer of the resource$_j$ from provider$_p$ to the principal actor.

   If the provider$_p$ has no more interface with the outside THEN delete it.

Secondary action:

b. IF ((stop offering) AND (¬ Prev(T2)) THEN call T2.

   $\sigma = \{T2.resource_j/T4.resource_l, T2.customer_i/T4.customer_l\}$

c. ELSE IF ((start producing) AND (¬ Prev(T2)) THEN call T5.

   $\sigma = \{T5.resource_j/T4.resource_j, T5.valueactivity_k\ T4.valueactivity_k\}$

As it is visible, the test with the function Prev(Ti) is used to prevent the call to template 5 and 2. This comes from the problem of redundant changes mentioned in the Section 3.2.2.3. Notice that this template can be seen as an alternative to the insourcing if the part "start producing" is chosen.

3.2.3.5 Improvement of the Rule Associated to Template 5

Template 5: <*start producing,* resource$_j$*, in,* value activity$_k$>
[start offering *resource*$_j$, to, *customer*$_i$]

Rule associated to template 5:

a. IF the value activity$_k$ is not present THEN add the value activity$_k$ in the principal actor.

Secondary action:

b. IF Prev(T1)

b1. THEN connect the value activity$_k$ to the value exchange concerning resource$_j$

b2. ELSE connect the value activity$_k$ to the principal actor, then call T1.

$\sigma = \{T1.resource_j/T5.resource_j, T1.valueactivity_k/T5.valueactivity_k\}$

The rules associated to the template 5, 6, 7 and 8 are missing in [4] (due to space restriction). Therefore, these rules have been constructed following the same logic as the previous one.

Notice that in future work, it could be necessary, for a particular organization, to introduce other elements in the optional parts (e.g. `stop procuring resource`$_j$ `from provider`$_p$, `start using resource`$_j$ `in value activity`$_v$).

3.2.3.6 Improvement of the Rule Associated to Template 6

Template 6: <*stop producing,* `resource`$_j$*, in,* `value activity`$_k$>
[(start procuring *resource*$_j$ from *provider*$_p$) XOR (stop offering *resource*$_j$ to *customer*$_i$)]

Rule associated to template 6:

Primary action:

a. Delete the duality with the value_exchange from the value_activity$_k$ concerning the resource$_j$ within the principal actor.

b. IF resource$_j$ is the only value object produced in the value activity$_k$ THEN delete the value activity$_k$

Secondary action:

c. IF ((start procuring) AND ($\neg$ Prev(T2)) THEN call T3

$\sigma = \{T3.resource_j/T6.resource_l, T3.provider_p/T6.provider_p\}$

d. ELSE IF ((stop offering) AND ($\neg$ Prev(T2)) THEN call T2

$\sigma = \{T2.resource_j/T6.resource_j, T2.customer_i/T6.customer_i\}$

In future work, it could happen that some organizations require a `start producing resource`$_j$ `in value activity`$_k$ in the optional part.

3.2.3.7 Improvement of the Rule Associated to Template 7a

Template 7a: <*increase* fraction *of production of,* resource$_j$*, in,* value activity$_k$>

Rule associated to template 7a:

Primary action: no action to be taken here.

Secondary action: **empty**

Notice that in the Section 3.1.2.1 the template 7 of [4] has been divided in two parts to have two dual templates. In order to make easier the comparison between the method of [4] and the templates of this thesis, the two parts have been called T7a and T7b.

The absence of action in the primary action is explained by the fact that an increase of the production do not impact the business model in e^3value ontology. In this ontology, an increase of the production only changes the value in the data sheet linked to the model. As this data sheet is out of the scope of our thesis, the rule does not contain any action. As there is no optional part, there are not any action taken in the secondary part.

As future work, it could be interesting for some organization to introduce a `start offering` resource$_j$ `to a new customer`, or `start using` resource$_j$ `into value activity`$_k$ into the optional part.

3.2.3.8 Improvement of the Rule Associated to Template 7b

Template 7b: <*decrease* fraction *of production of,* resource$_j$*, in,* value activity$_k$>

Rule associated to the template 7b:

Primary action: no action to be taken here.

Secondary action: **empty**

3.2.3.9 Improvement of the Rule Associated to Template 8

Template 8:. $<$*insource* fraction *of production of,* resource$_j$*, in,* value activity$_k$$>$ (start producing *resource*$_j$ in *value activity*$_k$ XOR increase production of *resource*$_j$ in *value activity*$_k$) AND (stop procuring *resource*$_j$ from *outsourcer*$_o$)

Rule associated to template 8:

Primary action:

a. IF fraction of insource of resource$_j$ in value activity$_k$ = 100% THEN delete the dual value exchange between the principal actor and the outsource$_o$ concerning the resource$_j$ and its related compensation. Delete the outsourcer$_o$.

Secondary action:

b. IF start producing THEN call T5

$\sigma = \{T5.resource_j/T8.resource_j, T5.valueactivity_k/T8.valueactivity_k\}$

c. ELSE IF increase production THEN call T7a

$\sigma = \{T7.resource_j/T8.resource_j, T7.valueactivity_k/T8.valueactivity_k\}$

d. IF insourcing = 100% THEN call T4 and apply part (a) of associated rule

$\sigma = \{T4.resource_j/T8.resource_j, T4.provider_p/T8.outsourcer_o\}$

The last fragment of this rule is to call the fragment (a) of the template 4. It consists to delete the duality with the value exchange concerning the transfer of the resource$_j$ from provider$_p$ to the principal actor.

3.2.3.10 Improvement of the Rule Associated to Template 9

Template 9: <*outsource* fraction *of production of,* resource$_j$*, in,* value activity$_k$> [(stop producing *resource*$_j$ in *value activity*$_k$ XOR decrease *fraction* of production of *resource*$_j$) AND start procuring *resource*$_j$ from *outsourcer*$_o$]

Rule associated to template 9:

Primary action:

a. IF actor outsourcer$_o$ not present THEN create actor outsourcer$_o$

Secondary action:

b. IF ((stop production) AND (outsourcing= 100%)) THEN call T6 and apply part (a) to (b) of associated rule

$\sigma = \{T6.valueactivity_k/T9.valueactivity_k, T6.resource_j/T9.resource_j\}$

IF ((stop production) AND (outsourcing < 100%)) THEN ERROR

c. ELSE IF ((decrease production) AND (outsourcing <100%)) THEN call T7b

$\sigma = \{T7.resource_j/T9.resource_j, T7.valueactivity_k/T9.valueactivity_k\}$

d. call T3

$\sigma = \{T3.resource_j/T9.resource_j, T3.provider_p/T9.outsourcer_o\}$

In this rule, it is assumed that the choice of the business modeler is rational. Indeed, if the business modeler chooses to outsource 100% of the production of the resource$_j$, then he must also stop the production of the resource$_j$.

3.3 The Improved Method

The first subsection gives a summary of the improved method, its inputs and outputs (see Sect. 3.3.1). Then, the necessity to extend the method with a new input is discussed (see Sect. 3.3.2).

3.3.1 Summary of the Improved Method

The purpose of the method is to align two models located at two different levels. The first model is the goal model. It is situated at a strategic level and expresses the goals and strategic objectives of an organization. This model is designed by a goal modeler with the $i^\star$ ontology.

The second model is a business model. It is situated at the level below the goal model : the business level. It expresses the value exchanges between an organization and its environment. This model is designed by a business modeler with the e^{3}value ontology. This model has to reflect the strategic objectives of the goal model.

At the beginning of the method, the organization needs to have an as-is goal model and as-is business model. These as-is models express the current state of the organization at the strategic and business levels. It is assumed that these models are aligned (meaning that the business model reflects the strategic objectives of the organization).

One day, the organization may decide to change its strategic objectives. These changes concern the introduction of new elements inside its as-is goal model (e.g. new actors, new goals, etc.) In order to show how the organization can achieve its new strategic goals, the goal modeler must add new tasks (means) in its goal model (as the $i^\star$ ontology suggests). The output of this transformation of the goal model is called to-be goal model.

Due to this changes introduced at the strategic level, the as-is business model is no more aligned. Therefore, the method proposed in this thesis suggests that each means introduced into the as-is goal model (in order to produced the to-be goal model) has to match with one of the templates. It means that it must be possible to formulate the means with a template in which the variables are substituted to elements of the goal model (e.g. resources, actors, etc.). By proceeding this way, all new means highlighted in the to-be goal model (which allow to achieve the new goals of the organization) can match with a template of the method.

Each template has an optional part describing what are the different possibilities to reach the objectives of the means (e.g. what the organization has to do for offering a resource to its customer, produce or procure a resource). Notice that in this method, most of the elements situated into the optional part of a template are links to other templates. As these possibilities are closer from the business level, it may be impossible for the goal modeler to fill them in, because of lack of information. Therefore, for each template the business modeler will complete the optional part if necessary.

The method associates to each template a transformation rule described in a semi-formal language. This rule implements the templates in terms of e^3value transformations. For each template highlighted in the to-be goal model or for each template called by the template highlighted, the associated rule is applied on the as-is business model. Thus, the as-is business model is continually transformed until every template has been applied.

At the end of the application of the different rules associated to templates, the as-is business model is fully transformed and called to-be business model. This model is aligned with the to-be goal model because it has been transformed according to the new means which allow to reach the new goals of the organization.

Figure 3.42 illustrates in a graphical form the principle of the improved method of alignment.

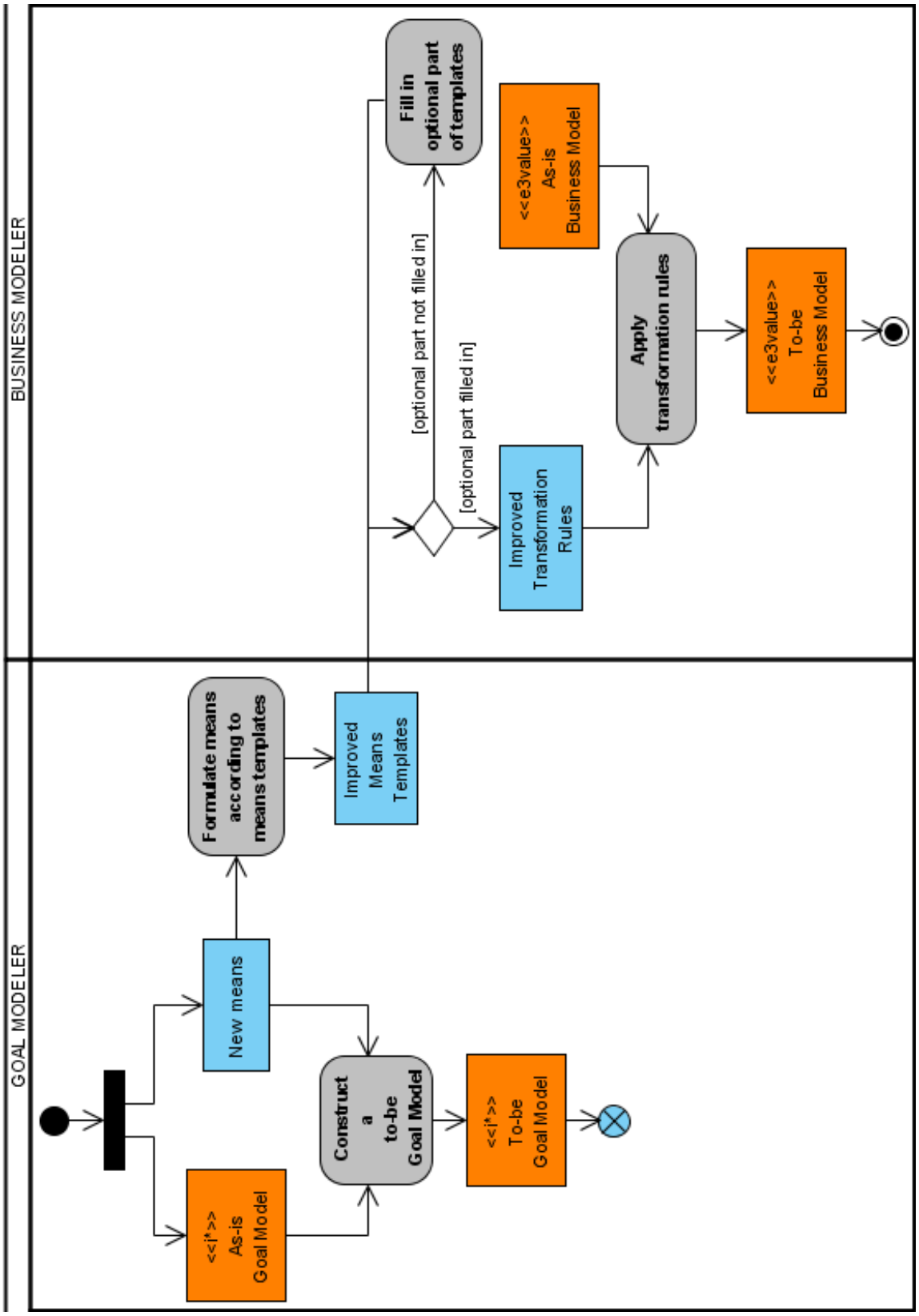


Figure 3.42: *How the improved method aligns a goal model with a business model*

3.3.2 Why Use an As-is Business Model ?

As the goal and the business models are situated in a layered view (as represented in Figure 1.3), the reader could think that the production of a to-be business model could only be based on a goal model without requiring an as-is business model.

This idea can be equated to the production of a physical scheme in some database method. Starting with a logical scheme, a relational scheme is drawn, and only after, a physical scheme is drawn. Thus, the following question could be asked: why use an as-is business model in order to produce a to-be business model while it could maybe only possible to use a to-be goal model, templates, and the associated rules to produce a perfectly aligned to-be business model ?

The advantages of a such solution can be interesting in many cases for several reasons: lack of time for drawing the as-is business model, lack of knowledge about e^{3}value, etc. The advantages linked to this idea would be mainly time saving, less efforts, and would permit an easier transition to an automatization of the alignment method.

But, actually, the real cases where the method can be applied with an empty as-is model are rare. Most of the time, companies will use the method suggested in this thesis to see the impacts on their current business. For example, a company needs to check what will be the impact of starting to outsource the product z and starting to procure a good w from producer p. Moreover this organization will probably want to do that only according to its current business. Therefore, if the method is not taking as input an as-is business model, it could draw a to-be business model completely different from the running organization. Consequently, in this thesis, it has been considered that it was necessary to keep the as-is business model as input.

Thinking further, the previous idea of working without an as-is business model can also be applied in the templates and rules approach suggested in this thesis. It means that in the case of a new company, the current templates and rules approach is also able to take as input an as-is business model which is empty or at least contains the organization (main actor). In this last case, the as-is business model can be perfectly transformed by the rules.

Thus, keeping an as-is business model as input enables to see the possible changes which occur at business level, without drawing a completely different model for the organization. However, an empty as-business model can also be used to fit the case of a start-up company or a complete reorganization of an existing company.

3.4 Discussion about the Improvements

This section discusses about the improvements made in this chapter. The first subsection (see Sect. 3.4.1) aims to summarize the approach followed for the improvement of the templates and the rules of [4]. Then, some justifications for the choices made in this thesis are evoked (see Sect. 3.4.2). Finally, the arguments regarding to the completeness and the coherence of the improved method are discussed (see Sect. 3.4.3).

3.4.1 Methodology Followed for the Improvement

In some cases, it is not possible to demonstrate the accuracy of a method. Indeed, all the possibilities can not be tested in an exhaustive way. In such cases, the only thing we can do is to highlight the issues in the method, propose solutions for them, show that these solutions correct the issues in the right way and test the method on some cases to check the improvement.

However, what can be analyzed is the approach followed to improve the method. This analysis serves as basis for judging the consistency of the method. Therefore, as this chapter concerns the improvement of the method of [4], this section aims to clarify the approach followed in this thesis which led to the improved templates and rules based method.

In a first time, issues have been highlighted into the templates. These issues have been classified in two types: syntactical issues and other issues (in Sect. 3.1.1 and 3.1.2). Each issue has been illustrated in this thesis by a template from [4]. Obviously, some issues are present in many templates. That is why, for every issue a general solution has been proposed.

Then, when all issues have been identified and when the solutions have been suggested, all the templates of [4] have been corrected. From this time, the list of improved templates has been showed next to list of the previous templates to make the comparison possible (in Sect. 3.1.3). Finally, the improved templates have been written in a higher level of formalism with a well founded syntax defined by a BNF grammar (in Sect. 3.1.4).

A little more further, UML activity diagrams have been used to represent the templates. This graphical notation has made the templates more explicit for the future users of the method (in Sect. 3.1.5). This ease of use comes from the activity diagrams because they allow to organize temporally the different elements situated inside the textual templates.

Finally, the last parts of this section relate to the templates aimed to correct some inconsistencies and informal elements from [4]. These improvements are : the switch from implicit to explicit calls between the templates with the subscripted variables inside the templates (in Sect. 3.1.6); the explicit explanation of how to link the goal model with the templates (in Sect. 3.1.7); the introduction of some scheduling conditions between the templates to avoid inconsistencies in the output (in Sect. 3.1.8).

In a second time, a section has been dedicated to the rules. An distinction has been made between the rules and the templates in order to clarify the ideas for the reader (in Sect. 3.2.1). Then, some issues have been highlighted in the rules of [4]. For each issue, an illustration has been given. As the issues happened most of the times in many rules, a general solution was proposed (in Sect. 3.2.2). At the end of this section, the general solutions have been applied on each rule (in Sect. 3.2.3).

In a third time, a section has been devoted to the whole method. The first part of this section gave a summary of the method. This summary showed the different inputs and outputs of the improved method and how the templates and the rules could be articulated (in Sect. 3.3.1). Regarding to the inputs, a discussion has been made about the importance of the as-is business model (in Sect. 3.3.2).

Notice that, the test on a real-life case study, and the comparison between [4] and the improved method of this thesis is addressed on a separate chapter (see Chapter 4). This case study will be the basis for a discussion about the improvements realized in this chapter.

3.4.2 Choices Justification

Like in every work, choices have to be done. The most important choices done in this thesis concern the level of details and the level of formalism used in the rules. These choices can be well justified by the fact that most of the time, the method will be used by managers and not by programmers. It is conceivable that people will take time to acquire some notions introduced in this thesis like the frameworks use, how to apply the templates and the rules, the substitutions, etc.

Therefore, in order to keep a maximum of clarity and ease of use, it has been decided to do not introduce other details which could be make the method non understandable by these people. For this reason, the notion of interfaces, ports, start/stop stimuli, or the possibility to make complex value exchanges through different interfaces have not been introduced within the rules.

The same reason has motivated the choice to use a semi-formal language instead of fully formal language for the rules. While the method is not implemented into an automated process, the use of a high level of formalism is not desirable. Indeed, if it is too formal, it will restrict the number of users of the method and will make the steps of the method harder to follow. However, notice that the usage of a semi-formalism chosen in this thesis does not really represent a weaknesses with respect to choices made. Actually, in this thesis, we passed from the natural language of [4] to a semi-formal language. This switch allows to strike the balance between the understanding of the method and the possible ambiguities.

3.4.3 Completeness and Consistency of the Method

According to the approach described previously, there are many reasons to think that the method better reaches what it aims to: aligning a goal model with a related business model.

In order to obtain this alignment, a particular method must go through the following steps :

1. Identify all new strategic objectives of the organization
2. Identify possible choices for reaching these objectives, and the different consequences of the strategic objectives at business level
3. Choose between different alternatives proposed to reach the new objectives of the organization
4. Translate the choices taken and the consequences in terms of business ontology
5. Introduce in a consistent way all the necessary changes at business level, without introducing irrelevant or inconsistent transformations

1. Two possible cases are addressed by the improved method to identify the new objectives.
The basic case is when an organization does not have an as-is goal model (e.g. a start-up company). In this case, the method will highlight all the new means (introduced in the goal model) which are achieving all of the goals (because all these goal are new).
The more general case is the case of a company which already has an existing as-is goal model. When passing from the as-is goal model to the to-be goal model, the goal modeler has to highlight to new means introduced into the as-is goal model. That allows the organization to achieve its new goals (as explained in 3.1.6).
In both cases, the goal modeler has to use and instantiate the compulsory part (and complement the optional part if possible) of a suggested template for naming each new means (e.g. start offering computer to Faculty Of Namur).

2. The different templates used to express the means (as explained in 1.) are related to this part. For each template, the possible choices and consequences are situated into the optional part. As the goal modeler may have a lack of information about the business possibilities, the business modeler needs to complete this part (if the goal modeler was not able to do it).

3. The choice between the different alternatives is made by the business modeler with the elements situated into the optional parts of the templates. For helping the business modeler to decide, he can have a look at the graphical representation of the templates (which clearly reveals the possible choices). By transitivity, as the templates match with the means, and as the means are achieving the new goals of the organization, the templates are also achieving the new goals of the organization.

4. The method associates a rule to each template. Each rule implements, in terms of business notion, the elements stated in the templates. With the use of the same subscripts for some variables situated inside the templates, and these situated in the rules (which refer to the same elements), the variables of the rules can also be instantiated in relation to elements situated into the templates. By transition, the variables situated into the rules are instantiated at the execution with the elements situated into the to-be goal model.

5. The necessary changes are introduced at the execution of the rules. As the method suggests it, the templates can be represented by a tree (due to the calls between the templates linked to the choices made in the optional part , as in Fig. 3.30). For each leaf of the tree, an associated rule will be applied on the as-is business model. When the last bottom-right leaf of the tree is reached, the as-is business model is then completely transformed and aligned with the to-be goal model. Hence, it is called to-be business model.
It is important to notice that each rule modifies the business model as expressed by the semantic of the associated template. Actually, for each part of a template (the compulsory part, and the elements of the optional part) there is a part in the rule which implements the changes into the business model. Moreover, even if a rule contains the whole implementation for all elements situated in the template optional part, the rule only introduces the necessary modifications on the business model. This is due to the semi-formalism used. It contains "IF,THEN,ELSE" statements and allows the business modeler to choose an alternative in the optional part of the template.

Regarding to the completeness and the consistency of the improved in method, the templates and the rules still have to be discussed. One important thing to notice is that each template is highly context dependent. It means that a particular organization may find a template useful, while another organization may find it useless. This is related to options situated within the optional part reflecting the possible choices offered by the method to the goal and business modelers.

For example, in this thesis, the template which represents the offering of a resource to a customer models the offering of the resource with a post-payment. However, a particular organization might find this template useless because the organization needs a pre-payment or other alternatives. Following the same logic, a particular organization might need a <start outsourcing, resource_j, from, outsourcer_o> as option to get the resource to offer within the template <start offering, resource_j, to, customer_j>.

However, as one goal of this thesis was to improve the list of templates proposed in [4], the semantic proposed by the authors of [4] has been reused as basis for the context.

Therefore, not any new elements have been introduced in the optional parts in order to focus mainly on the improvements of the existing templates and rules of the approach. However, a basis for future work is build up: a BNF grammar for the templates (see Sect. 3.1.4), scheduling conditions 3.1.8, ideas for new options in the optional part of the templates (see Sect. 3.2.3), etc.

About the consistency of the improved method, a template and its associated rule have to be seen as a tool to produce consistent transformations on the business model. “Consistent transformation” means that the rule associated to template will modify the business model with respect to the semantic of this template. Consequently, as the method application uses a set of templates that makes consistent transformations, the result of the method can be seen as a consistent transformation as well.

Chapter 4

Case Study

Now that some changes have been proposed for the method of [4] in the previous chapter, it is necessary to compare the results of the method of [4] and the improved method suggested in this thesis.

Therefore, this chapter illustrates the templates and rules based approach with a real life business case : a Massively Multiplayer Online Player company (MMOG). This case was not chosen at random. At the origin, this case has been imagined by [1] to test another method. Then this case was used to illustrate the method of [4].

This chapter starts off by explaining the context of the MMOG company. As the method consists of the alignment between a goal and a business model, the introduction of the case study is divided into two parts.

The first part of the introduction gives some information about the MMOG company. It defines mainly the actors and their strategic objectives. This information constitutes the basis for creating the as-is goal and business model.

The second part of the introduction reveals the changes which could appear in a few years in the strategic objectives of the MMOG company (see Sect. 4.2). These changes are considered as the basis for the construction of the other input of the method (the to-be goal model). As this section introduces changes at the strategic level, some strategic objectives will no more be reflected in the as-is business model. This unalignment constitutes the motivation for application of an alignment method.

Once the different necessary elements for the case study have been introduced, both methods, the previous method of [4] and the new improved method, are applied separately. Section 4.3 explains the results obtain in [4] with the application of the previous method on this case. The Section 4.4 constitutes the application of the improved method on the same case. These applications are respectively done according to the methodology suggested by the Figures 2.13 and 3.42.

Finally, this chapter concludes with a discussion in Section 4.5. This discussion relates to the improvements made on the method of [4]. It aims to compare the results produced with both methods basing on the methods application detailed in Sections 4.3 and 4.4. This comparison shows how the method of [4] is improved and extended. These differences are underlined with the problems highlighted in the Chapter 3 and the elements produced in the case study.

4.1 Presentation of the Case

This case study concerning a Massively Multiplayer Online Player company (MMOG) has been imagined in [1]. In this paper this case is described as follows : the case *"is useful for those studying or building new business models, since the approach is more sensible to social and technological aspects of digital economies*" [1]. Moreover, this case study has already been used to test the previous method of [4]. These two elements motivate to use the same context to try our approach and to compare the results obtained by both methods.

A MMOG is a game in which thousands of players around the world can participate via Internet

and compete with each other within the same game. The most popular online games are: *Sony's Star Wars Galaxies*, *Blizzard's World of Warcraft* and *Final Fantasy XI*.

In this case, the main actor is represented by the MMOG provider. Two other actors interact with him: the *Internet Service Provider* (ISP) and *the players*. The ISP plays the role of a business associate, and the players represent its customers.

The MMOG company has mainly two responsibilities: to produce oneself the game content and to distribute the game client application on a CD. With the service of its business associate (the ISP), the MMOG company can distribute the information which is necessary to play via Internet.

The revenue model for the MMOG company is based on a fee to get access to the game server. This payment gives the right to access in a unlimited way to the game during a certain period of time (usually US$10 per month). Obviously, the players need to be connected to internet to play. For this internet connection, they have to pay the ISP.

4.2 Changes in the Organization

Some time after its creation, the MMOG company will probably acknowledge that some goals have changed or can be supported by new activities. These changes rise new ideas based on the experience acquired by the MMOG company. According to [1], the changes are the following.

Change 1. One new goal will be an **easier distribution of the CD**. For this, the MMOG company will probably try to **outsource the production of CD delivery**. The MMOG company will use the services of a shipper. Indirectly, that will contribute to increase the number of players and thus the longevity of the gameplay.

Change 2. The MMOG company will also try to **reduce her cost of content creation** (3D modelling) in order to increase her incomes. For this reason, the MMOG company will offer to the users the possibility to create new contents for the games. Actually, some of the players are professional designers who want to make money. Thus, the MMOG company will **outsource 50% of the game content**.

Change 3. The MMOG company will probably realize that most of its outcomes are coming from the story boarding. One of its new objectives will be to **reduce the cost of story boarding.** For this reason, the MMOG company will probably notice that a huge part of its customers are able to write themselves very good game stories. Thus, the MMOG company will think about **procuring game stories from customers.**

Change 4. The MMOG company will acknowledge that it will **need more users** to ensure the longevity of the gameplay. In order to attract more players, the MMOG company will **offer free trial games**.

4.3 Presentation of the Application of the Previous Method [4]

This section aims to show the results of the application of the method as presented in [4]. Actually, it is noticed in [4] that their case is a subset of a real case. However this subset takes

enough actors and relations between them to test the method. Consequently, later while testing the method suggested in this thesis in Section 4.4, the same level of abstraction is used in order to compare the results of both methods. The methodology followed is the one summarized in Figure 2.13.

The first section (see Sect. 4.3.1) shows the as-is goal model in the BMM framework and the as-is business model in REA and e^{3}value framework. These models are displayed as stated in [4]. Although this REA business model is not used in the method suggested in this thesis (and could therefore not be used for a comparison), it is interesting to show how the business model in e^{3}value framework would probably be more expressive for the future users of the method.

Then, in Section 4.3.2, a to-be goal model is constructed regarding the templates of [4]. After the application of the method, a to-be business model is produced in output.

4.3.1 As-is Models

4.3.1.1 Goal Model: BMM

In [4], the authors have drawn a goal model using BMM ontology. This goal model has been created regarding to the elements of the case introduced previously in Section 4.1. This goal model is displayed on Figure 4.1. Notice that this goal model has been used in this thesis, as an example for the introduction of the BMM framework (see Sect. 2.1).

It is important to note that, in this thesis, this figure is called “as-is goal model with BMM”. However, in [4], there is no mention of “as-is goal model”. Moreover, in [4], the figure is called “Excerpt of a goal model for the MMOG case”. The authors were perhaps thinking about this notion of as-is goal model implicitly.

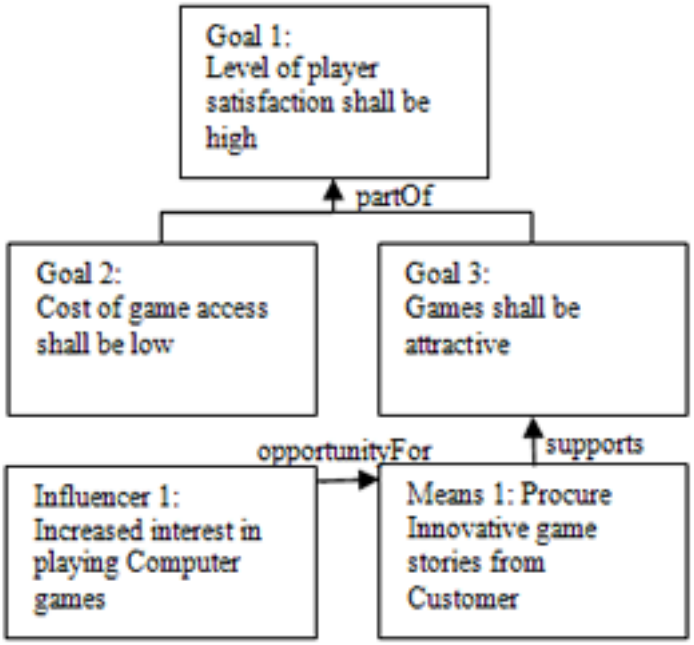


Figure 4.1: *Previous method : as-is goal model with BMM (Source: [4])*

4.3.1.2 Business Models: REA and e^{3}value

This subsection aims to present the as-is business models used in [4] for the application of their method. Actually, in [4] two as-is models are presented. Both of them are expressing the ideas of the case as introduced in Section 4.1. Figure 4.2 uses the REA framework, while the Figure 4.3 uses the *e*^{3}*value* framework.

The first figure is extracted from the last published version of [4]. The second figure comes from a draft for a new version of [4]. This latter is a translation of Figure 4.2 into the e^3*value* framework by the authors of [4]. Although the business model in e^3*value* is unpublished it has been suggested by the authors of [4] to show it in this thesis to allow a better comparison between both methods. It is also interesting to display the figure in REA framework to allow a comparison between a model in REA and another one in e^3*value* which relate to the same organization.

Figure 4.2 has been used in Section 2.2 for the illustration of the REA framework.

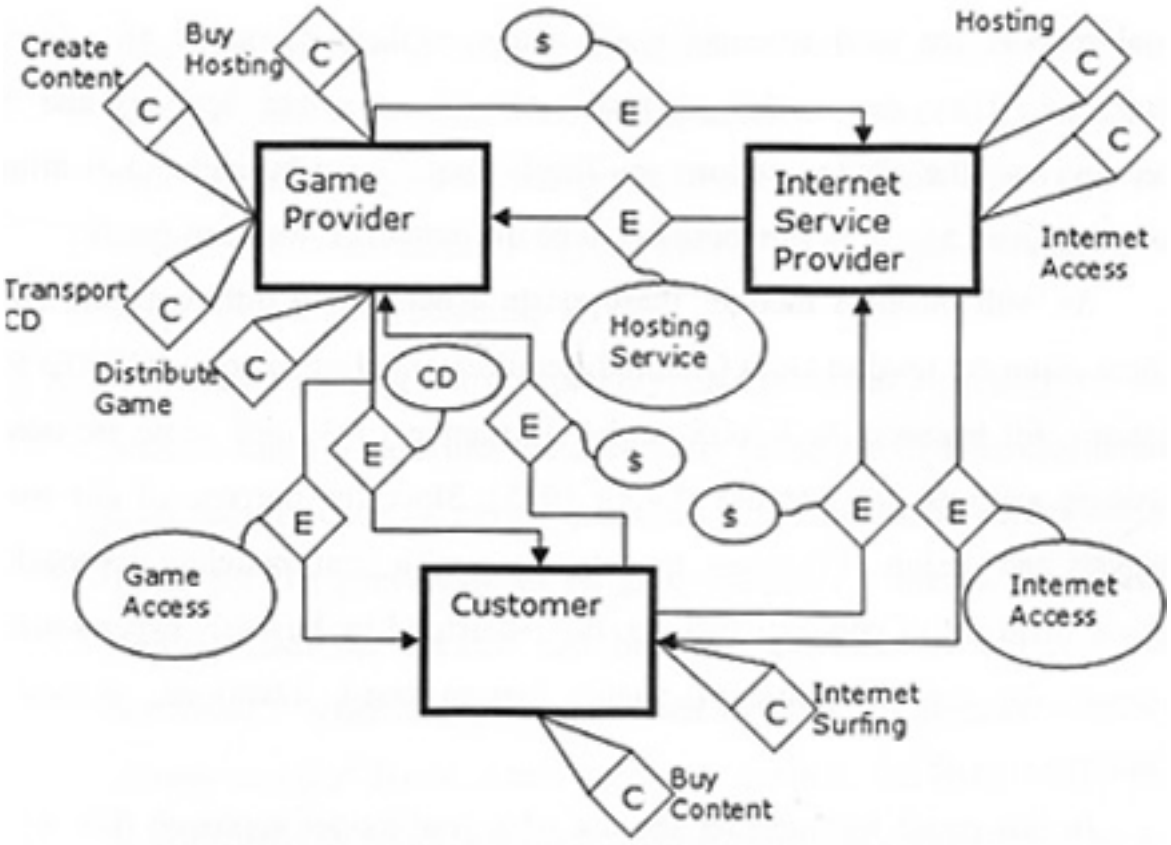


Figure 4.2: *Previous method: as-is business model with REA (Source: [4]).*

The Figure 4.3 is the translation of the Figure 4.2 in the e^3*value* framework. Consequently, the actors, the resources, exchanges, etc. have the same semantic as in Figure 4.2. In this e^{3}value business model, some stereotypes are situated. It seems that these stereotypes come from the translation. However, there are not any explanation in [4] about these latter.

The reader should also notice that Figure 4.3 is shown as stated in [4]. It is visible that it is not exactly the formal e^3*value* syntax (e.g no interfaces, ports, etc. are visible). As the rules of [4], do not care about so many details, maybe the authors preferred not to show these details

in the as-is business model.

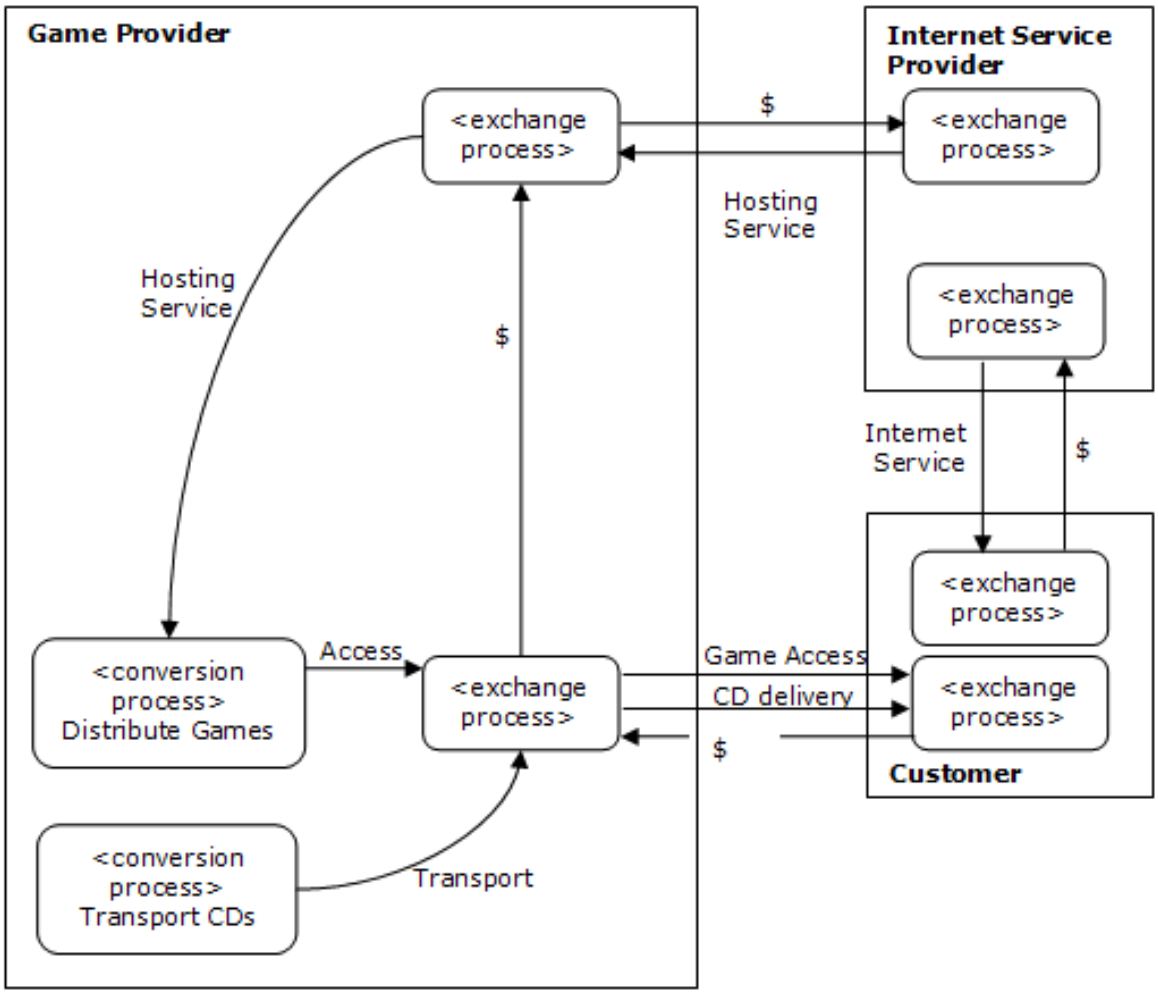


Figure 4.3: *Input of the previous method: as-is-be Business model with e^3value (Source: [4])*

4.3.2 Construction of the To-be Models

As introduced previously in Section 4.2, some changes could occur at the strategic layer of the MMOG company and in its environment. Therefore, in [4] a to-be goal model is suggested. This goal model is depicted in Figure 4.4.

In [4] this goal model is interpreted as follows : *"In most cases economic resources are explicitly modeled in each means, for instance in Means 1: "Outsource CD delivery", the resource affected is "CD delivery". In mapping these means onto the corresponding templates it is, however, assumed that the explicitly present resources (and corresponding exchange events) are related to additional exchange events in the opposite direction (forming a duality), most commonly payment for receiving a good or service. In some cases other ways of providing compensation for a value transfer are present, such in the case of Means 2: "Offer Free trial games to customer". Here the game provider offers the resource "Free trial games" to the Customer, and receives the resource "Attention" in return".* Notice that although the "CD delivery" is a service, it has also been considered as a means in [4]. This can be justified because the CD delivery probably needs

some activities (as the packaging) to deliver.

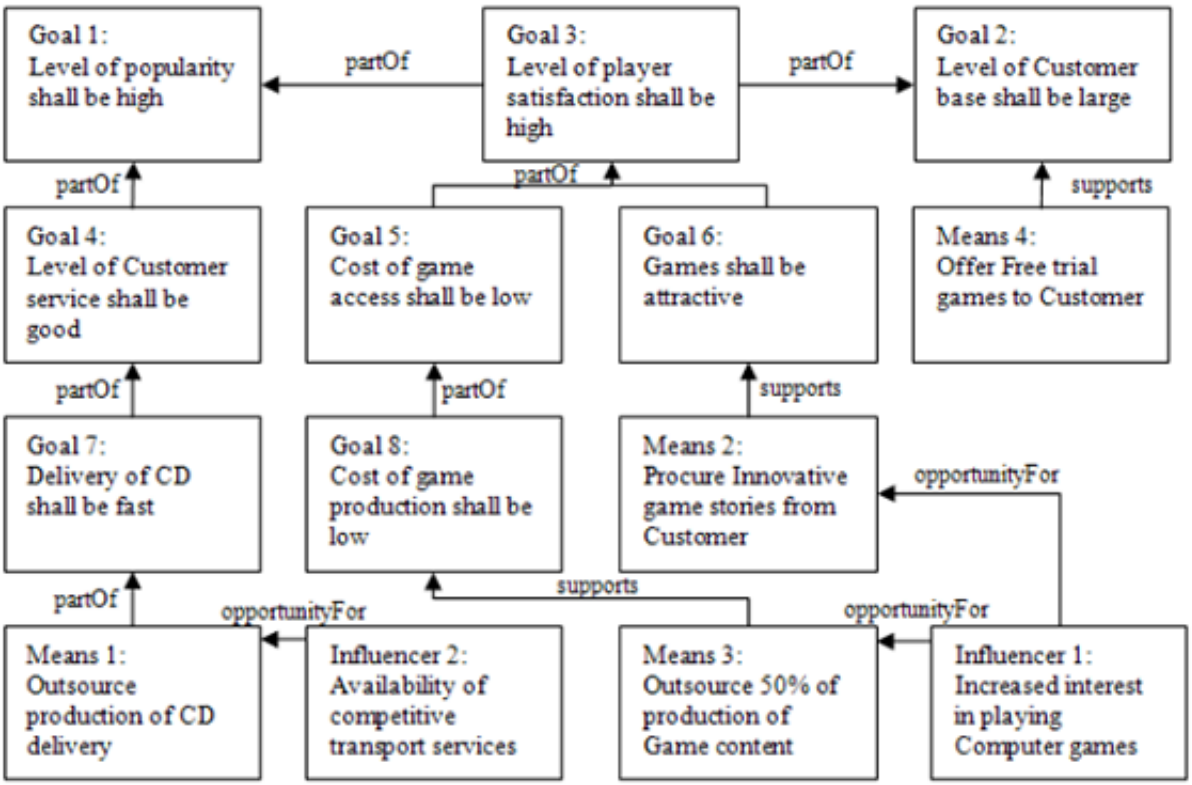


Figure 4.4: *Input of the previous method: to-be goal model with BMM (Source: [4]).*

According to [4], some templates have been used to construct the means of the goal model used as input of the method. The means formulated according to the templates are the following :

- Means 1: Outsource production of CD delivery
- Means 2: Procure Innovative game stories from Customer
- Means 3: Outsource 50% of production of Game content
- Means 4: Offer Free trial games to Customer

4.3.2.1 To-be Business Model

As for the as-is business model, this section presents two to-be business models stated in [4]. The first model is illustrated in Figure 4.5 with the REA framework. The Figure 4.6 is its translation in e^{3}value framework.

Actually, the to-be business model in Figure 4.6 should not be displayed in this thesis because it has not been published yet. However, the authors of [4] have advised us to show it, in order to allow the comparison between the output of their method and the improved method suggested in this thesis. Moreover, showing the REA and the e^{3}value frameworks in the same time, allows the reader to understand why a switch of ontology (from REA to e^{3}value) has been done in the improved method.

These figures have the same semantic as these presented for the as-is business models (in Sect. 4.3.1.2). However, in these to-be business models the elements stated in the Section 4.2 have been introduced.

In [4], it is written that these to-be business models are obtained by application of the rules. These latter are associated to the templates used to express the means inserted into to to-be goal model. These different templates and rules of [4] have been introduced in Chapter 2.

However, the reader should notice that some rules have not been shown in the Chapter 2 during the presentation of the method of [4]. Actually, the rules associated to the templates 5, 6, 7 and 8 have not been defined in [4] due to space restriction[1].

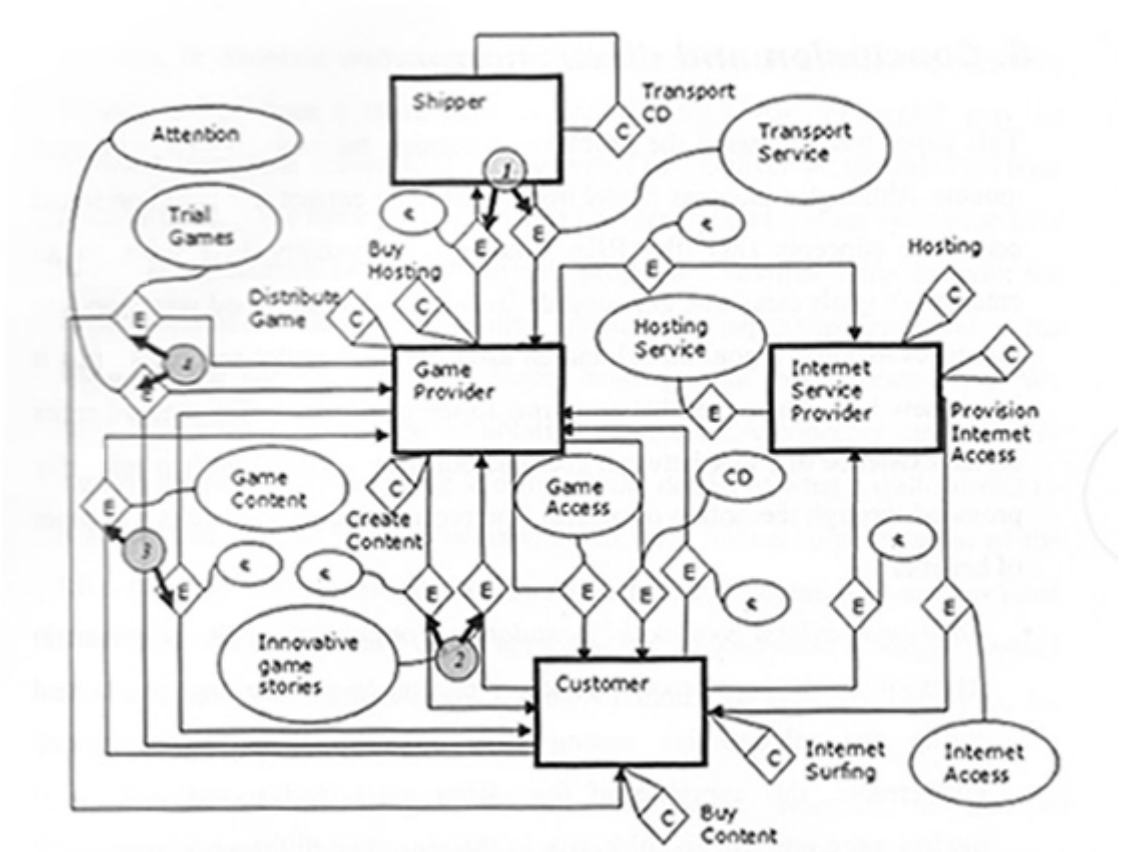


Figure 4.5: *Output of the previous method: to-be business model with REA (Source: [4])*

[1]Notice that these rules have been added in the improved method suggested in this thesis.

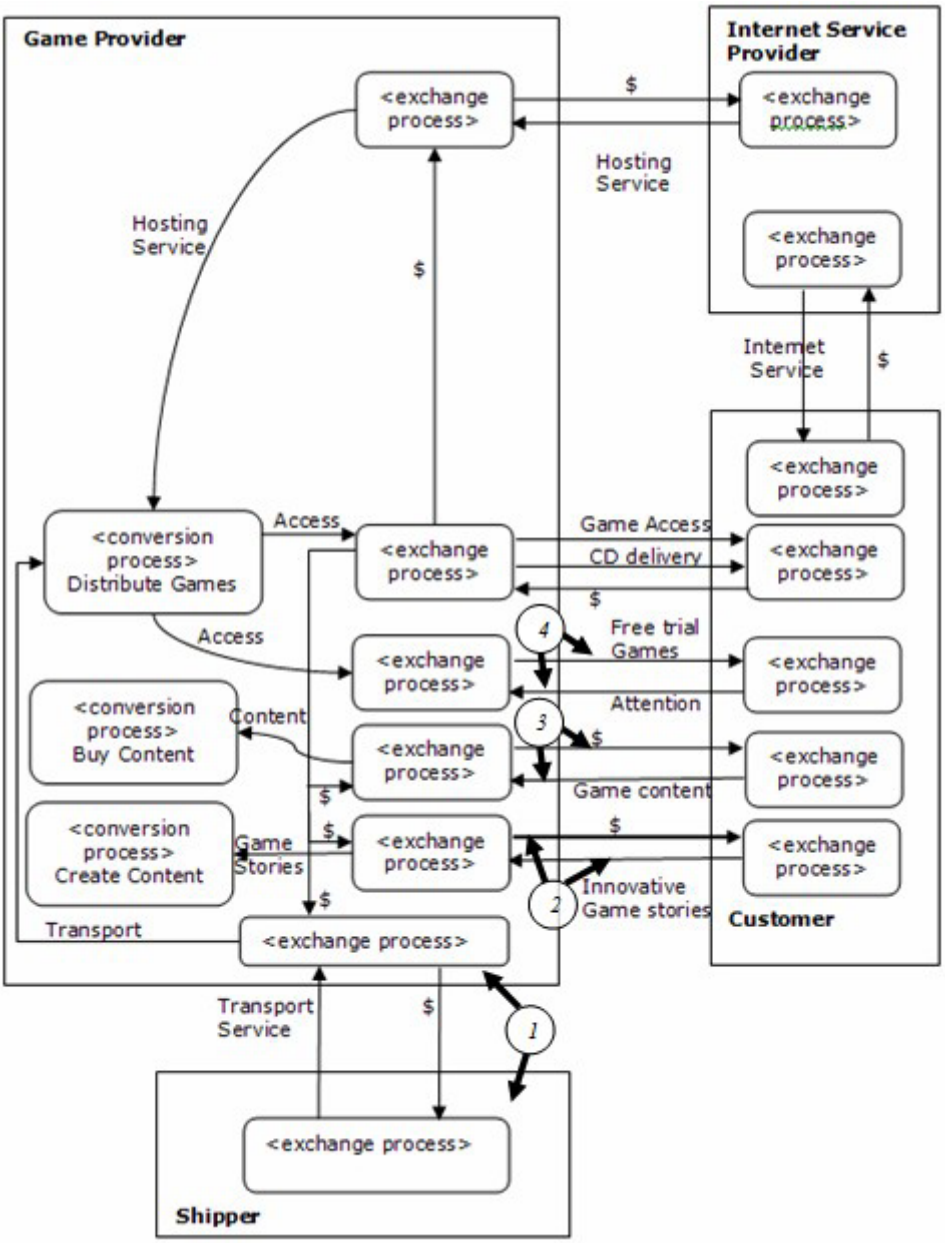


Figure 4.6: *Output of the previous method: to-be business model with e^{3}value (Source: [4])*

4.4 Application of the Improved Method

This section illustrates the application of improved templates and rules on the MMOG case study. In the improved method a switch of ontology is introduced, thus, $i^\star$ is used instead of BMM, and e^{3}value is used instead of REA.

The reader should notice that the methodology used in the improved method is a bit different from the methodology of [4]. Consequently, this application is done according to the methodology stated previously in Section 3.3.1. However, both methods are producing a to-be business model which will be compared at the end of the case study.

The first subsection (see Sect. 4.4.1) constructs the inputs of the improved method : the as-is goal model, and the as-is business model. After that, in Section 4.4.2, the to-be goal model is introduced to take in account the strategic changes of the organization. Then, the improved method is applied to produce the aligned to-be business model.

4.4.1 As-Is Models

4.4.1.1 Goal Model: *i*⋆

Figure 4.7 is a goal model designed with $i^\star$ framework. It represents the as-is goal model of the organization. It will be used as input for the improved method. This model has been drawn by looking at the same statements of the case than the previous method (see Sect. 4.1).

This model can be understood as follows :

The most important goals in the MMOG company is the economic viability of the company on a long term. This goal is divided in two subgoals : **longevity of the gameplay** and the **scalability of the infrastructure**[2]. In general, it is not easy to achieve them.

The MMOG **creates** and **distributes content** in order to ensure the longevity of the gameplay. The activity of creation is divided in three sub-activity: **story boarding**, **3D modelling**, **game programming** and **game designing**. The distribution of this content is provided with the **hosting service** provided by the ISP. The ISP gets a payment for this service.

The **satisfaction of the clients** represents a softgoal. As long as the clients are satisfied, the longevity of the gameplay is ensured. This **satisfaction** depends mainly of the **access cost** (which must be low) and the **attractiveness of the game**. To supply the game to its clients, the MMOG company **distributes the game on CD**. This helps to reduce the cost for the hosting service.

A **customer** wants to **have fun**, so he can **play to MMOG software** to achieve his goal. However, in order to play he needs to **buy the CD** which contains the client application. He also has to **pay for an internet connection** to ISP.

Although this as-is goal model in $i^\star$ (see Fig. 4.7) could seems different of the as-is goal model in BMM presented in [4] (see Fig. 4.1), this $i^\star$ goal model has been constructed cleverly. It means that it has been constructed to let possible the introduction of the same means as in [4] in order to use the same templates and rules than in [4].

[2] Actually it can be considered that at long term, the scalability of the infrastructure will contribute to make profit by reducing the costs

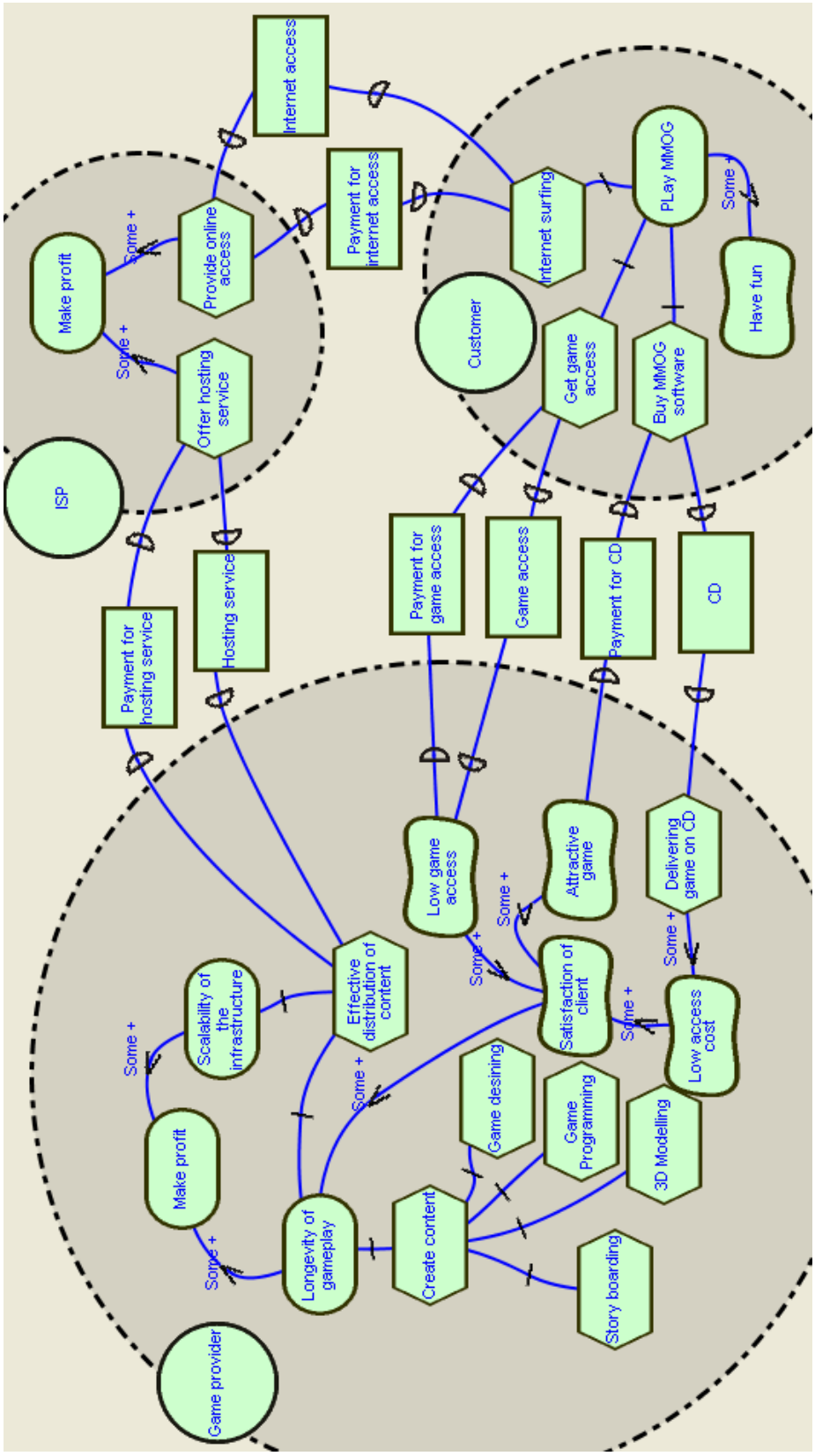


Figure 4.7: *Input for the improved method: as-is goal model with i**

4.4.1.2 Business Model: e^3 value

Figure 4.8 presents the as-is business model of the MMOG company. This model has been designed from the statements of the case (see Sect. 4.1). It is assumed that this model is aligned with the as-is goal model of the MMOG company (see Fig. 4.7). The semantic of the elements situated in this model is the same as the semantic of the elements situated in the as-is business model of the previous method (see Sect. 4.3.1.2).

Some readers could think that it is more logic to include the value activities “buy hosting”, “create game content”, and “transport CD” in the value activity “distribute content”. The current element which motivate the place of these value activities is that neither the rules of the improved method, nor these of [4] can deal with sub-value activities.

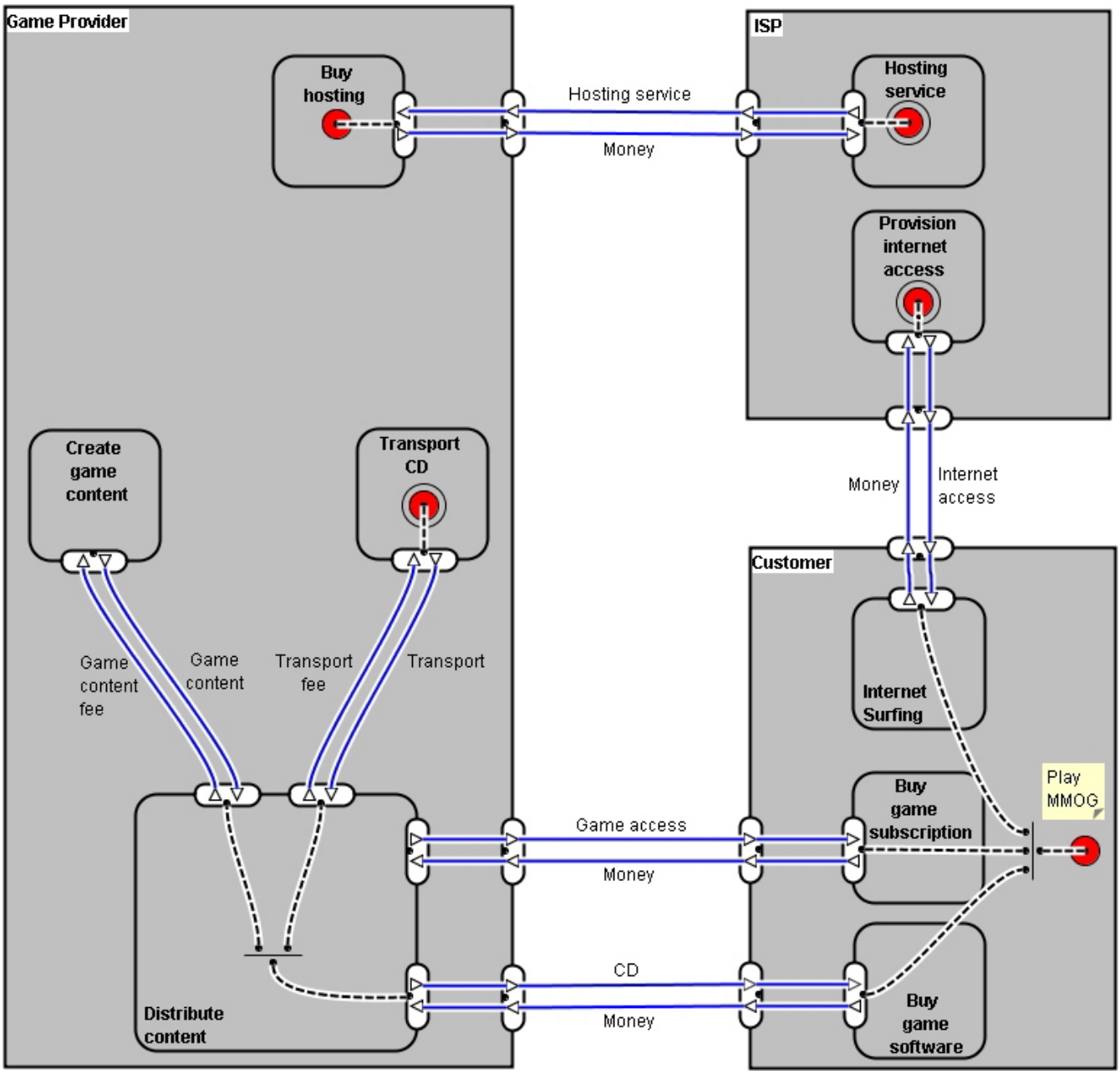


Figure 4.8: *Input for the improved method: as-is business model with* e^3*value*

4.4.2 Construction of the To-be Business Model

Section 4.4.2.1 presents the to-be goal model which includes the new goals and new means of the organization (as stated in Sect. 4.2).

Then, in Section 4.4.2.2, the new means which allow to satisfy the new goals are highlighted on the to-be goal model. Notice that this highlighting of the new means in the to-be goal model is not present in [4]. The reason which motivates this step it that it constitutes a lack of methodological support in [4]. This problem has been enounced in Section 3.1.7 in order to introduce a formal link between the to-be goal model and the templates.

With the templates associated to the new means, Section 4.4.2.3 is applying the associated rules on the as-is business model.

The last section (see Sect. 4.4.2.4), presents the aligned to-be business model[3].

4.4.2.1 To-be Goal Model

In the improved method, we suggest to design the to-be goal model by adding some new tasks, goals, actors, etc. in the as-is goal model (see Fig. 4.7). These elements are inserted to reflect the new strategic objectives of the MMOG company (see Sect. 4.2). It is important to notice that the names of the new tasks (also called "means") have to be similar with the names of the suggested templates. It means that it must be possible to match the means with one of the ten templates with a substitution.

All of these new elements inserted in the as-is goal model to form the to-be goal model have been highlighted in the model in Figure 4.9.

The four new goals for the MMOG company in the to-be business model are :
1. Easier distribution of the CD,
2. Reduce the cost of content creation,
3. Reduce the cost of story boarding,
4. Get more users.

To achieve these new goals, the game provider will perform the following means :
Means 1: Outsource CD delivery,
Means 2: Outsource 50% of game content,
Means 3: Procure innovative game stories,
Means 4: Offer trial game.

To achieve the first means, the MMOG company has to setup a new business partnership with a shipper. This one ensures the transport of the CD to the customer and gets a financial compensation in return. The idea of outsourcing 50% of the game content also matches the new goal recently elicited for the customer: make money. The customer has two possibilities to satisfy this goal: create content and provide innovative game stories.

[3]Notice that the comparison between the different outputs produced by the improved method and its predecessor will be discussed in a separate Section (see Sect. 4.5).

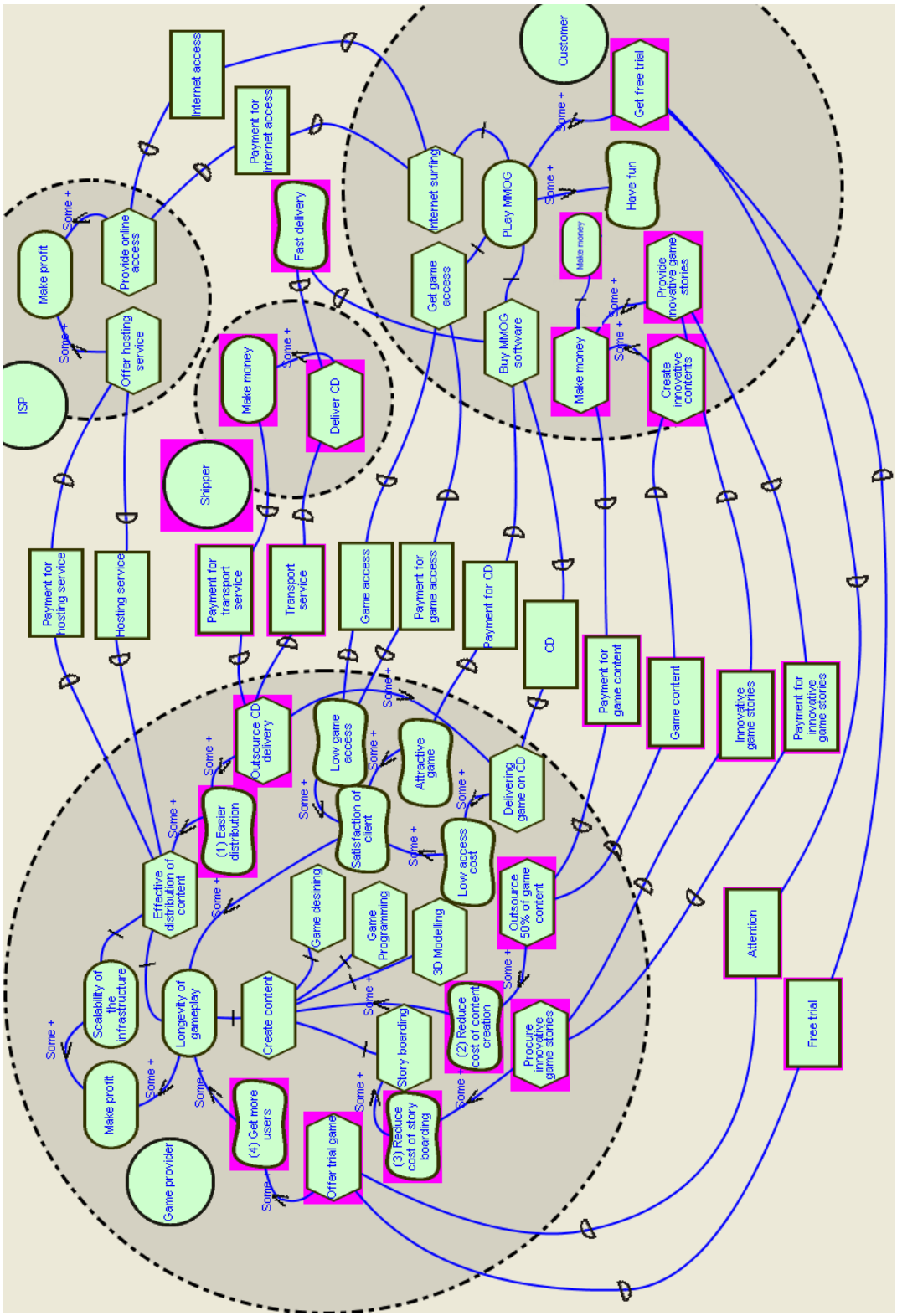


Figure 4.9: *Improved method: to-be goal model with i**

4.4.2.2 Templates

In the to-be goal model established previously (in Figure 4.9), four new means have been introduced for achieving the new goals. These means can be matched with the instantiated templates according to the list of templates. In order to translate them, the variables have to be instantiated with the right terms situated into the to-be goal model. To express this, four gamma substitutions γ_i={X/Y} are used. In these substitutions, the X are the variables situated within the templates, and the Y are the names of some resources, actors, value activities situated into the to-be goal model.

The highlighted templates and their γ_i substitution are :

Means 1 matches with mean template 9:

9. <outsource *fraction* of production of, *resource*$_j$, in, *value_activity*$_k$>
[stop producing *resource*$_j$ in *value_activity*$_k$ AND start procuring *resource*$_j$ from *outsourcer*$_o$]
γ={fraction/100%, resource$_j$/CD delivery, value_activity$_k$/transport CD, outsourcer$_o$/shipper }

Means 2 matches with mean template 3:

3. <start procuring, *resource*$_j$, from, *provider*$_p$>
[start using *resource*$_j$ in *value_activity*$_k$ AND start providing *resource*$_j$ to *provider*$_p$]
γ={ resource$_j$/innovative game stories, provider$_p$/customer, value_activity$_k$/create content, compensation/payment }

Means 3 matches with mean template 9:

9. <outsource *fraction* of production of, *resource*$_j$, in, *value_activity*$_k$>
[decrease *fraction* of production of *resource*$_j$ AND start procuring *resource*$_j$ from *outsourcer*$_o$]
γ={ fraction/50%, resource$_j$/game content, value_activity$_k$/create content, outsourcer$_o$/Customer }

Means 4 matches with mean template 1:

1. <start offering, *resource*$_j$, to, *customer*$_i$>
[start using existing *value_activity*$_k$ AND receive *compensation* from *customer*$_i$]
γ={ resource$_j$/free trial game, customer$_i$/customer, value_activity$_k$/distribute game, compensation/attention }

4.4.2.3 Application of the Rules

The four rules associated to templates highlighted in the to-be goal model are used in this section to transform the as-is business model into an aligned to-be business model.

In order to save space, this section displays only the relevant parts of each rule. By relevant we mean that the parts which are not executed have been hidden. Some part are not executed because the business manager makes some choices in the optional part of each template. Therefore as the execution of the rules is a dynamic execution, the parts situated inside a boolean

expression which is false will not be executed. The parts which are executed have been marked in bold.

Aligning of means 1 (with the template 9)

9. <outsource *100%* of production of, *CD delivery*, in, *Transport CD*>
[stop producing *CD delivery* in *Transport CD* AND start procuring *CD delivery* from *Shipper*]

Primary action:

a. IF actor *Shipper* not present THEN create actor *Shipper*.

Secondary action:

b. **IF ((stop production) AND (outsourcing = 100%)) THEN call T6 and apply part (a) and (b) of associated rule**
σ = **{T6.value_activity$_k$/Transport CD, T6.resource$_j$/CD delivery}**

IF ((stop production) AND (outsourcing < 100%)) THEN ERROR

c. ELSE IF ((decrease production) AND (outsourcing < 100%)) THEN call T7b

d. **call T3**
σ = **{T3.resource$_j$/CD delivery, T3.provider$_p$/Shipper, T3.value_activity$_k$/Distribute content}**

Call of T6 and application of the associated rule

6. <stop producing, *CD delivery*, in, *Transport CD*>
[(start procuring resource$_j$ from provider$_p$) XOR (stop offering resource$_j$ to customer$_i$)]

Primary action:

a. **Delete the duality with the value_exchange from the *Transport CD* concerning the *CD delivery* within the principal actor.**

b. **IF *CD delivery* is the only value object produced in the *Transport CD* THEN delete the *Transport CD***

Secondary action:

c. IF ((start procuring) AND (¬ Prev(T2)) THEN call T3

d. ELSE IF ((stop offering) AND (¬ Prev(T2)) THEN call T2

Call of T3 and application of the associated rule

3. <start procuring, *CD delivery*, from, *Shipper*>
[(start using *CD delivery* in *Distribute content*) AND start providing *Payment* to *Shipper*]

Primary action:

a. **IF actor *Shipper* is not present THEN add the actor *Shipper*.**

b. **Add a new value exchange for the *CD delivery* from *Shipper* to the principal actor.**

Secondary action:

c. **Add a new value_exchange from the principal actor to the *Shipper* (as *Payment* for the *CD delivery* offered by the *Shipper*).**
Connect the new value exchanges to an existing or new value activity of *CD Delivery* within the *Shipper*

d. **IF start using THEN connect the new value exchanges of *CD delivery* to the existing *Distribute content* activity.**

e. ELSE IF (start offering AND ¬Prev(T1)) THEN apply rules of T1.

Aligning with means 2 (with the template 3)

3. <start procuring, *Innovative game stories*, from, *Customer*>
[start using *Innovative game stories* in *Create content* AND start providing *Payment* to *Customer*]

Primary action:

a. **IF actor *Customer* is not present THEN add the actor *Customer*.**

b. **Add a new value exchange for the *Innovative game stories* from *Customer* to the principal actor.**

Secondary action:

c. **Add a new value_exchange from the principal actor to the *Customer* (as *Payment* for the *Innovative game stories* offered by the *Customer*).**
Connect the new value exchanges to an existing or new value activity of *Innovative game stories* within the *Customer*.

d. **IF start using THEN connect the new value exchanges concerning the *Innovative game stories* to an existing or new *Create content* activity.**

e. ELSE IF (start offering AND ¬Prev(T1)) THEN call T1 .

Aligning with means 3 (with the template 9)

9. <outsource *50%* of production of, *Game content*, in, *Create content*>
[decrease *50%* of production of *Game content* AND start procuring *Game content* from *Customer*]

Primary action:

a. **IF actor *Customer* not present THEN create actor *Customer***

Secondary action:

b. IF ((stop production) AND (outsourcing = 100%)) THEN call T6 and apply part (a) and (b)

IF ((stop production) AND (outsourcing < 100%)) THEN ERROR

c. **ELSE IF ((decrease production) AND (outsourcing < 100%)) THEN call T7b**
σ = {T7.resource$_j$/game content, T7.value_activity$_k$/create content}

d. **Call T3**
σ = {T3.resource$_j$/game content, T3.provider$_p$/customer, T3.value_activity$_k$/Create content}

Call of T7b and application of the associated rule

7b.<decrease *50%* of production of, *game stories*, in, *Create content*>

Rule 7b related to T7b:

Primary action: no action to be taken here.

Secondary action: empty.

Call of T3 and application of the associated rule

3. <start procuring, *Game content*, from, *Customer*>
[(start using *Game content* in *Create content*) AND start providing *Payment* to *Customer*]

Primary action:

a. **IF actor *Customer* is not present THEN add the actor *Customer*.**

b. **Add a new value exchange for the *Game content* from *Customer* to the principal actor.**

Secondary action:

c. **Add a new value exchange from the principal actor to the *Customer* (as *Payment* for the *Game content* offered by the *Customer*).**
Connect the new value exchanges to an existing or new value activity of *Game content* within the *Customer*

d. IF start using THEN connect the new value exchanges concerning the *Game content* to an existing *Create content* activity.

e. ELSE IF (start offering AND ¬Prev(T1)) THEN call T1 .

Aligning with means 4 (with the template 1)

1. <start offering, *Free trial games*, to, *Customer*>
[start using existing *Distribute game* AND receive *Attention* from *Customer*]

Primary action:

a. **IF actor *Customer* is not present THEN add the actor *Customer*.**

b. **Add one value exchange for *Free trial games* (in an existing or new duality) from the principal actor to *Customer*.**

Secondary action:

c. **Add a new value exchange from *Customer* to the principal actor (as *Attention* for the *Free trial games* offered by the principal actor).**
Connect the new value exchanges to an existing or new value activity of *Free trial game* within the *Customer*.

d. **IF start using THEN connect to the existing *Distribute game* the new value exchanges.**

e. ELSE IF start producing THEN call T5 .

f. ELSE IF start procuring THEN

IF Prev(T5) THEN connect value_activity$_k$ to the value exchange of resource$_j$

Call T3 .

Figure 4.10 shows the complete chain of templates called for the transformation of the as-is business. It is associated to a tree. The first level represents the means highlighted (in the rectangles) into the to-be goal model which matched with the templates. Then, for each call from these templates, there is one or two sons when other templates are called and instantiated with a σ substitution.

This tree has to be read with a pre-order walk. It means that at first, the parent is visited and then, the left child before the right child.

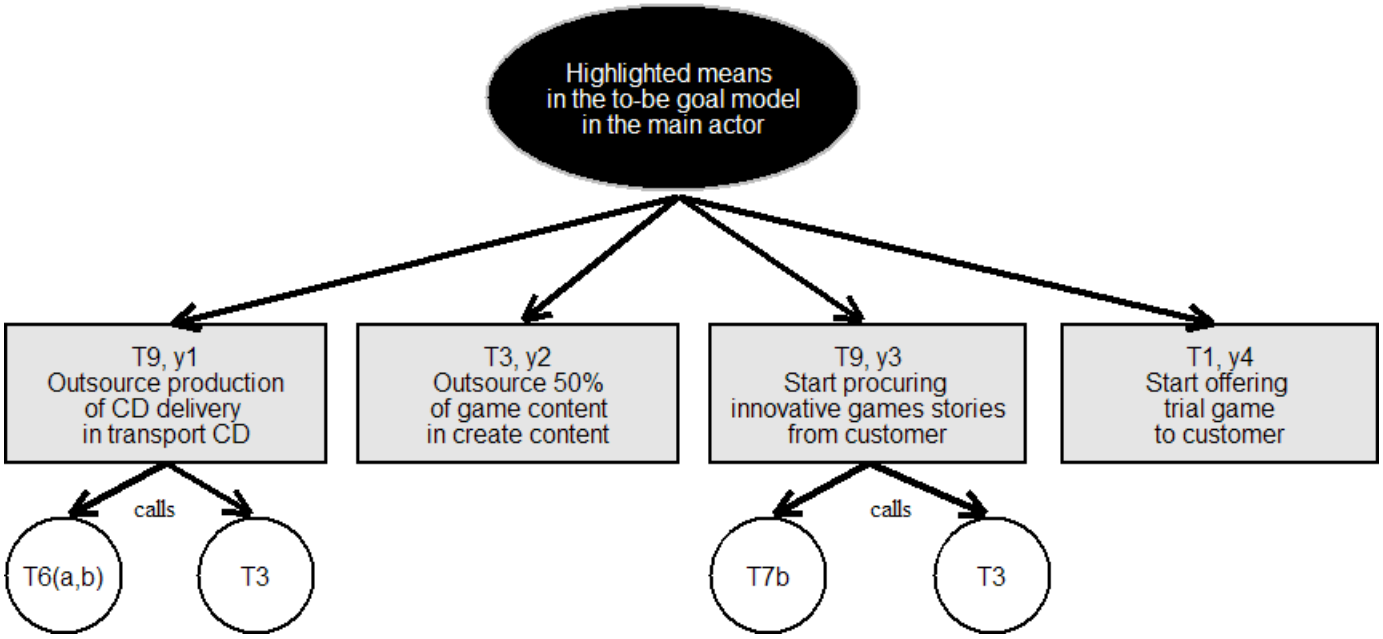


Figure 4.10: *Improved method: chain of templates*

The γ-substitutions used for the call from the templates are the following :
$\gamma_1 = \{\text{T6.value\_activity}_k/\text{Transport CD}, \text{T6.resource}_j/\text{CD delivery}\}$
$\gamma_2 = \{\text{T3.resource}_j/\text{CD delivery}, \text{T3.provider}_p/\text{Shipper}, \text{T3.value\_activity}_k/\text{Distribute content}\}$
$\gamma_3 = \{\text{T7.resource}_j/\text{game content}, \text{T7.value\_activity}_k/\text{create content}\}$
$\gamma_4 = \{\text{T3.resource}_j/\text{game content}, \text{T3.provider}_p/\text{customer}, \text{T3.value\_activity}_k/\text{Create content}\}$

4.4.2.4 To-be Business Model

When all the transformation rules of the previous subsection have been applied on the as-is business model, a to-be aligned business model is obtained. Figure 4.11 represents this latter. By aligned, we mean that this model is able to meet the new goals introduced in the to-be goal model.

The new constructions on the model have been put in bold on the model to make a clear distinction with the unchanged one.

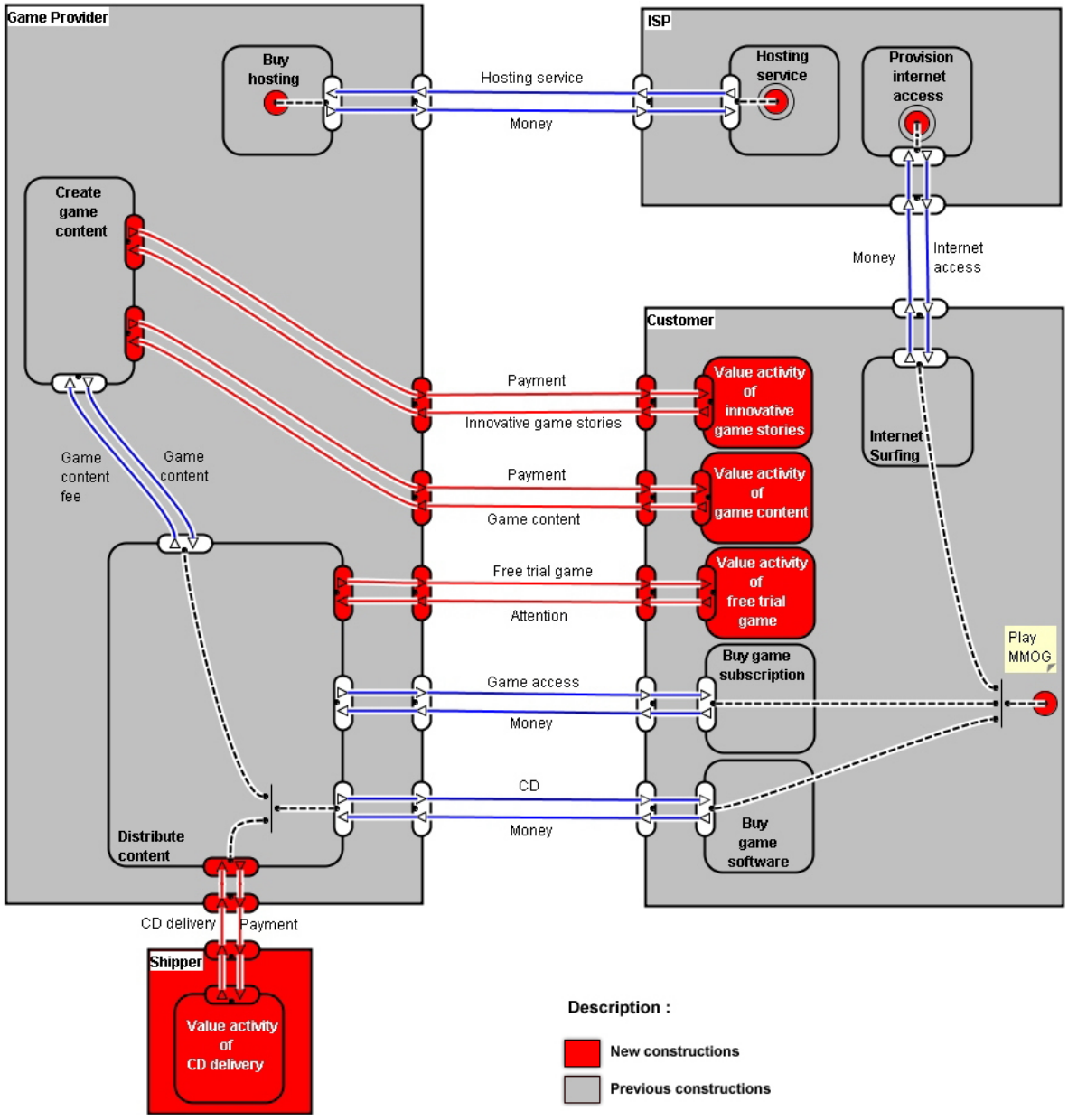


Figure 4.11: *Output of the improved method: the aligned to-be business model*

4.5 Discussion

This section aims to compare the methods regarding to the different outputs produced and the elements used in the case study. This comparison will consist of a general description of the problems in [4]. In Chapter 3, these problems have been illustrated on non-instantiated templates and rules. Hence, this case study, is a good approach to see the consequences of the problems in [4].

Regarding the real output of the method of [4], different issues can be raised. A lot of elements of the previous method are implicit. Actually, the method of alignment must be able to transform the as-is business model into a to-be business model without looking at something else than the

templates and their associated rules.

However, it seems that in [4] some other implicit elements are used to create the to-be business model. For example, Figure 4.12 represents the output given by the method of [4] by only applying (on the as-is business model of Fig. 4.3) the explicit content situated in the rules of [4]. In this figure, the new elements explicitly introduced are marked in green on the scheme.

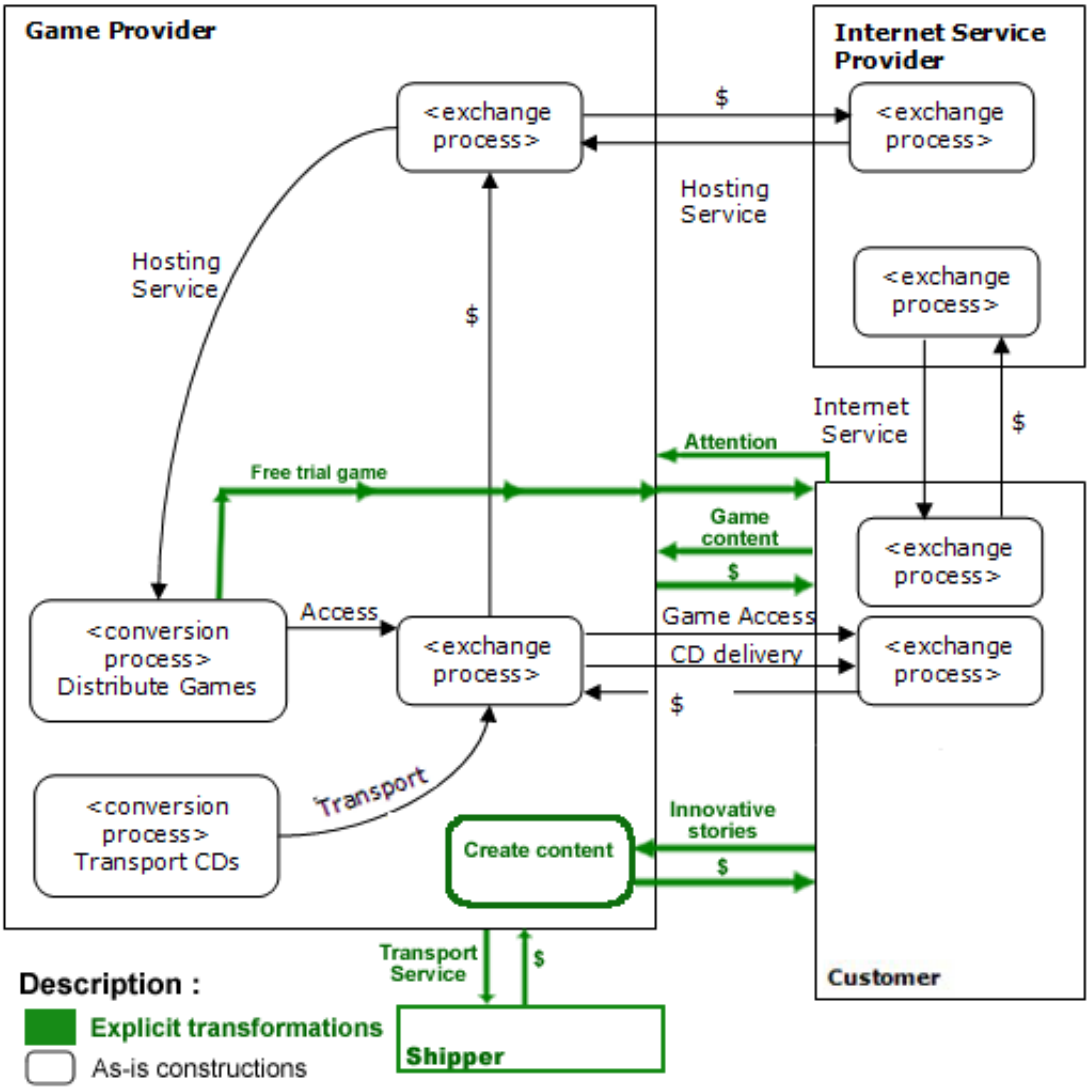


Figure 4.12: *Explicit results with the method of [4]*

If the explicit result displayed in the Figure 4.12 is compared with the output presented in [4] (see Fig. 4.6), it is visible that both figures are quite different. Regarding to the output given in [4], it is also possible to highlight some inconsistencies and incompleteness in their method. These elements are highlighted in the Figure 4.13. The two following paragraphs are explaining these inconsistencies.

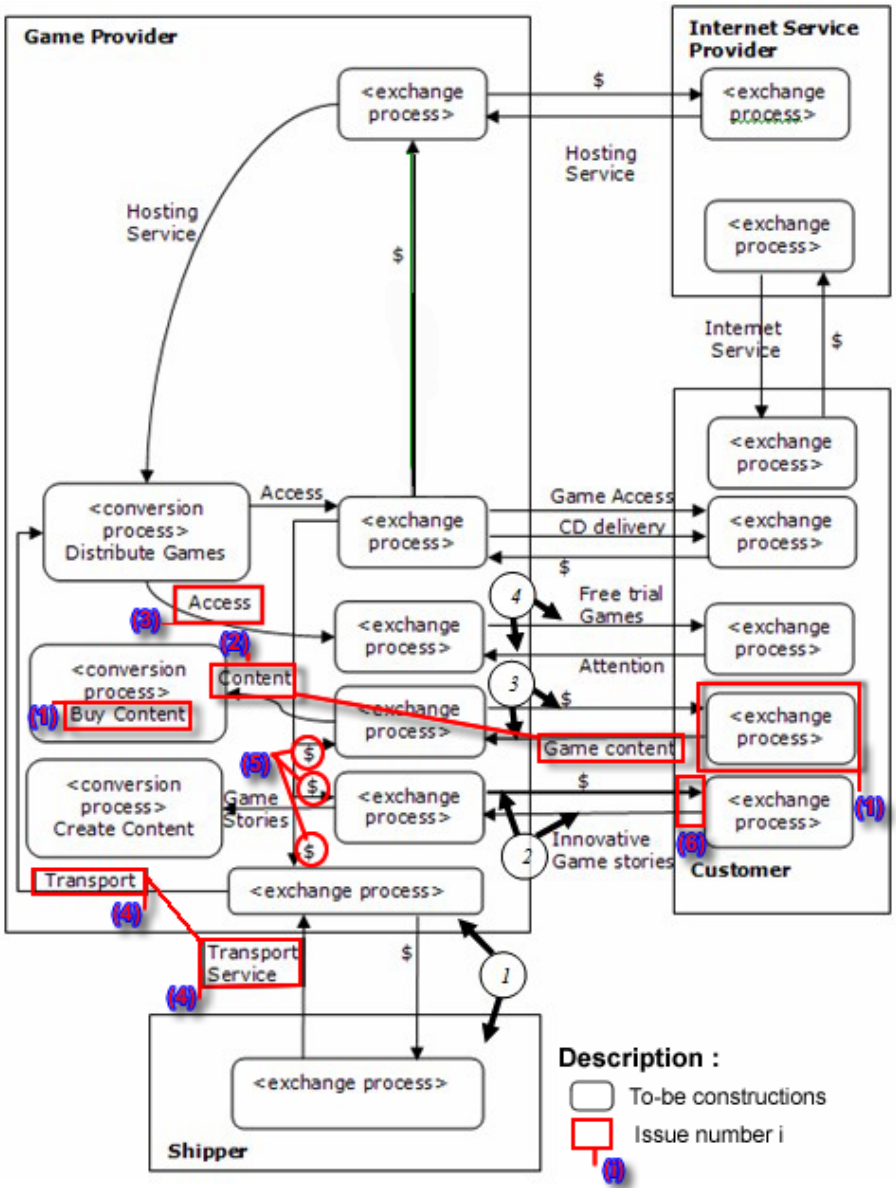


Figure 4.13: *Highlighted issues in output with the previous method*

First of all, some elements have been drawn in the to-be model without being suggested by the rules. It is for example the case with the rules of the 9^{th} template used in the case for the alignment of the means 2 (concerning the outsourcing of the production of game content). We can see that the outsourcing of the production has introduced a value activity < *Conversion event* > *Buy Content* inside the Game Provider, and a value activity <*exchange process*> inside the customer. The problem is that these elements (situated in (1) on Figure 4.13) in the model have not been explicitly introduced by the non-improved rule.

It seems also that the value exchanges within the actors (to make the link with a value activity) are not always explicit. It is the case in (6) on Figure 4.13, where the value exchange is extended into the customer to a value activity <*exchange process*>. This issues come from the lack of information inside the associated rule. Figure 4.14 shows the rules used in the case study in [4] for the alignment of the means 3.

Means 3: Outsource 50% of production of Game content
Primary action:
N/A
Secondary action:
- Add a new exchange event to procure the 50% of production of *Game content* (resource) from *Customer* to the *Game provider* (principal agent).
- Add a new exchange event to make the *Payment* (resource) from *Game Provider* (principal agent) to the *Customer*.

Figure 4.14: *Previous method: alignment with means 3 (Source: [4])*

In the improved rules of this thesis, these new value activities are explicitly introduced in the business model. However, in this case study, for the alignment with the means "Outsource 50% of production of game content", the assumption has been made to use the content obtained from the customer in an existing value activity within the main actor (instead of creating a new one). Figure 4.15 shows this evidence with the T9 and its instantiated rule as used in the case study. This template is called from the rules associated to the template for the alignment of the means 3.

3. <start procuring, *Game content*, from, *Customer*>
[(start using *Game content* in *Create content*) AND start providing *Payment* to *Customer*]
Primary action:

a. **IF actor *Customer* is not present THEN add the actor *Customer*.**

b. **Add a new value exchange for the *Game content* from *Customer* to the principal actor.**

Secondary action:

c. **Add a new value exchange from the principal actor to the *Customer* (as *Payment* for the *Game content* offered by the *Customer*).**
Connect the new value exchanges to an existing or new value activity of *Game content* within the *Customer*

d. IF start using THEN connect the new value exchanges concerning the *Game content* to an existing *Create content* activity.

e. ELSE IF (start offering AND ¬Prev(T1)) THEN call T1 .

Figure 4.15: *Previous method: alignment with means 3, call to template 9 (Source: [4])*

In the same way, the links (or value exchanges) from an interface to a value activity situated within an actor are explicitly written in the improved rules of this thesis. These information take place on Figure 4.16. This figure represents the improvements to the associated rule of template 9 of [4] (expressed in the Fig. 4.15).

Aligning with means 2 (with the template 3)
Primary action:

a. **IF actor *Customer* is not present THEN add the actor *Customer*.**

b. **Add a new value exchange for the *Innovative game stories* from *Customer* to the principal actor.**

Secondary action:

c. **Add a new value exchange from the principal actor to the *Customer* (as *Payment* for the *Innovative game stories* offered by the *Customer*).**
Connect the new value exchanges to an existing or new value activity of *Innovative game stories* within the *Customer*.

d. **IF start using THEN connect the new value exchanges concerning the *Innovative game stories* to an existing or new *Create content* activity.**

e. ELSE IF (start offering AND ¬Prev(T1)) THEN call T1 .

Figure 4.16: *Improved method: alignment with means 2.*

It is also obvious in Figure 4.13 that a number of various value activities (processes) are presented under the same name in the to-be business model produced by [4]. These value activities (<`Exchange process`> `or` <`Conversion process`>) have not been introduced in an explicit way by a rule. This constitutes a problem because many value activities are called with generic names such as <`Exchange process`> or <`Conversion process`>. Even if they were introduced in an explicit way within the rules, these names make the model more complex to read and understand. Moreover, the names introduced in an implicit way do not reflect the real underlying concept within actors of e^{3}value: the value activity.

In Figure 4.13, other elements are also ambiguous. It is the case in (2) on the model. The value object given by the customer is called "Game content" but the output of the <`Exchange process`> is "`Content`". It is acknowledgeable that the associated rule do not explain how to link these two activities, or why this value object has been renamed. The same problem appears in (4) (see Fig. 4.13) with the "`Transport service`" value object which is renamed into the value object "`Transport`".

Some other elements are more implicit than these indicated previously. This is for example the case of the value exchange concerning the value object "`Access`" (situated in (3) in Figure 4.13). This object is never present in any rules, but has been added in the to-be business model.

In the same way, it is not possible to find, in one of the rules used, why the money in (5) (see Fig. 4.13) is going to different value activities.

At the opposite, by looking at the model produced in output of the improved method (see Fig. 4.11), it is obvious that the problems highlighted before have been corrected. This correction has been done through Chapter 3 which contributes to improve the templates and rules of [4]. Among other things:

- the value exchanges between the value activities are modeled in an explicit way,

- a new value activity can be introduced in the model, but only if a rule asks it,
- each new value activity will have a consistency name (not redundant, significant, ...),
- the value exchanges are extended within the actors (explicitly within the rules),
- the improved method draws only what the rules suggest.

Consequently, the output of the improved method corrects all the issues highlighted through this discussion.

Chapter 5

Conclusion

This chapter concludes this thesis. Section 5.1 aims to give a summary of this thesis trough the different goals enounced in the Section 1.3. Then, regarding to our contributions, Section 5.2 expresses the limits of the results and gives some interesting ideas to further improve the method suggested in this thesis.

5.1 Summary

Models are often used in the early requirement process of an organization and approved in various domains. Most of the time, they serve as basis for a common understanding of a problem. These models can express different parts of an organization : actors, resources, resources exchanges, goals, business processes, etc.

The initial motivation of this thesis is the alignment between two models: the goal model and the business model. These two models are situated at different levels. The goal model is situated at the strategic level. It clarifies the goals of the organization and the different actors which are interacting with it. This kind of model expresses a consistent view of the *"why ?"*. The business model gives a overall view of the value exchanges, the value activities, and the value creation inside the organization. This model expresses a consistent view of the *"what ?"*. The necessary background for the understanding of these frameworks have been presented in the Chapter 2 "Background".

In the literature, much great debate about the use of goal models or the business models, but only few of them consider both of these models at the same time. However, in a top-down approach the production of a business model must take as input a goal model. This can be understood by the fact that a goal model is expressing "the why", and so contains a huge part of the important information. Thus, ignoring the goal model as input for the production of the business model could lead to a non-representative or unwanted business model output. As such, the business model would be irrelevant because it would omit a crucial aspect of a model : the matching with the strategic objectives of the business.

For this reason, it is interesting to think about the production of an aligned business model through a valuable method. A method related to this topic has been suggested in the literature in [4]. In this paper, the authors suggest a templates and rules based approach to solve the problem of alignment between the business model and its associated goal model. The main concepts of this method have been introduced in Chapter 2. By taking a careful look at this existing method, it is quite easy to find out that the method was not completely mature and could be refined and improved.

Therefore, Chapter 3 of this thesis aims to improve and extend the templates and rules based approach of [4]. In this chapter, two of our goals are achieved : the analyze of the previous suggested method of [4] by highlighting and illustrating the issues in the templates and rules, and suggest several improvements on these templates and rules to improve the method. This goals has been reached by dividing the chapter in three parts : the analyze and the improvement of the templates (see Sect. 3.1); the analyze and the improvement of the rules (see Sect. 3.2), and the clarification of the method (see Sect. 3.3). Finally, in the fourth part, the methodology

used for the improvement in this chapter is justified (see Sect. 3.4).

Our third goal lead us to test the new method on a case study to allow a comparison between the method of [4] and the method suggested in this thesis. This has been realized through Chapter 4. In this chapter, the same case study as [4] has been used to compare the outputs. This case concerns the Massive Multiplayer Online Game (MMOG). This chapter starts by showing the results of [4], and then, the results obtained with the new method application (see Sect. 4.3 and 4.4). These different outputs produced in the case study allow to reach our fourth goal which consists of the comparison between the different results produced (see Sect. 4.5). In this comparison, it is obvious that the method suggested in this thesis is more formal, gives a better methodological support and is less heuristic. These improvements facilitate the use of the method, lead to the reduction of a large number of possible mistakes or ambiguities, and contribute to reduce the necessary time to get the output business model. This chapter concludes by enouncing why the improved method represents a real improvement.

5.2 Future Work

According to the authors of [4], it was not advisable to bring in new templates or introduce extra problems in this thesis to focus mainly on the current state of [4]. This is why the theoretical approach and the investigations have been limited to the nine templates of [4]. However, in order to allow the method to match with more goal models, some new templates need to be added.

By adding new templates the method could be applied on other business cases (e.g. business case situated outside of the e-business field) and hence, match with more organizations. Adding new templates could be done without problems, with the formal BNF grammar, and the ideas of scheduling conditions introduced between the templates. Future work could for example base on the workshop of [3] where some possible new ideas of templates are suggested.

Currently, the templates are highly context-dependent. It means that some organizations could probably find all the necessary elements to use the method, while some others would have other options in the optional part of the templates. Consequently, future work could add new alternatives in the optional part to enlarge the context of use. These new options could based on the ideas suggested under some rules in Section 3.2.3.

Regarding the level of details, it should be interesting to study the (dis)advantages that we could find by using a higher level of details in the rules (e.g. introducing the notion of port, sub-value activity, stimuli, or the possibility to distinguish the interfaces in the rules).

In this thesis, a semi-level of formalism has been chosen for expressing the rules. This choice has been done to strike a balance between a higher formalism (which is very difficult to understand but not ambiguous), and a lower formalism as the natural language (which is easier to use but contains a lot of ambiguities). However, the level of formalism chosen in this thesis does not constitute a weakness. The reason is that it improves the level of formalism of [4] (where the rules are written in natural language). Currently, the method has to be executed manually by goal and business modelers. Consequently, this choice also seems the best way to keep the rules comprehensible by the users. It is especially the case if the goal and the business modelers do not have strong knowledge in formal languages.

It could also be interesting to create some tools related to this method. We are particularly thinking about two tools. The first one, could be helpful for the goal modeler and the business modeler to create themselves their new templates. For example, this tool could take as input

a textual template, and draw as output the graphical notation of the template. Or, it could also do the opposite. Another idea, is a tool which can produce the to-be business model while taking as input the as-is models, the to-be business model, and a library of templates and associated rules. A such tools could be easily created because the method has been improved with a semi-formalism quite close from pseudo-code without imposing a particular language.

Regarding to the frameworks used, it could also be interesting to add new aspects into the business model. Although e^3value is able to support the activity of business modelling, this one seems insufficient to explain the rationale of the produced model (e.g. currently, e^3value model does not describe "the why" [27]). In order to fill this lack, an extension to e^3value has been proposed in [27] with c^3value. The main idea of this approach is to support strategic analysis to draw and analyze various alternatives. In this way, an c^3value model should provide a more stable description, representing what business is aiming at with the value model. According to [27], this extension of the e^3value could for example help a firm to choose one particular business model rather than another.

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Appendices

A. Main definitions

The goal of this part is to define some relevant terms used in this work.

Business model: the business model describes the "what" of the organization. This kind of model represents the value propositions, the goods and services, the values exchanges, etc. between the actors. Some of the possible frameworks used for business modelling are Resource-Event-Agent (REA) [8], e^{3}value [12], e-Business Model Ontology (eBMO) [22], Weil-vitale [28].

Compensation: resource which is given in a value exchange. Most of the time this resource will be financial.

End: *"...An End is something the enterprise seeks to accomplish, without any indication of how it will be achieved. When an enterprise intends to describe ends in the form of desired qualitative business results, it uses the notion of goal. A goal is a statement about a condition of the enterprise to be achieved or sustained.*
A typical goal of a car-rental company could be "to provide leading customer service..." [4].

Goal model: the goal model expresses the "why" of the organization. It clarifies the interests, the goals and the strategies of the different actors situated in its environment. Many frameworks can be used to represent the strategic objectives, the needs, the goals, etc. to be achieved by an organization. Some of the possible frameworks used for goal modelling are Tropos [7], KAOS [26], the Business Motivation Model (BMM) [30], $i^\star$ [31], and the SWOT Analysis [19].

Influencer: *"...An Influencer is anything that may impact the achievement of means (and thereby goals). An influencer is either external to the enterprise (such as customers, competitors, environment, technology, etc.) or internal (for instance, resources or infrastructure). An influencer is neutral until its impact on means or goals is assessed. An impact may be categorized in different ways - a simple and commonly accepted classification is as strength or weakness for internal influencers, and as opportunity or threat for external ones..."* [4]

Means: *"...A Means represents any capability or instrument that may be used to achieve Ends. Means may be differently categorized. When formulated as a course of action, a means describes the realizations of desired goals..."*
For the example given in the definition of "An end" (providing a leading customer service), then a means for this means can be "hire experienced customer service personnel".[4]
Usually, some goals will be situated at a high abstract level. In this case, it is necessary to refine them into subgoals which can be supported by means. By proceeding this way, it is possible to construct a goal tree.

Principal agent: a single enterprise concerned by strategic changes on its business. The model is drawn in order to represent its business and relations with its environment.

Rule: a rule is an operationalization of an associated template. Its goal is to transform a business model (given as input). A rule removes (or adds) elements from (or into) the business model according to its associated template. A rule has two parts: the primary and the secondary action. The primary action is based on the compulsory part of the associated template. It draws on the model what the template aims to do. The secondary action represents the information contained in the optional part. For each element situated into the optional part of a template, a matching fragment (piece of the rule) is present inside the rule to apply these changes on the business model.

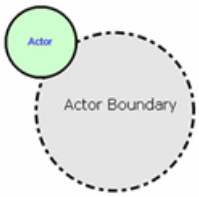
Resources: good or service.

Template: a template is the translation of a means in terms of business model notions. Each template is divided in one compulsory part and one optional part. The first part or compulsory part of a template expresses what this template aims to do. The second part or optional part expresses the different possibilities to satisfy the compulsory part. This part is denoted as optional because the way to solve the compulsory part is not always known by the goal modeler.

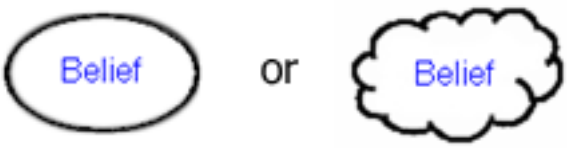
Value model: synonym of business model.

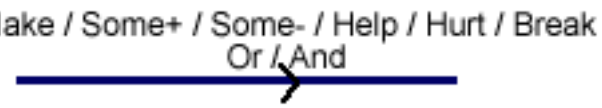
B. Syntax and Semantic of *i*⋆

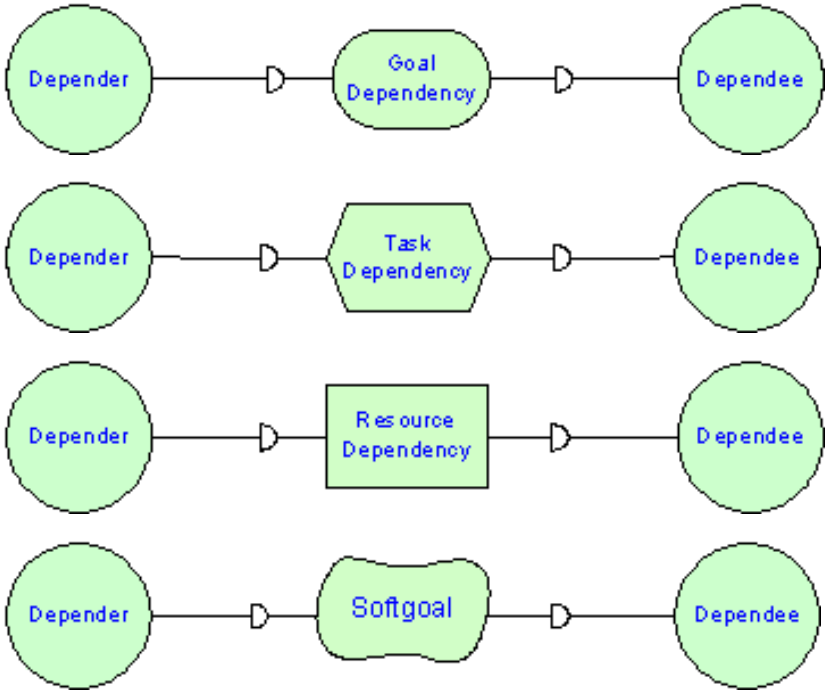
The following array (Table 1) summaries the syntax and the semantic of the $i^\star$ framework.

Name	Semantic - Syntax
`Actor`	**Semantic:** • has goals, beliefs, abilities, commitments • is semi-autonomous – freedom of action, constrained by relationships with others – not fully knowable or controllable – has knowledge to guide action, but only partially explicit • depends on other actors for goals to be achieved, tasks to be performed, resources to be furnished [31] **Syntax:** 
`Agent`	**Semantic:** actor with concrete, physical manifestations, such as a human individual. We use the term "agent" instead of person for generality, to refer to human as well as artificial (hardware/software agents). An agent has dependencies that apply regardless of what roles he/she/it happens to be playing. These characteristics are typically not easily transferable to other individuals, e.g. its skills and experiences, and its physical limitations [16]. **Syntax:** 
`Role`	**Semantic:** abstract characterization of the behavior of a social actor within some specialized context or domain of endeavor. Its characteristics are easily transferable to other social actors. The dependencies associated with a role apply regardless of the agent who plays the role [16]. **Syntax:** 

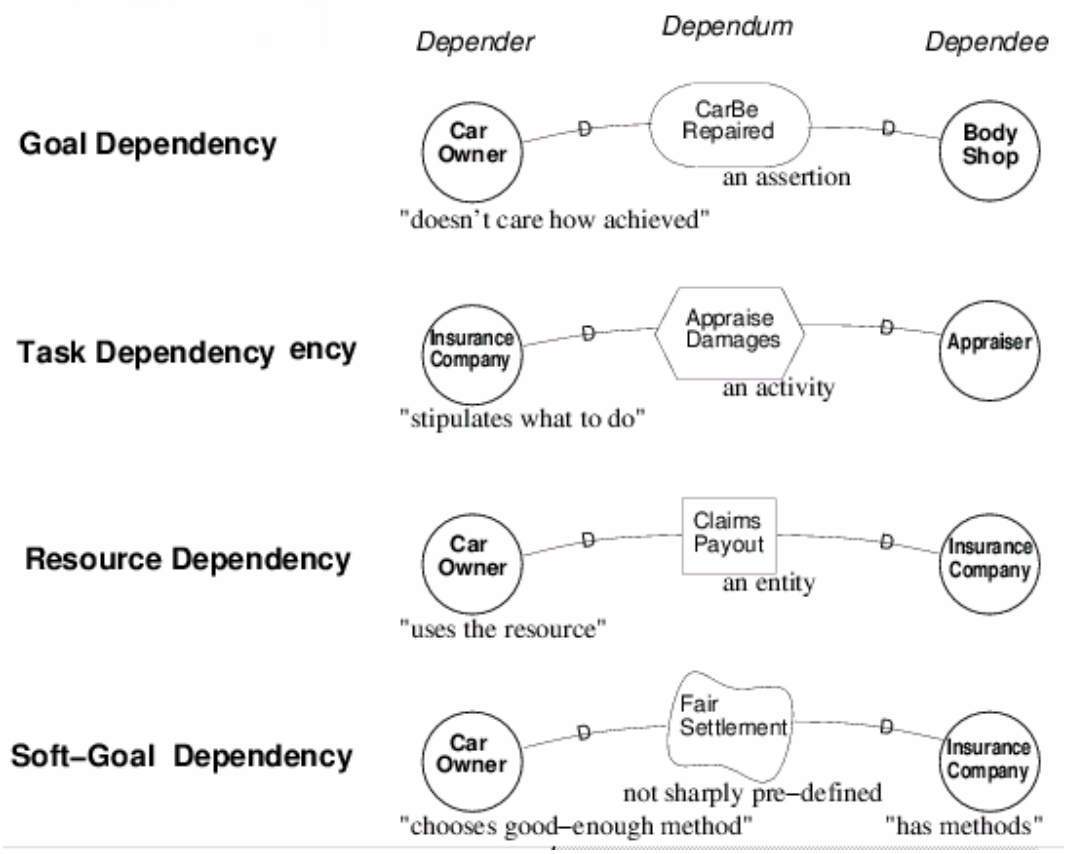
`Position`	**Semantic:** Intermediate abstraction that can be used between a role and an agent. It is a set of roles typically played by one agent (e.g., assigned jointly to that one agent). We say that an agent occupies a position. A position is said to cover a role [16]. **Syntax:** 
`Goal`	**Semantic:** a condition or state of affairs to be achieved. An actor can choose freely among different ways to achieve a goal [14]. **Syntax:** 
`Soft-goal`	**Semantic:** a goal without a clear-cut criterion for achievement, thus requiring further refinement and judgment. You might typically use this to represent quality goals [14]. **Syntax:** 
`Resource`	**Semantic:** a physical or informational entity needed to achieve some goal or to perform some task [14]. **Syntax:** 
`Task`	**Semantic:** a course of action to be carried out. It specifies a particular way of doing something, typically to achieve some goal [14]. Notice that "task" is synonyms of "mean". **Syntax:** 

`Belief`	**Semantic:** a condition about the world that the actor holds to be true. The actual degree of truth (as indicated by evaluation labels) is influence by contributions from other beliefs. A belief is distinct from a goal in that the actor has no explicit desire to make the specified condition become true. Beliefs can effect other elements in the model via contribution links. Such links can effect other links, saying that this belief effects the effect of an element on another, or can have a direct effect on soft-goals [16]. **Syntax:** 
`Means-ends link`	**Semantic:** it shows a particular way (typically a task) to achieve a goal [14]. **Syntax:** 
`Decomposition link`	**Semantic:** it shows how an intentional element (typically a task) is decomposed into subelements, which can include goals, tasks, resources, and soft-goals [14]. **Syntax:** 

`Contribution link`	**Semantic:** it shows a contribution toward satisfying a soft goal, typically from a task or another soft goal [14]. • *Make* : a positive contribution strong enough to satisfied a softgoal. • *Some+* : either a make or a help contribution, a positive contribution whose strength is unknown. • *Help* : a partial positive contribution, not sufficient by itself to satisfied the softgoal. • *Unknown* : a contribution to a softgoal whose polarity is unknown. • *Break* : a negative contribution sufficient enough to deny a softgoal. • *Some-* : either a break or a hurt contribution, a negative contribution whose strength is unknown. • *Hurt* : a partial negative contribution, not sufficient by itself to deny the softgoal. • *Or* : the parent is satisfied if any of the offspring are satisfied. • *And* : the parent is satisfied if all of the offspring are satisfied. **Syntax:** 

`Dependency link`	**Semantic:** it is composed of a dependee (actor who is depended upon on a dependency relationship), a depender (depending actor on a dependency relationship) and a dependum (element around which a dependency relationship centers). It is possible to distinguish four types of dependencies: goal dependency, task dependency, resource dependency and soft-goal dependency [16]. **Syntax:** 

Example : from [31].



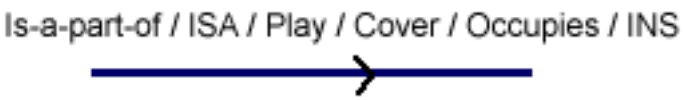
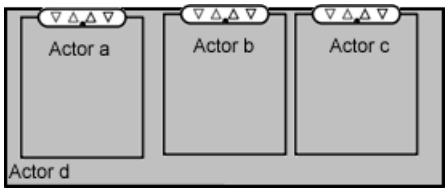
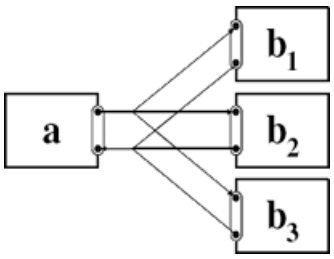
`Actor association link`	**Semantic:** According to [16] the relationships between actors are described by graphical association links between actors. • *"Is-part-of association* : roles, positions, and agents can each have subparts. Aggregate actors are not compositional with respect to intentionality. Each actor, regardless of whether it has parts, or is part of a larger whole, is taken to be intentional. There can be intentional dependencies between the whole and its parts, e.g., a dependency by the hole on its parts to maintain unity. • *"ISA" association* : this association represents a generalization, with an actor being a specialized case of another actor. Both ISA and Is-part-of can be applied between any two instances of the same type of actor. • *"Plays" association* : this association is used between an agent and a role, with an agent playing a role. The identity of the agent who plays a role should have no effect on the responsibilities of that role, and similarly, aspects of an agent should be unaffected by the roles it plays. • *"Covers" relationship* : The association link covers is used to describe the relationship between a position and the roles that it covers. • *"Occupies" relationship* : The occupies link is used to show that an agent occupies a position, meaning that it plays all of the roles that are covered by the position. • *"INS" relationship* : The ins association, representing instantiation, is used to represent a specific instance of a more general entity. An agent is an instantiation of another agent. **Syntax:** 

Table 1: Syntax and semantic of i* framework

C. Syntax and semantic of e^{3}value

The first array represents the concepts of this framework (Table 2). With these concepts it is possible to represent the exchanged of economic value between stakeholder. The second array (Table 3) represents other necessary constructions to get a full comprehension of the business scenario.

Name	Semantic - Syntax - Example
`Actor`	**Semantic**: it is an independent economic entity which can makes increase utility and makes profit. **Syntax**:  **Example**: a shop, the government, an university, a customer...
`Composite actor`	**Semantic**: for providing a particular service, a number of actors may decide to work together, and to offer objects of value jointly, using one value interface to their environment. We call such a *partnership* a composite actor [10]. **Syntax**:  **Example**: In the previous figure, the actors could be instantiate like this : (a) Television suppliers, (b) Internet provider and (c) Phone supplier. These are offering to the final customer what we call the "triple play" which is provided by a single company - actor (d).
`Market segment`	**Semantic:** it breaks a market (consisting of actors) into segments that share common properties. It models that a number of actors assign economic value to objects the same way [10]. The "actor a" exchanges value objects with the actors b1,b2,or b3, who may value these objects differently [18]. **Syntax:**  **Example:** Normal/Premium Gold customer.

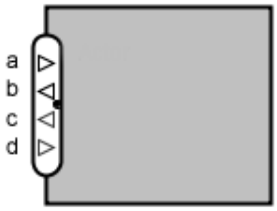
`Value object`	**Semantic:** goods or services which represent value for at least one of the actors. **Syntax:**  **Example:** money, tea, bus ticket, ...
`Value activity (offering)`	**Semantic:** it models what an actor offers or requests from his environment. [10]. **Syntax:**  **Example:** if on the previous picture the actor is a listeners, then the ports could be (a) music, (b) payement , (c) payement online , (d) online access. The value offering is music and online access. [18]
`Value port`	**Semantic:** an actor uses it to show to its environment that he wants to provide or request value objects. This concept enables us to abstract away from the internal business processes, and to focus only on how external actors and other components of the business model can be "plugged in" [10]. **Syntax:**  **Example:** offering money (`out-port`) money, requesting a good (`in-port`).
`Value interface`	**Semantic:** it models groups in-going and out-going value offerings [18]. **Syntax:**  **Example:** on the previous picture of the value activity, the value interface is (a),(b),(c),(d).
`Value exchange`	**Semantic:** a value exchange is used to connect two value ports with each other. It represents one or more potential trade(s) of value objects between value ports [10]. **Syntax:**  **Example:** connection between good in-port and payment out-port.

Table 2: Concepts of the e^3value framework

Name	Semantic - Syntax - Example
`Scenario path`	**Semantic:** a scenario path consists of one (or more) segment(s), related by connection elements, start and stop stimuli. A path indicates via which value interfaces the value objects must be exchanged, as a result of a start stimulus, or as result of exchanges via other value interfaces [10]. **Syntax:** see Section 2.4. **Example:** listening to online music or get cd at the shop. In both cases, you have to paid to get content.
`Segment`	**Semantic:** a scenario path has one or more segments. Segments are used to relate value interfaces with each other (e.g. via connection elements) to show that an exchange on one value interface causes an exchange on another value interface [10]. **Syntax:** see Section 2.4.
`End Stimulus`	**Semantic:** it indicates that the scenario path ends. It is the last part segment(s) of a scenario path. **Syntax:** see Section 2.4.
`Start Stimulus`	**Semantic:** it represents the consumer need and the start of scenario path. **Syntax:** see Section 2.4.
`Connection`	**Semantic:** there are different types of connections related to segments : "AND", "OR" and the "direct link". • The "AND" could be on of this elements : – a JOIN which gather many sub paths into a single one. – a FORK which splits a scenario path into two (or more) sub-paths. • The "OR" could be : – a FORK which models a continuation of the scenario path into one direction that is to be chosen from a number of alternatives. – the JOIN merges two (or more) paths into one path. • The direct link which interconnects two individual segments. **Syntax:** see Section 2.4.

Table 3: *Other concepts of the e^3value framework*

D. A Paper published for the BUSiness/IT ALignment and Interoperability 2008

This thesis has been summarized as a paper published for BUSITAL'08 – *A workshop on Business/IT Alignment and Interoperability*. Notice that since the publication of this paper, the thesis has still been improved regarding to the reviews of the paper. Therefore some difference between the paper and this thesis may occur. The contents of this publication follows on the next fifteen pages.

A Method to Support the Alignment of Business Models and Goal models

Pierre Halleux[1], Ludovic Mathieu[1], and Birger Andersson[2]

[1] Faculty of Namur, Department of Computer Science,
rue Grandgagnage 21, 5000 Namur, Belgium
{phalleux, lmathieu}@info.fundp.ac.be
[2] Royal Institute of Technology, Dept. of Computer and Systems Sciences,
SE-164 40 Kista, Sweden
ba@dsv.su.se

Abstract. This paper addresses one part of business and IT-alignment by proposing a method to align goal models and business models. The method takes as input a goal model and a business model, and outputs a business model that is aligned with the explicit goals of a business actor. The method builds on previous work with the same approach but extends that work in at least two ways: the syntax of some method constituents is altered and a way to combine them is introduced. The result is an improved method that better support a modeller when designing business models based on goal models.

1 Introduction

Generally, the raison-d'être of ICT in an organization is to support the organization's business goals and this is often materialized as IT-systems for support of operational processes. The goals should therefore be made so explicit that supporting IT-systems can be aligned with them. A problem then is how to formulate business goals so that the alignment can be made. One solution approach is to utilize models that focus on different aspects of an organization and its collaborations. Addressing the problem then amounts to aligning a chain of models.

A common view is that goal models are used in the earliest phases of business and information systems design, where they help in clarifying interests, intentions, and strategies of different stakeholders answering to the "why" of the business. Business models give a high level view of the activities taking place in and between organizations by identifying agents, resources and the exchange of resources between the agents. So, a business model focuses on the "what" of a business. Process models focus on the "how" of a business, as they deal with operational and procedural aspects of business communication, including control flow, data flow and message passing.

The purpose of this paper is to present a method for addressing one part of the problem of aligning the IT-resources with the goals of an organization — the alignment of goal models and business models. The method approach

is to use templates for formulating goals and apply rules for business model transformations. The method builds on work presented in [1]. As that work outlined the method on a high level a research question was how to make it more formalised. This work extends previous work in several ways, most notably in the amount of formalism used. In this paper we illustrate the extended method in a case application making use of two well known modelling techniques; for goal modeling we use i* [2] and for business modelling we use e^{3}value [3].

The amount of research and literature pointing out the importance of business and IT alignment is vast. Notable examples of approaches for alignment through model use can be found in [4], [5], and [6].

This paper is structured as follows: the method is presented in section 2. An illustration of the method by its application on a small case is in section 3. Finally, the concluding section 4 contains a discussion of the results and directions for future research.

2 A Method for Goal and Business Model Alignment

A common problem in goal modelling is that goals are difficult to formulate, i.e., the formulations of goals often become loose, highly abstract and unfocused. In [7], the authors argue that goal models become unfocused because goals range from the value propositions of an enterprise to general goals of economic sustainability. However, largely all means in goal models (a means is an action carried out to attain a goal) relate to the acquisition, production, maintenance, or provisioning of economic resources. As mentioned in section 1, business models describe the use and exchange of resources that are of economic value for agents participating in collaborations. We exploit this relation between means and business model notions when formulating the following method for goal model and business model alignment.

2.1 Method Overview

The method, originally introduced in [1] but here substantially extended, takes as input an as-is business model and a to-be goal model and produces a new to-be business model conforming to the goal model.

The method has two main steps, where the first concerns goal modeling and the second concerns business modeling. In the first step, it is the responsibility of a goal modeler to construct a goal model using business model notions; in particular the means are formulated according to a template structure (see Sect. 2.2). In the second step, it is the responsibility of a business modeler to make use of the means supplied by the goal modeler by applying transformation rules to a business model. If the business modeller do not have required information to apply a rule, then this information must be elicited in order to continue. The method can be outlined as:

1. The goal modeler constructs a goal model using the means templates.

2. For each means template the business modeler:
   (a) complements the means by filling in the required and optional parts when needed.
   (b) applies the relevant transformation rule.

For each means template, there will be exactly one transformation rule telling how means of this template will influence the to-be business model. 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 requiring changes at the process level (see Sect. 1). While the first two groups have a visible effect on the to-be business model, the effects of the means in the third group is not visible in this model but will only have impact on a process model.

2.2 Grammar of Means Templates

A means template is formulated according to the following grammar:

```
MEANS_TEMPLATE  ::= COMPULSORY_PART  |  COMPULSORY_PART '[' OPTIONAL_PART
                    ']'
COMPULSORY_PART ::= '<' event ',' resource ',' DIRECTION ',' A_OR_CE
                    '>'
DIRECTION       ::= 'from' | 'to' | 'in'
A_OR_CE         ::= agent | value activity
OPTIONAL_PART   ::= E
E               ::= E 'AND' T | T | COMPULSORY_PART
T               ::= T 'XOR' F | F | COMPULSORY_PART
F               ::= other_event value_activity | other_event resource ','
                    DIRECTION ',' A_OR_CE | '(' E ')' | COMPULSORY_PART
```

The compulsory part of a template[3] is represented by a 4-tuple *<Event,Resource,DIRECTION,Agent>*. This part may be followed by an optional part providing complementary information about the consequences of the compulsory part. In the compulsory part, `DIRECTION` indicates the direction of an *event*, thus enabling us to distinguish between different situations (e.g. a resource moving "from" or "to" an agent). Notice also that the "`COMPULSORY_PART`" introduces the possibility to combine templates.

2.3 List of Means Templates

The following list of nine templates follows the list proposed in [1]. It covers goals related to the acquisition, production, maintenance, or provisioning of resources for a business actor.

[3] In this paper the notation "Ti" is the abbreviation for "Template number i"

1. <`start offering, resource`$_j$`, to, customer`$_i$ > [(start using existing *value activity*$_k$ XOR start producing *resource*$_j$ in *value activity*$_k$ XOR start procuring *resource*$_l$ from *provider*$_p$) AND receive *compensation* from *customer*$_i$]

Template 1 is used to express an exchange of an economic resource between agents. The main part represents the offering of the resource. There are three possible consequences in this template and they appear before the exchange showing the origin of the resource that is exchanged:
(1) The resource is converted thanks to an existing value activity in the agent,
(2) The resource is produced thanks to a new value activity in the agent,
(3) The resource is obtained by an exchange with another agent (intermediary).
After the exchange, the consequence is that a compensation is offered to the main actor for the resource provided.

2. <`stop offering, resource`$_j$`, to, customer`$_i$>
[(stop procuring *resource*$_l$ from *provider*$_p$ XOR stop producing *resource*$_j$ in *value activity*$_k$)]

Template 2 is used when an agent desires to stop offering a resource to another agent. The two possible (mutually exclusive) consequences are:
(1) The agent stops producing the resource,
(2) The agent stops procuring the resource from an intermediary.

3. <`start procuring, resource`$_j$`, from, provider`$_p$>
[((start using *resource*$_j$ in *value activity*$_k$) XOR (start offering *resource*$_j$ to *customer*$_c$)) AND start providing *compensation* to *provider*$_p$]

Template 3 is to express how the main actor deals with the procurement of a resource from an intermediary agent. The two possible (mutually exclusive) consequences of the acquisition are:
(1) The agent transforms (or use) the resource in one of its value activities,
(2) The agent offers the resource to another agent (or to the customer of the main actor, without changes).
After that, the main actor provides a compensation to that agent.

4. <`stop procuring, resource`$_j$`, from, provider`$_p$>
[(stop offering *resource*$_l$ to *customer*$_i$) XOR (start producing *resource*$_j$ in *value activity*$_k$)]

Template 4 focuses on stopping the acquisition of a resource from an agent. There are two possible consequences (mutually exclusive). The first of is to consider whether the agent stops procuring from all of its providers or not.
(1) To offer the resource to its customer(s), the agent must start the production,
(2) The agent do not want to continue the offering of the resource, so the offering of the resource is stopped.

5. <`start producing, resource`$_j$`, in, value activity`$_k$>
[start offering *resource*$_j$, to, *customer*$_i$]

Template 5 shows the consequences of starting the production of a resource in a value activity. The only effect is that the main actor must offer the resource to other agent(s).

6. <stop producing, *resource*$_j$, in, *value activity*$_k$>
[(start procuring *resource*$_j$ from *provider*$_p$) XOR (stop offering *resource*$_j$ to *customer*$_i$)]

Template 6 shows the consequences when an agent stops the production of a resource in one of its value activities. There are two mutually exclusive consequences:
(1) Keeping on going with the offering to other agent, the main actor starts procuring the resource from another agent.
(2) The agent do not want to continue the offering.

7a. <increase *fraction* of production of, *resource*$_j$, in, *value activity*$_k$>
7b. <decrease *fraction* of production of, *resource*$_j$, in, *value activity*$_k$ >

Template 7 is to increase (7a) or decrease (7b) the capacity of the production of a resource. According to [1], this template and template 8 has normally no structural effects on the business model.

8. <insource *fraction* of production of, *resource*$_j$, in, *value activity*$_k$>
[(start producing *resource*$_j$ in *value activity*$_k$ XOR increase production of *resource*$_j$ in *value activity*$_k$) AND (stop procuring *resource*$_j$ from *outsourcer*$_o$)]

Template 8 shows what is happening when the production of a resource from a value activity is insourced. There are two possible consequences (mutually exclusive):
(1) The production increase in an existing value activity,
(2) A new value activity is introduced to produce the resource.

9. <outsource *fraction* of production of, *resource*$_j$, in, *value activity*$_k$>
[(stop producing *resource*$_j$ in *value activity*$_k$ XOR decrease *fraction* of production of *resource*$_j$) AND start procuring *resource*$_j$ from *outsourcer*$_o$]

Template 9 captures the consequence of an outsource of production. An outsource is leading to:
(1) The stopping of the production of the resource (if the outsource represents 100% of the production),
(2) The decrease of the production of the resource.
In both cases, the main actor must start procuring the resource.

2.4 Transformation Rules

One transformation rule is associated with each template. A rule has two parts called the primary and the secondary action. The primary action is related to the compulsory part of the template. The secondary action is related to the optional part of the template. When applied, both parts of the rule affect the design of the business model.

The elements of the secondary action are either possible precursors of an event (i.e., what is needed to enable the event in a compulsory part of a template), or the possible consequences (i.e., what is done after a compulsary event). In other words, elements of the secondary action can both trigger or be triggered by events.

For space reasons we present here the rule that is associated with the 1^{st} template and omit the rules associated with templates 2–9. Table 1 gives the rule associated to the template 1:

1. $<$ *start offering,* resource$_j$*, to,* customer$_i$ $>$
[(start using existing *value activity*$_k$ XOR start producing *resource*$_j$ in *value activity*$_k$ XOR start procuring *resource*$_l$ from *provider*$_p$) AND receive *compensation* from *customer*$_i$]
Primary action:
(a) IF actor customer$_i$ is not present THEN add the actor customer$_i$.
(b) Add one value exchange for resource$_j$ (in an existing or new interface) from the principal actor to customer$_i$.
Secondary action:
(c) Add a new value exchange from customer$_i$ to the principal actor (as compensation for the resource$_j$ offered by the principal actor). Connect the new value exchanges to an existing or new value activity of resource$_j$ within the customer$_i$.
(d) IF start using THEN connect to the existing value activity$_k$ to the new value exchange.
(e) ELSE IF start producing THEN call T5 and apply associated rule.
σ = { T5.resource$_j$ /T1.resource$_j$, T5.value activity$_k$/T1.value activity$_k$ }
(f) ELSE IF start procuring THEN IF Prev(T5) THEN connect value activity$_k$ to the value exchange of resource$_j$. Call T3 and apply associated rule.
σ ={T3.resource$_j$/T1.resource$_l$, T3.provider$_p$ /T1.provider$_p$, T3.value activity$_k$/T1.value activity$_k$}

Table 1. Example of rule : rule associated to 1^{st} template.

It is important to notice that templates may be combined with other templates. We also say that a template may "call" another template. For example, the template matching with the offering of a resource is able to call the template responsible for the production of the resource to offer. In the rules, a function

"Prev(P_i)" has been introduced to avoid the possible issues of redundant changes. For example, if a rule says that an actor should be introduced, then the function "Prev(P_i)" is used to ensure that, in case templates are combined, the actor is not introduced twice.

Variables in templates are substituted before application analogously to how substitutions are carried out in Prolog [8]. For a better readability, the method distinguishes the initial substitution (γ_i) from those done when an additional template in a rule (σ_i) is called.

The calls (or combinations) between the templates can be represented within a tree for better visualization. While traversing the tree, the rules are modifying the as-is business model. Arriving at the right-most leaf of the tree (the final node), the as-is business model will be completely transformed and will be aligned with the goal model. Figure 1 shows an example of a substitution tree.

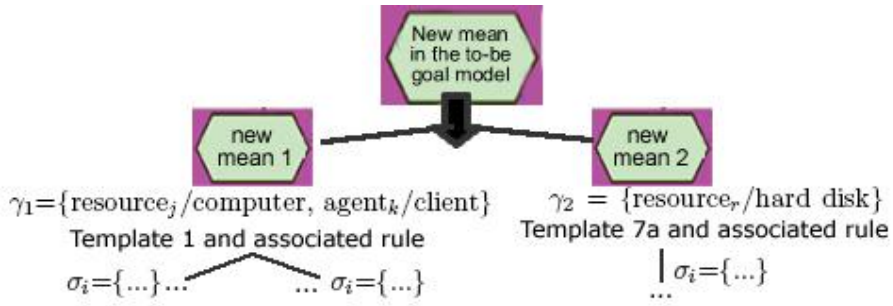


Fig. 1. Through the goal model to the templates with a substitution tree.

2.5 Relations Between Templates

Consistency checking of combinations of templates is important. In an automated process, the matching templates found by the goal modeler in the "to-be goal model" have to be consistent. For instance, a business modeler must not declare a <`stop offering, resource, to, agent`> without a previous <`start offering, resource, to, agent`>.

In order to address consistency the notion of scheduling conditions is introduced. A scheduling condition is an expression of a particular combination of templates on which precondition must be checked to ensure its legality. A list of such conditions is highly context dependent. For instance, one combination may be allowed in one organization, while the same combination in another organization is forbidden. It is, however, interesting to sketch out and give an example of how one such listing can be done.

A scheduling condition has two parts. The first part is the combination part represented by two template symbols together with an infix composition op-

erator "∘". This operator is used to express that a particular template can be combined with another. The second part is the conditional which contains a guard expression. Following is an example list of scheduling conditions. The first item, for example, express that template 2 can be combined with template 1 when the resource of T1 is equal to the resource of T2 and the agent of T1 is equal to the agent of T2.

$\mathbf{T}_i \circ \mathbf{T}_j$	**Precondition**
T2 ∘ T1	T1.resource=T2.resource and T1.agent=T2.agent
T4 ∘ T3	T3.resource=T4.resource and T3.agent=T4.agent
T6 ∘ T5	T5.resource=T6.resource
	and T5.value activity=T6.value activity
T7a	production(T7a.resource)≤100%
T7b	production(T7b.resource)≥0%
T8 ∘ T9	T9.resource=T8.resource and T5.value=T6.agent

The scheduling conditions may be organized and visualized in an "implication array" (Fig. 2). Template names are on the vertical and horizontal axes of the array. Implication dependencies are indicated by putting a symbol in the intersecting cell of a template column and row. Three symbols are used to indicate the implication direction[4]. A square indicate that the direction is from vertical to horizontal, a diamond from horizontal to vertical, and a bullet for a combination of both directions.

	T1	*T2*	*T3*	*T4*	*T5*	*T6*	*T7a*	*T7b*	*T8*	*T9*	*a*	*c*	*e*	*f*
T1		1 □	1		1						1			
T2				1		1								
T3	1			1 □									1	
T4		1			1									
T5	1					1 □						1		
T6		1	1											
T7a								1 •						
T7b			1				1 •							
T8				1			1							
T9						1		1	1 ◊					
a												1		
c														
e														1
f														

Fig. 2. Implication array for drawing global network

When drawing the array, two kinds of call between templates can be written: the "explicit" or the "implicit" calls. The explicit calls are highlighted in grey scale in the array. They regroup calls to some templates made from a rule associate

[4] The implication symbols are chosen to allow for gray-scale printing: □, ◊, •.

to another template. For instance, the rule associated to T4 can call T2 and T5. For these explicit combinations, there is no need of scheduling rules because the calls are made from inside the rule and ensure in this way, the satisfaction of the precondition. For implicit calls, scheduling rules with preconditions need to be considered. In the implication array three implicit calls has been added and highlighted.

- A link from the start to the stop (because it is only possible to stop something that has been started before) (□).
- A link between increase from decrease (in both directions) (•).
- A link from outsource to insource (because it is only possible to insource something that has been outsourced before) (◊).

Notice that a,c,e, and f are not templates but "other_events" as mentioned in the BNF grammar and that the implications between those events are "informal". We call those implications informal as they are merely for expressing implications in a language more natural to use. An analysis of the links between the templates is interesting because it makes it possible to avoid redundant changes on the "to-be business model" within the templates, thanks to the Prev(Ti) function.

3 Case Study

In this section we illustrate the method by applying it in a small case study (adapted from [1]). Due to space constraints it is not possible to show all models. We will, however, detail four templates matched with the means of a to-be goal model, one application of a rule associated with one of those templates, and the final output.

3.1 The Case

The case involves a Massive Multiplayer Online Gaming (MMOG) provider as the main actor. In this kind of game, thousands of players can participate via Internet and compete with each other. Two other actors interact with the MMOG provider: an Internet Service Provider (ISP) playing the role of a business associate, and the players as its customers. The MMOG provider has mainly two responsibilities: producing the game content by itself and distributing the game client application on CDs. Thanks to the ISP, the MMOG provider can distribute the information needed to play via the Internet. The revenue model for the MMOG company is based on fees collected to get access to the game server. This payment gives the right to access to the game. Obviously, the players need to be connected to the Internet in order to play.

For future development of its business the MMOG provider plans to change its goals and add new activities to support them:

1. Easier distribution of CDs by outsourcing the production of CD delivery to a shipper.

2. Reduction of its cost of content creation by outsourcing 50% of the game content creation to users.
3. Reduction of story boarding cost by procuring game stories from customers.
4. Increase the number of users by offering free trial games.

3.2 Method Application

To apply the method the goal modeller first has to draw the to-be goal model by introducing the changes into an as-is goal model. In the new goal model, new means are highlighted, matched, and formulated according to the means templates. After that, the rules associated to these templates are applied on the as-is business model to produce an aligned to-be business model as output.

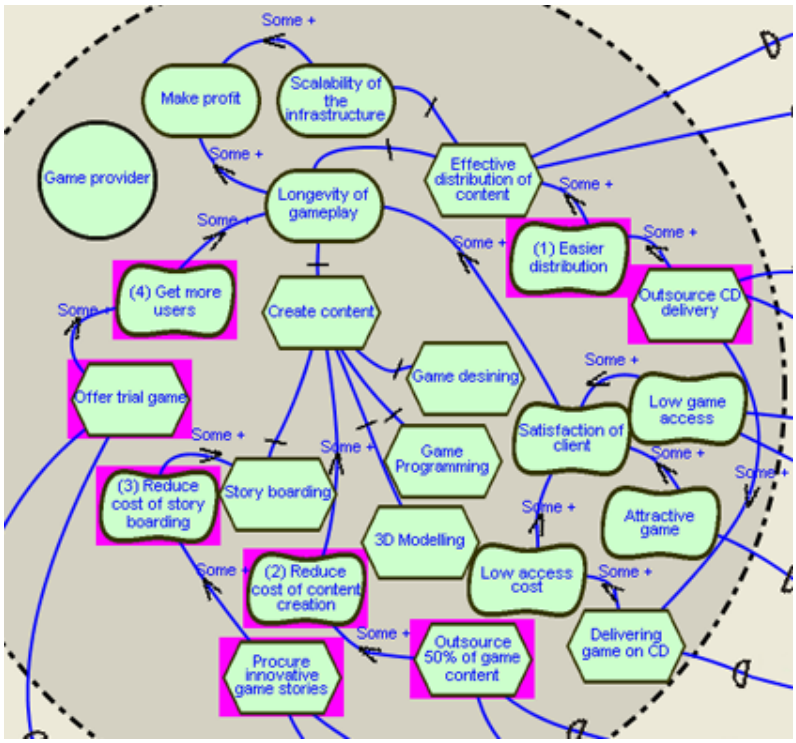


Fig. 3. Main part of the to-be goal model

To-Be Goal Model Figure 3 represents the to-be goal model of the MMOG company. This goal model was the as-is model that, when updated, became the to-be goal model. Eight new elements have been highlighted by rectangles.

Four of them are means (hexagonal) and four are so called soft goals (rounded rectangle).

New Means in the To-Be Goal Model From the MMOG provider's as-is goal model complemented with new goals according to the listing in the case description, we got the to-be goal model (Fig.3). Four new means are identified:

Means 1: Outsource 100% of CD delivery.
Means 2: Procure innovative game stories from customer.
Means 3: Outsource 50% of game content.
Means 4: Offer free trial games to customer.

Thanks to the usage of γ-substitutions, those means can match with some templates. The substitutions will have as effect instantiation of the terms: value activity$_k$, resource$_j$, ... The means 1, 2, 3, and 4 are respectively matched with the templates 9, 3, 9, and 1. The matching can be done thanks to substitutions chosen by the business modeler:

γ1={fraction/100%, resource$_j$/CD delivery, value activity$_k$/transport CD, outsourcer$_o$/shipper}
γ2={resource$_j$/innovative game stories, provider$_p$/customer, value activity$_k$/create content, compensation/payment}
γ3={fraction/50%, resource$_j$/game content, value_activity$_k$/create content, outsourcer$_o$/Customer}
γ4={resource$_j$/free trial game, customer$_i$/customer, value activity$_k$/distribute game, compensation/attention}

Table 2 shows the 9^{th} template and the substitution matching with the 1^{st} means.

9. <outsource *fraction* of production of, *resource$_j$*, in, *value activity$_k$*>
[stop producing *resource$_j$* in *value activity$_k$* AND start procuring *resource$_j$* from *outsourcer$_o$*]
γ={fraction/100%, resource$_j$/CD delivery, value activity$_k$/transport CD, outsourcer$_o$/shipper }

Table 2. Matching means 1 with template 9.

Application of Rules Four rules associated with the means templates highlighted in the to-be goal model are used to transform the as-is business model into an aligned business model. Due to space constraints, only the rule associated the 9^{th} template is presented here. Also, to save space, only the applied part of the rule is included in the following listing. In reality more rules than this one should be applied (one rule for each template).

Alignment of Means 1 (application of template 9 and its associated rule)

9. <outsource *100%* of production of, *CD delivery*, in, *Transport CD*>
[stop producing *CD delivery* in *Transport CD* AND start procuring *CD delivery* from *Shipper*]

Primary action:
a. IF actor *Shipper* not present THEN create actor *Shipper*.
Secondary action:
b. IF ((stop production) AND (outsourcing = 100%))
THEN call T6 and apply part (a) and (b) of associated rule
σ = **{T6.value activity**$_k$**/Transport CD,T6.resource**$_j$**/CD delivery}**
d. Call T3 and apply associated rule
σ = **{T3.resource**$_j$**/CD delivery,T3.provider**$_p$**/Shipper,**
T3.value activity$_k$**/Distribute content}**

Call of T6 and application of the associated rule:

6. <stop producing, *CD delivery*, in, *Transport CD*>
[(start procuring resource$_j$ from provider$_p$) XOR (stop offering resource$_j$ to customer$_i$)]

Primary action:
a. Delete the duality with the value exchange from the *Transport CD* concerning the *CD delivery* within the principal actor.
b. IF *CD delivery* is the only value object produced in the *Transport CD* THEN delete the *Transport CD*

Call of T3 and application of the associated rule:

3. <start procuring, *CD delivery*, from, *Shipper*>
[(start using *CD delivery* in *Distribute content*) AND (start providing *Payment* to *Shipper*)]

Primary action:
a. IF actor *Shipper* is not present THEN add the actor *Shipper*.
b. Add a new value exchange for the *CD delivery* from *Shipper* to the principal actor.
Secondary action:
c. Add a new value exchange from the principal actor to the *Shipper* (as *Payment* for the ***CD delivery*** offered by the *Shipper*).
Connect the new value exchanges to an existing or new value activity of *CD Delivery* within the *Shipper*
d. IF start using THEN connect the new value exchanges of *CD delivery* to the existing *Distribute content* activity.

The chain of templates called for the transformation of the as-is business model can be visualized as a tree. The first level represents the templates related to the new means templates indicated in the to-be goal model. The tree is then traversed in a pre-order walk: first the parent is visited and then the left child before the right child. Figure 4 shows the tree with each template called.

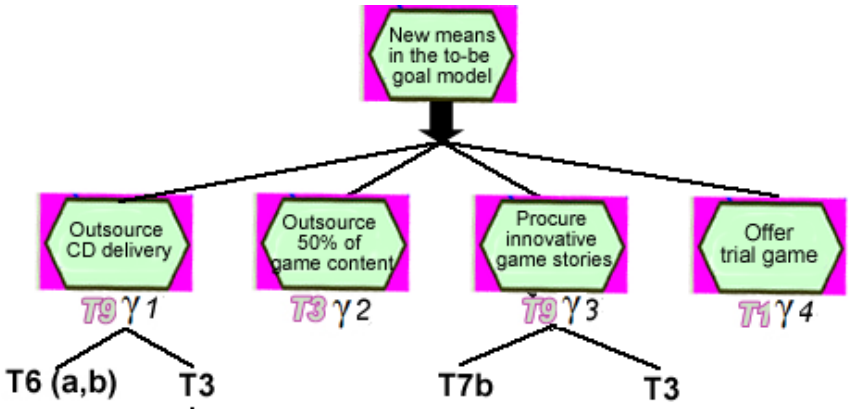


Fig. 4. Templates and calls from rules

Output: The To-Be Business Model Figure 5 represents the business model of the MMOG provider that is aligned with the to-be goal model. The figure is the as-is business model[5] where some transformations have been done by applying transformation rules. Newly added constructs in the model have been highlighted in the figure. The detailed example of a rule application resulted in the introduction of a new actor (Shipper) and constructs related to it.

[5] Notice that the as-is business model is omitted due to space restriction.

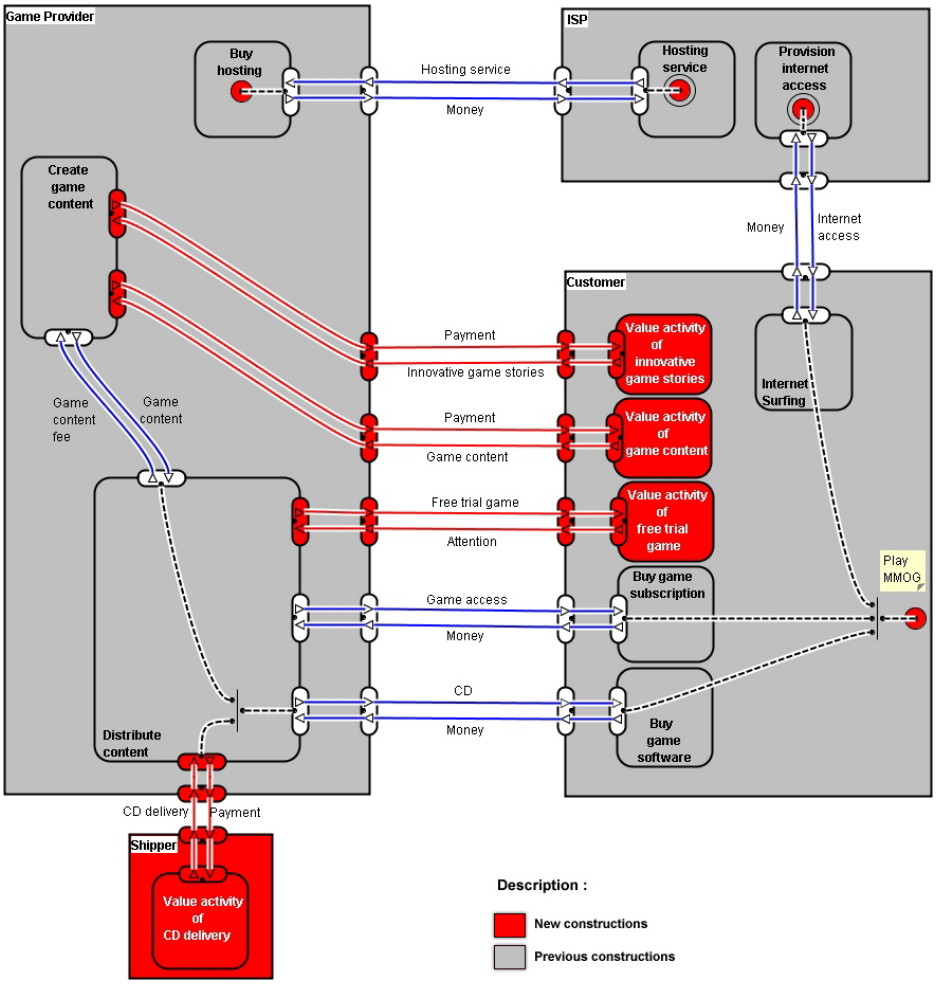


Fig. 5. Improved method : to-be business model

4 Conclusion and Future Research

In this paper we have addressed one part of the problem of business and IT alignment. We have done so by proposing a method that aims at aligning goal models and business models. The method takes as input a goal model and a business model, and outputs a business model that is aligned with the explicit goals of a business actor. The method builds on previous work presented in [1] and the benefits of that method still applies; clear and uniform goal formulations, well-founded business model design, and a high level of traceability. But this work extends the previous method in at least two ways. First, the syntax of both

the the means templates and the rules was clarified resulting in better methodological support through reduced ambiguity. Second, combining templates to an arbitrary level is now possible. This enables a modeller to express whole chains of actions (or scenarios) that affect the design of business models.

Future research include investigations about the completeness of both the set of templates and the set of rules. For instance, as presented one template is always associated with one rule. This is very convenient as it constrains a modeller to arrive at only a small number of end results. It may, however, be that this is overly constraining and that more options should be open for the modeller. Another direction for future research is the proposed implication array. This array expresses the legal (or illegal) combinations of templates paving the way for consistency checking in the method. In order to do this checking the nature of the combinations must be understood. Some implications are always true, but some are true only in special cases. For instance, for a particular organization one combination of templates may be allowed while for another the combination is forbidden.

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