MASTER IN COMPUTER SCIENCE

The business behavior model
concepts and usages

Lemaire, Denis

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The Business Behavior Model

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Author: Lemaire Denis

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Lemaire Denis

RÉSUMÉ – FRANÇAIS

Dans une société toujours plus exigeante en temps et en qualité, s'organiser pour faire face aux pressions croissantes est une nécessité inévitable. Une bonne organisation assure les moyens de s'adapter rapidement aux changements et de se préparer à contrer les compétiteurs. Cet environnent instable dans lequel évolue les firmes doit être contrebalancé par une gestion précise de la structure et des ressources de l'organisation. Dans ce contexte, les firmes mettent en place des outils schématiques pour améliorer leur compréhension de l'entourage qui les influence. Diverses techniques sont utilisées pour décrire une vision des différents niveaux de la vue organisationnelle. La vue organisationnelle est un ensemble de couches superposées des aspects de l'entreprise commençant par le niveau managérial et finissant par l'application de solutions effectives. Cependant, ces techniques émergeantes sont introduites pour modéliser des aspects particuliers de l'organisation. La modélisation de buts a pour objectif de décrire de façon schématique les ambitions managériales. La modélisation de valeur est utilisée pour définir et analyser une proposition de valeur. Toutes ces techniques fournissent une vision d'une partie d'un système complexe sans relations avec d'autres problèmes. En ignorant ces autres problèmes, les solutions proposées dans chaque couche peuvent ne plus être en accord avec les autres couches. Une solution qui pourrait fournir une vision complète de l'entièreté des aspects de la scène dans laquelle l'entreprise évolue est clairement inaccessible ; la complexité d'une telle scène en est la cause. La solution généralement envisagée est d'utiliser des outils pour améliorer l'alignement des couches. Ce mémoire se concentre sur la transition entre l'émission des objectifs stratégiques et leurs implications dans une proposition de valeur. La solution proposée aligne la couche stratégique avec la couche business grâce à un modèle intermédiaire ; le Business Behavior Model. Ce modèle représente les ressources, les décisions, et les motivations d'un agent.

Mot clés: Business/IT alignement, Business & Stratégie alignement, modèle de ressources, agent rationnel.

ABSTRACT – ENGLISH

In a society increasingly demanding in time and quality, getting organized to face the growing demand is an unavoidable necessity. A good organization provides means to quickly get adapted to variations and be prepared to face competition. This unstable environment which surrounds the firm has to be counter-balanced by an accurate management of the structure and the resources of the organization. In this context, firms deploy schematic tools to improve their understanding of the influencing entourage. Various techniques are used to describe gathered understanding of different levels of organizational view. This organizational view is a layered set of the company's aspects starting from the management level and ending in the creation of solutions. However, those emerging techniques are introduced to model particular aspects of the organization; Goal modeling is purposed to set, in a schematic way, the ambition of the management level. Value modeling is used to define and analyze the impact of a value proposition[13]. All those useful techniques are providing a view of a part of a complex system without any relation to other issues. By ignoring those other problems, the proposed solutions in each layer may become inconsistent with the others. A solution which could provide a complete view of the entire aspects of the scene where the considered company is performing is clearly unaffordable due to the complexity of that scene. The commonly considered solution is to use tools to pull out consistency among layers. This thesis focuses on the transition between the emissions of the strategic goals and their implication in a value proposition[13]. The proposed solution aligns the strategic and the business layers thank to a new intermediary model, the Business Behavior Model. This model represents the resources, the decisions, and the motivations of an agent.

Keywords: Business/IT alignment, Business & Strategy alignment, resource modeling, rational agent.

Business Behavior Model

CONTENT

1. Section: Introduction

1.1. Context

Companies are facing challenges while managing their interactions with their environment; competitors, customers, partners, and governments. This major concern constantly puts the company on the edge. Therefore, adaptation to this environment is the key for the long survival of the firm. Failing in the adaptation process leads to a non sustainable firm activity. This process is named the alignment.

The stated alignment problem has been discussed in several papers [34, 32]. The alignment focuses on two major issues; the Business & Strategy Alignment and the Business & IT Alignment (BIA).

The first issue aims at aligning the business perspectives with the strategic perspectives. The second one is especially concerned by the integration of the business and the IT in a consistent strategy. However, those approaches of the alignment are not that different. The BIA splits the strategy and the business (from the first issue) into two perspectives; one focusing on the business, and the other on the IT (figure 1). Therefore, BIA concerns alignment on four aspects; the business strategy, the IT strategy, the business infrastructure and process, and the IT infrastructure and process.

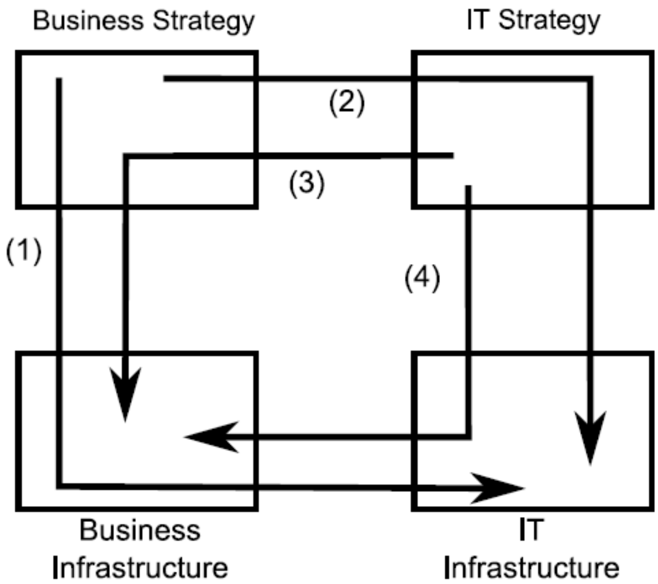


Figure 1 Strategic Alignment model [54]

The alignment as exposed by Venkatraman [32] is composed of four possible way of ensuring alignment (figure 1). Those interactions are described as follows [53];

1. Strategic execution: the business strategy as a driver for both the business infrastructure choices and the logic for IT infrastructure.
2. Technology potential: The business strategy is also the driver. However, it involves an IT strategy to support the chosen business strategy and the corresponding specification for the IT infrastructure.
3. Competitive potential: It concerns the exploitation of IT capabilities to influence the strategy.
4. Service level: It focuses on building a world class IT organization within the organization.

The considered alignment is necessary as IT Systems are always more integrated in the organization, thus, a modification on one of the component could have an undesired impact on the whole configuration of the companies. Additionally, when a decision is taken, it could modify the strategic objectives, and those modifications are not easily portable to the business perspective. If the problem is not handled, it could result into incoherent states between the expected goals and the real IT business investments, and ending in a loss of competitiveness for the company [34, 32, 2, 50].

1.2. PROBLEM

The problem is that organizations are not easily getting aligned. The truth is that in a recent survey [48], some 78% of European IT managers have indicated that their IT is not aligned with business strategy. Another recent survey shows similar results [49]. Yet, the organization must adapt itself to the constantly moving environment to survive (figure 2). Adaptation is necessary at all levels of the organization and this adaptation must be coherent from one level to another.

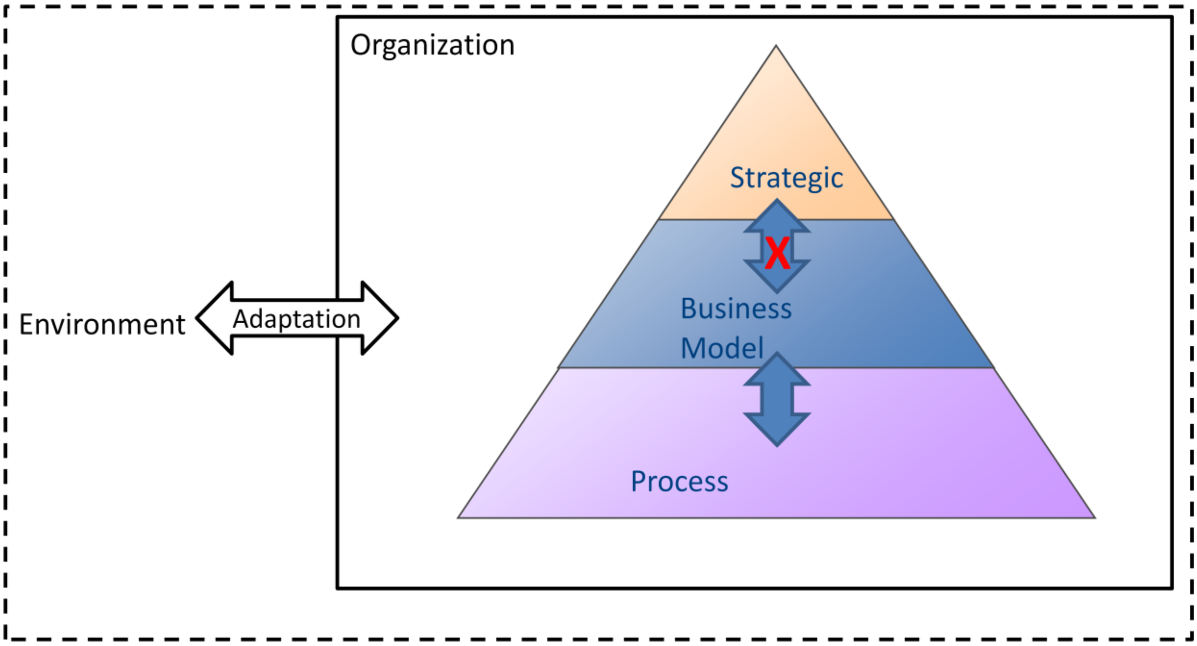


FIGURE 2 LAYERS OF ORGANIZATION IN THEIR ENVIRONMENT, ADAPTED ON [3]. THE ARROW WITH A CROSS IS THE PROBLEM STUDIED IN THIS THESIS

However, to adapt efficiently, managers firstly need to understand where and how they can adapt their organizations. The layered abstraction model (figure 2) shows a pyramidal view of the organization and highlights the adaptable level of the firm. This pyramid is a three-layer framework;

Strategic layer: The layer can be described by means of goal models like KAOS [30, 31], i* [17, 18], BMM [24]. “Goal models are used in the earliest phases of business where they help in clarifying interests, intentions, and strategies of different stakeholders answering to the "why" of the business” [2].

Business model layer: The layer can be described by means of business models like e³value [42] or BMO [9]. “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. A business model focuses on the “what” of a business.” [2]. the business layer defines and analyzes value propositions[13].

Process layer: The process layer can be described by means of process models such as BPMN [55]. “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” [2] .

Those layers are not independent; they are connected through direct relations. The strategic goals must constantly be adapted to face changing environment. A change in the goal layer has to be impacted to the business layer. Otherwise, what is proposed is not consistent with the desired expectation of the strategic layer. Likewise, the changes in the business layer have to be impacted on the process layer to ensure that what is performed is consistent with the business formulation. This problem is bilateral as it also works in the other direction; innovation in the processes can lead to desired adaptations in the strategic layer. This step-by-step adaptation is often a complex process, and through numerous adaptations, distortions appear between the expectations and the operational solutions. This lack of alignment is problematic to the capability of the firm to get adapted due to the application of inappropriate solutions in regards of the problem the firm is facing.

This Master thesis focuses on improving a subset of the alignment; the alignment between the layers concerning the strategy and business (figure 2); the first issue of the alignment - the Business & Strategy alignment. Concerning the Business/IT alignment, this thesis does not make the differences between the IT and the business perspectives. Yet, it gives basis for further works on IT specificity.

Some researches have already been led on this specific problem of alignment [21, 33]. Nevertheless, this thesis proposes a new solution to improve the alignment. This solution is a model that aims to bridge the two layers through original concepts.

1.3. OBJECTIVES

As said, this thesis is purposed to improve the alignment. Aligning the two layers requires bridging the main concepts from both layers to make them consistent together. The main concepts are described below and schematized in the figure 3.

- Strategic layer is about goals to fulfill the mission[1] of the organization. Goals are realized through decisions. Strategic layer is also concerned by external agents that influence goals.
- The Business layer aims at providing the 'what' of the business; the agents, the resource and the exchange of resources between the agents [2].

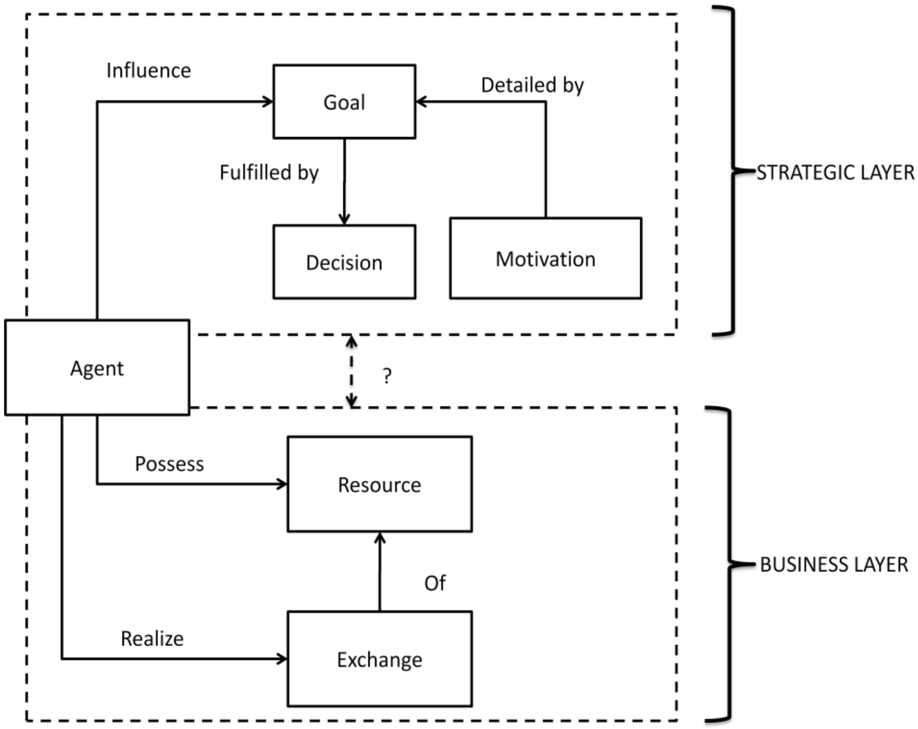


FIGURE 3 THE STRATEGIC AND BUSINESS LAYERS WITH THEIR MAIN CONCEPTS. THE DOTED ARROW SHOWS THE AIMED OBJECTIVE OF BRIDGING THE TWO LAYERS. THE SYNTAXES AND MEANINGS ARE DESCRIBED IN APPENDIX II.

Words with exponent such as [1] are defined in the appendix I.

As layers use models to express those concepts, a feasible solution to align those layers is a new model that aims to link their models. Therefore, the design objective is to develop a language with the concepts from the business and strategic layers and to integrate the language in a methodology.

The aimed language (syntax and semantic) must be connected with strategic and business models (figure 4). The connection would be supplied by shared concepts among the developed model and strategic and business models. In order to help the user, a methodology of use has to be provided with the model.

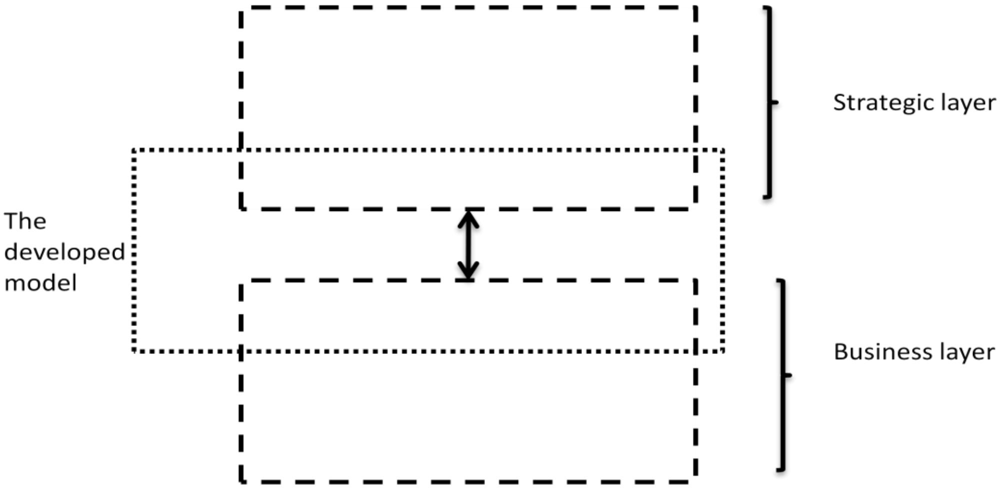


FIGURE 4 THE POSITIONING OF THE AIMED MODEL. THE ARROW REPRESENTS THE DESIRED ALIGNMENT.

1.4. METHODOLOGY

In order to follow a rigorous research, we based the thesis on a specific methodology of work; the Design-Science. The Design-Science paradigm 'seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts' [28]. The Design-Science includes two design processes and four design artifacts. The two processes are 'build' and' evaluate' and the four artifacts are the construct, the model, the method and the instantiation. The design research is also influenced by the environment (people, organizations and technology) and by the knowledge base (foundations and methodologies).

The research is based on the two processes and uses the four artifacts. It also interacts with the environment through the business needs for alignment. The knowledge base is exposed in state of art (section 2). As a methodological basis, we used the guidelines from [28].

Note that the Design-Science is actually purposed for Information System (IS) research. Yet this exact research does not concern directly IS matters. Nevertheless, the context of this research lies in IS as the proposed solutions is a basis for further IS development. The thesis is also using different models (i* and e³value) that are used to represent IS problems. A short explanation on the Design Science is available in appendix (appendix V).

Guideline 1: Design as an Artifact

The result of design-science research in Information System is, by definition, a purposeful IT artifact created to address an important organizational problem.

Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation. The research is directed towards the creation of a model for helping strategic and business alignment. This model is composed of two artifacts;

- The language: a construct (syntax) and a model (semantic and meta-model) – section 3.
- The methodology: a method under the guise of processes - section 4.

Both are also using instantiation through cases – section 5.

Guideline 2: Problem Relevance

This guideline is about an unsolved problem [50, 51] and therefore about the conceptualizations of a relevant solution. The problem is the adaptation to the unstable environment that surrounds companies.

The addressed problem is far too wide to be entirely approached in the research. The alignment which is described (section I.2) involves numerous norm and model issues that are too complex to be tackled out in one research. Therefore, the aimed problem of the research (alignment between value and goal models) is limited to the few studied models (due to time limitation). Those models are i* [17] and BMM [24] as standards for the strategic layer and e³value [42] as a standard for the business layer.

Guideline 3: Design Evaluation

The utility, quality, and efficiency of a design artifact must be rigorously demonstrated via well-executed evaluation methods. IT artifacts can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes.

Different design evaluations are proposed; Observational, Analytical, Experimental, Testing and Descriptive [28]. For this research, we opted for descriptive and experimental methods. Experimental method is deployed in the instantiation of some cases (MMOG section 5.2, Health care section 5.3) for testing.

The applied 'descriptive' method uses the informed argument [28] based on a comparative approach with studied models (BMM, i*, e³value) (section 3.4 and section 4). Some scenarios (for experimental design evaluation [28]) around the artifact are also developed through the cases (section 5). In addition, the language aims some quality criterions [52].

Guideline 4: Research Contributions

The main contributions are the artifact themselves. Through validations, they can help to improve the alignment for organization. A second contribution lies in the improvement of the state of the art considering the studied theories (section 2)

Guideline 5: Research Rigor

Design-science research requires the application of rigorous methods in both the construction and evaluation of the designed artifact. Rigor is settled up as far as possible by using relevant and serious researches (i.e.; Resource Based Theory, Bayesian networks, goals models, e³value) as basis to the development.

The research process itself was organized around precise schedule and timeline. Weekly meeting were organized to discuss advancements and to evaluate the work with the research institute. Moreover, the tested cases provided feed-backs for the evaluation of the language and of the methodology.

Guideline 6: Design as a Search

Design as a search means that the process should be iterative (generate and test) and purposefully directed to achieve in an efficient way the fixed goals by considering the environment constraints.

We aim at having a satisfactory solution to the considered problem; the language has been adapted after cases' evaluation. However, further iteration may be needed to achieve efficiency.

Guideline 7: Communication of Research

A research paper [56] has been released and presented at the BUSITAL conference 2010. The research is available in appendix (appendix VI).

The build and evaluate processes

The design science is iteratively processed around a two-steps cycle; the build and the evaluation. This cycle is intended to improve every artifact (construct, model, method, instantiation). The table 1 summarizes this design process in the context of this research:

TABLE 1 THE RESEARCH FRAMEWORK ADAPTED FROM [29]

	Build	Evaluate
Construct	The syntax based on the causal graphs and on the contribution model. Section 3.	Discuss the language – section 3.4. Test on cases – section 5. Evaluation through the research paper.
Model	The semantic and the meta-model - section 3.	Discuss the language - section 3.4. Test on cases – section 5. Evaluation through the research paper.
Method	The processes for the methodology – section 4.	Discuss the obtained results – section 4. Test on cases – section 5. Evaluation through the research paper.
Instantiation	Two cases solved; MMOG and Health care by the way of two different approaches. Section 5.	The cases' feed-back (section 5.2 and 5.3) Evaluation through the research paper.

1.5. SUB-OBJECTIVES

As we adopted a design science approach, some more precise objectives are aimed;

I. The first objective is to determine exactly what the limits of this research and of the problems are.

II. The second objective is to define how to bridge those two layers; which concepts to integrate in the developed model and how. Indeed considering the figure 3, many solutions are possible and the derived language depends on it.
   a. Analyze various models and find lacking concepts.
   b. Select concepts that are relevant considering the alignment.
   c. Determine how concepts can be aligned on a theoretical basis.

III. In a consistent way with the second objective, the language has to be defined. Considering the context, the model has to be 'bridgable' to a large number of models from both business and strategic layers.
   a. Determine the syntax. Preferably, a syntax that respects quality framework for models.
   b. Define the semantic considering the selected concepts and the context.
   c. Check consistency with other models.
   d. Aim the adaptability of the model to various types of languages.

IV. Ideally, the model has to bring extra-contribution to the domain by integrating lacking concepts in the present models; it requires inquiring a state of art of those models.
   a. Find adding-value concepts.
   b. Integrate those concepts into the developed model.
   c. Check adaptability with other models.

V. Additionally, a methodology of use has to be settled.
   a. Determine how to use the model considering other models.
   b. Define the methodology; guidelines, processes….

VI. The developed model has to be tested on cases.
   a. Find cases.
   b. Develop those cases with the described processes.

VII. Finally, the model has to be validated for alignment improvement.
   a. Discuss the developed cases.
   b. Discuss the developed language for alignment.
   c. Discuss the developed processes for alignment.
   d. Discuss the utility of the developed model for itself.

1.6. STRUCTURE

The first section is the introduction. A second section, as suggested in the Design-Science Methodology [29], gives the state of art that has motivated the proposed solution. This section explores the used models in both layers but also relevant theories for the problem. The third section describes the first artifact; the language of the developed model. It provides the definition of the model, its syntax and semantic and its meta-model. This third section is ended with a discussion on the contribution of the language. The fourth section focuses on the second artifact; the methodology. The methodology is described through processes and evaluated in a discussion. The fifth section is about the instantiations of the model for two cases and the related discussion. The last section concludes this thesis and discusses the obtained results. This last section also explores further feasible research on the subject.

The thesis is completed with the references and the appendixes. The appendixes are ordered as follows; the lexicon, the syntax for some concept graphs, the problem description for one of the cases, the syntax and semantic of BBM, the design science summary, the research paper, the syntax and semantic of causal graphs, and possible questions to evaluate the model.

2. SECTION: STATE OF ART

2.1. INTRODUCTION

This section discusses and describes theories and models that are necessary for understanding the following thesis. The state of art concerns, in one hand, the theories and models that had been used to create the language and the methodology; Rational agent (1), causal graphs (2), contribution model (3), Balanced Scorecard (4), Business Model Ontology (5) and resource based view (6). In the other hand, this section describes models that are considered as representative of the layers to be aligned. For the strategic layer: i* (7) and BMM (8). And for the business layer: e^3value (9).

The theories and models used to create the model are described through a short description. Models are detailed with a meta-model. The causal graphs (2) are detailed thank to an example and a meta-model. This meta-model is important to understand the meta-model of the developed model (section 3).

The models from the two layers are described through their syntax and semantic and their meta-models. They are also illustrated with an example and with a schema that highlight the represented flow of information of those models inside their respective layers. Finally, a small additional point describes the main notions of the models. All those elements are important for the following research; the main notions and the schemas of the flow of information are used to validate the language whereas the meta-model and the semantic are useful for the methodology's validation. The syntax is also used for the cases (section 5).

The example as used in this section is described as follows;

A biscuit company wants to inquire on a new segment of the biscuit market. In that ambition, they plan to produce cookies that will be sold directly to customers. They have a motivation for this production; increase their solvability which was not good at the last trimester. They aim to make cookies that meet the customer's need for pleasure.

This section is ended by a discussion that spots some issues in the studied theories and models but also some clues of solutions in others. It dresses a table of problems to be answered and emphasizes problem in the flow of information of the studied models.

The appendix II describes the syntaxes and the associated meaning for the figures 13, 16, 19, 20, 31, 32, 33.

2.2. PRESENTATION

2.2.1. RATIONAL AGENT THEORY

Rational Agent Theory [44] is a widely used theory in the Decision [46] and Game theory [45] and an agent oriented model must be consistent with this theory.

The Rational Agent Theory is a complex subject that aims at describing how actors react in various contexts that involve decisions. Considering the decision theory [46] there are three fundamental concepts [44];

- *Actions*. These are the options an agent ponders (considers)
- *Conditions*. These are how things turn out independently of actions.
- *Outcomes*. These are the states that result from actions under various conditions.

Considering those concepts, the decision theory represents agents having Beliefs, Desires and Intention (BDI) or mental attributes that makes them rational (or at least we consider in the problem that they are rational). "These mental attitudes determine the system's behavior and are critical for achieving adequate or optimal performance when deliberation is subject to resource bounds" [44]. The figure 5 models those attributes.

- Beliefs are about information on the agent's environment.
- Desires are about motivation. The outcomes that capture the agent's desires.
- Intentions are about deliberative states of the agent.

A rational agent has clear preferences and aims at performing actions that result in the optimal outcome from among all feasible actions.

META-MODEL FOR BDI FRAMEWORK

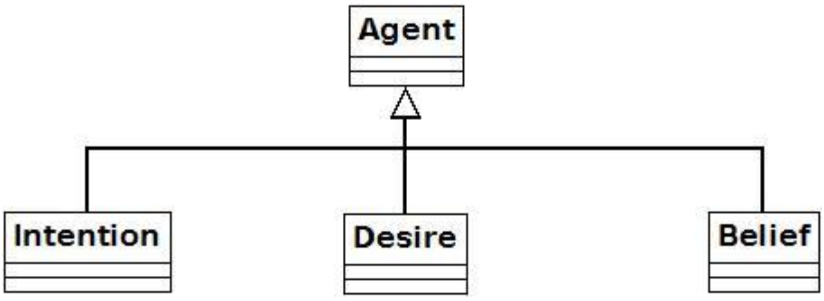


FIGURE 5 META-MODEL FOR BDI FRAMEWORK

2.2.2. CAUSAL GRAPH

Causal graphs are directed acyclic graphs, "in which vertices denote variable features of a system and edges denote direct causal relations between these features" [47]. The type of Causal graph we used here is a model exposed in the paper [4]. To understand those causal graphs it is necessary to start from the initial theory, 'The decision theory' [46], and to spoor the evolution of causal graphs.
The *decision theory* is a widely used interdisciplinary subject which concerns mathematics, statistics, politics, economies, psychologies and social sciences. This theory is led by the human decision. However, the theory does not embrace all the aspect of the human activity; it is focused on goal directed activities. This theory is concerned about goal directed behaviors in the presence of options. Decision theory has then been developed in several different paths. Some of those paths use causality relation; Causal Graph, one of them, is the Bayesian networks [5].

Bayesian Networks (BNs) are graphs representing knowledge on uncertain domains. Those networks are issued from the graph theory, the probability theory, computer science, and statistics. Bayesian networks use two main structures: a Directed Acyclic Graph (DAG) and a Conditional Probabilistic Table (CPT). The DAG is the network itself with chance nodes and conditional arcs. Chance nodes are the variable of the problem whereas conditional arcs (renamed as causal links in extension) are causal relations between chances nodes. The CPT is the quantitative part; a table that gives the probabilistic dependences between nodes that are linked via conditional arcs. Note that the DAG is consistent with the Markovian property and so, does not allow circles (acyclic) in order to allow the factorization of the joint probability of a collection of nodes [6, 7]. BN has been extended through the usage of the influence diagrams.

Influence Diagrams (ID) proposes to use the basis of the Bayesian networks with additional nodes: the "*decisional nodes"*, and the "*value nodes"*. And also a new link: the "*informational link"*. The purpose of this kind of diagrams is to help contemporary companies to deal with always more complex IT-system modeling. Influence Diagrams are tools to improve the quality of the decisions on IT-system that could have an impact on a whole range of other system [8]. ID receives additional extensions in the Extended Influence Diagrams (EID) [35], [8]. These additional extensions concern mainly the possibility of using definitional relations between nodes. Those definitional relations allow having a leveled granularity for nodes.

Finally, Causal Graph as described in [4] appears with additional elements like ‘and’ and ‘or’ relations and Value Links. Value Links are useful for this research as they allow not modeling CPT, but instead to model the type of (the causal) effect between nodes.

A table in appendix VII summarizes the syntax and semantic of the Extended Influence Diagrams (with AND and OR relations). Note that this appendix also provides examples of possible relations. The table 2 shows the syntax of some causal graphs elements for the purpose of the example in figure 6.

TABLE 2 SYNTAX OF SOME CAUSAL GRAPH ELEMENTS.

<table>
<tr><td colspan="4">Nodes</td></tr>
<tr><td>Variable of the problem
Chance</td><td colspan="2">Expected outcomes of making decisions
Utility</td><td>Decisions that are made
Decision</td></tr>
<tr><td colspan="4">Links</td></tr>
<tr><td colspan="4">Causal</td></tr>
<tr><td colspan="4">Links value</td></tr>
<tr><td>Enable ++</td><td>Supports +</td><td>Undercuts -</td><td>Disables --</td></tr>
</table>

EXAMPLE OF A CAUSAL GRAPH:

This example (figure 6) is based on cookies producer’s case. The producer decides to produce quality cookies (Decision nodes). It supports (+) a good quality which is a variable of the problem and therefore a chance node. There is other variables that influence the problem: the cost which is ‘supported’ by the quality (i.e.; increased), the price which is supported by the cost, the customer enjoyment that is enabled by the quality and undercut by the price, finally there are sales that are influenced by the customer enjoyment. The sales enable the improvement of the solvability which is the utility of producing quality cookies and the expected outcomes (Utility nodes).

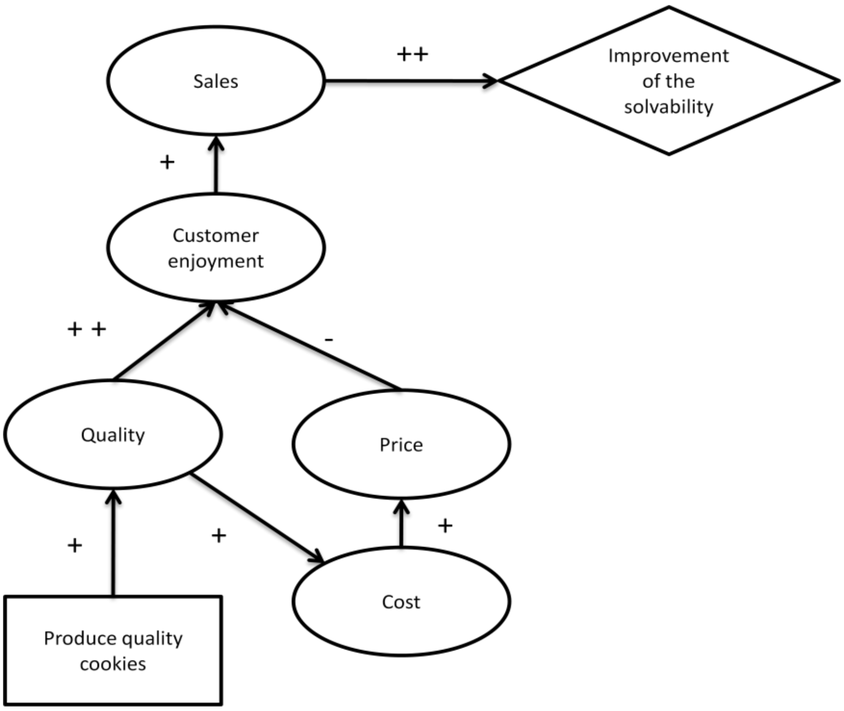


FIGURE 6 EXAMPLE OF A CAUSAL GRAPH FOR THE COOKIES PRODUCTION CASE

META-MODEL:

This meta-model (figure 7) shows the three main types of nodes (utility, decision and chance) and the three main relations (causal, informational and definitional links) of EID with the additional concepts from [4]. This figure also emphasizes the presence of the Conditional Probability Table. This meta-model is made of various literatures [4, 35, 8]. Note that value link and CPT are exclusives for a link (only one of them is applicable).

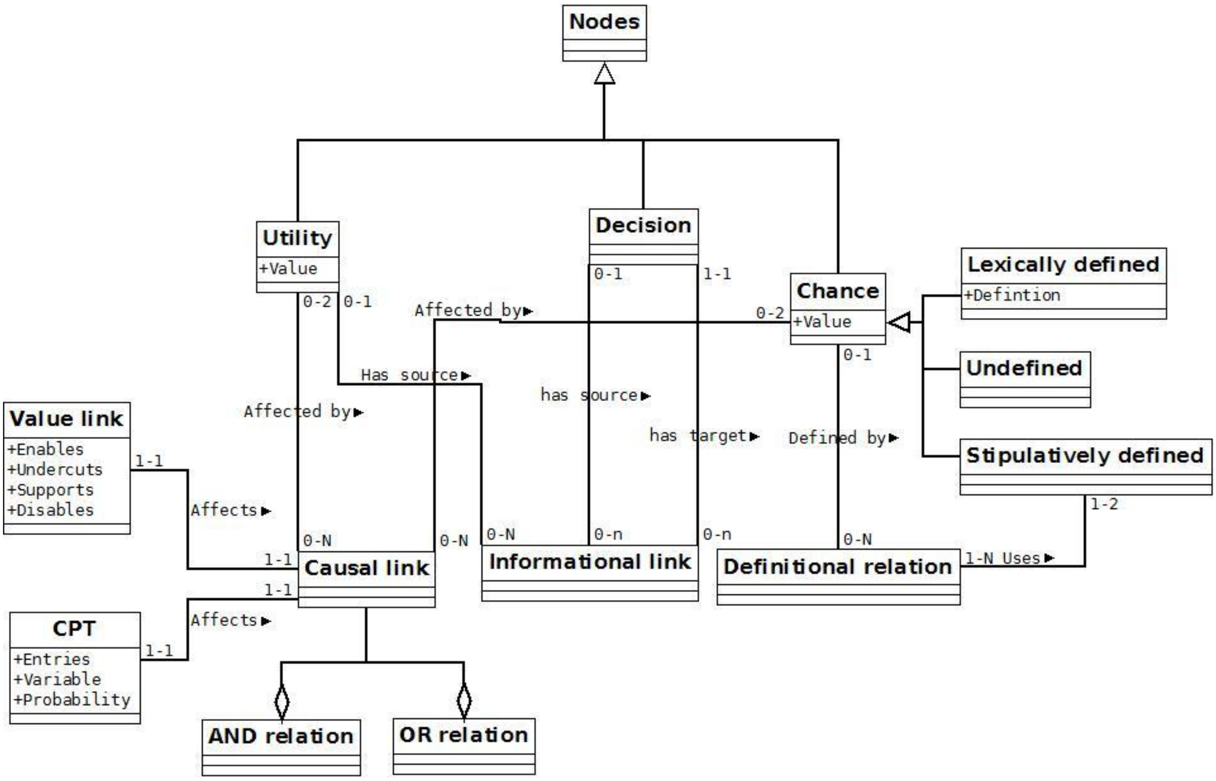


FIGURE 7 META-MODEL OF CAUSAL GRAPHS

2.2.3. CONTRIBUTION MODEL

The Contribution Model [1] points out a first draft of a feasible solution for the alignment problem. The solution focuses on the two first layers: the strategic and the business layers. The language of the model is presented under the guise of a structured set of nodes and arcs (Figure 8). The developed model contains some notions of the contribution models.

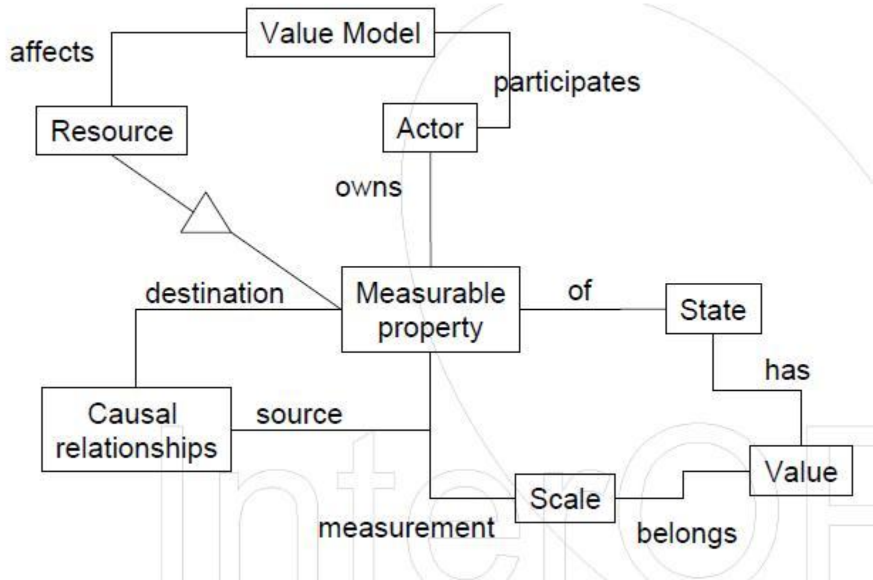


FIGURE 8 META MODEL OF CONTRIBUTION MODEL [1]

As observed in the meta-model (figure 8), the contribution model consists in three concepts: the participation of the actor, the affected resources and causal relationships that emphasize relations among nodes. Resources are described thank to their properties.

The Contribution Model has to be used in a particular process as described in [1]. The process is based on two models: i* and e³value respectively from the strategic and the business layers. The developed process aims at improving the goal model (i*) on the basis of a value model (e³value) by using the Contribution Model as an intermediate. The process is focused on two aspects or questions;

Does the actor's participation in the business layer fulfill the goals in the strategic layer?

Does the goal model contain conflicting goals?

The contribution model purposefully underlines the active participation of the actors in the value proposition. From a technical standpoint, the process consists in the building of a Contribution Model for every actor (based on e³value information) and in fusing the obtained instances in a unique. Finally, the process proposes to analyze the relation between the remaining properties to highlight conflicting and synergic relations in the goal model (conflicting relations should be modified consequently).

2.2.4. Balanced ScoreCard

Balanced ScoreCard (BSC) was initially developed through the work of R.Kaplan and D.Norton [36] in the early 1990s. Since then, the concepts in the BSC have been improved through three "generations" of BSC. Those BSCs are well known and widely adopted through the world [38].

BSC are not used directly in the developed model. Yet they are important to understand how the next theory (BMO) has been integrated into the developed model.

The origin of balanced scorecard stems from the idea of combining financial measures and non-financial measures in a single view. "BSC aims to provide managers with richer and more relevant information about activities they are managing than is provided by financial measures alone." [41]

The idea from the initial paper of Kaplan and Norton was to cluster into four perspectives the relevant information about activities [36] [37]. Clustering (sorting out information in the right perspective) is the key activity of the BSC.

BSC are intended for managers who want to improve their organizational performance by provisioning relevant data (1st generation BSC) and by following key measures in each perspective (2nd generation BSC). The last improvement allows managers to explore strategic objectives (3rd generation BSC). Finally, Strategic Maps are concerning BSC coupled with objectives within a diagram.

1st Generation Balanced Scorecard

Balanced Scorecard was initially described as a four perspectives approach to performance measurement [36].

- Financial: The identification of a few relevant high-level financial measures. "How do we look to shareholders?"
- Customer: "How do customers see us?"
- Internal business Process: "What must we excel at?"
- Innovation and learning: "Can we continue to improve and create value?"

Kaplan and Norton introduced the idea of causality relation between the four perspectives without any other details (figure 9). They also added prompt questions to "aid the information regrouping and to capture the essence of the organization's strategy material to each of the areas" [36].

The improvement of the performance is triggered by the provision of relevant measurement data itself. "It establishes goals but assumes that people will adopt whatever behaviors and take whatever actions are necessary to arrive at those goals". [36]

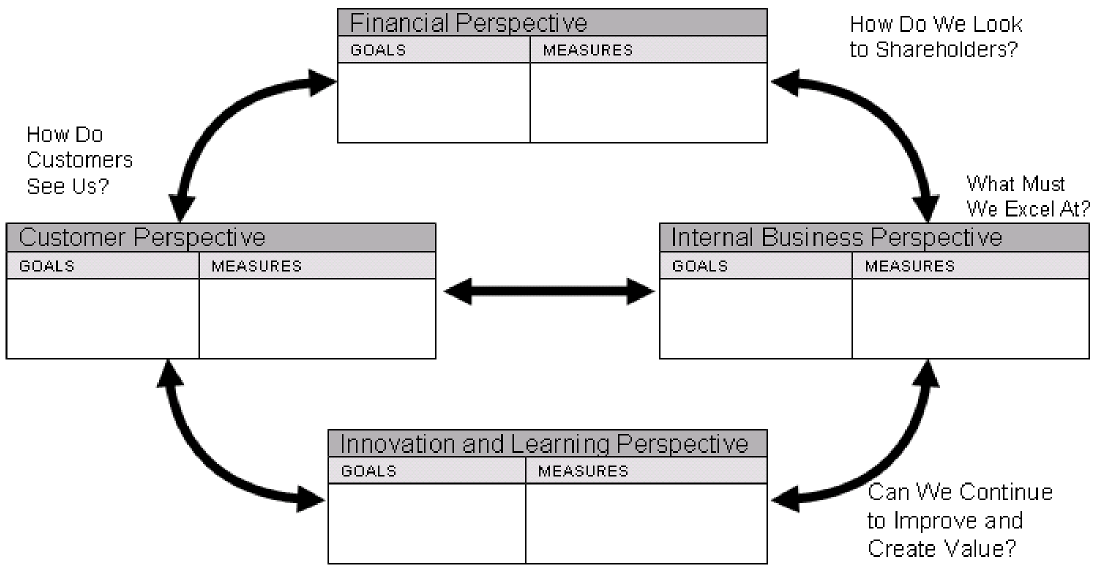


FIGURE 9 1ST GENERATION BALANCED SCORECARD FROM [41]

2nd Generation Balanced Scorecard

The definition of a Balanced Scorecard was initially vague, allowing for considerable interpretation. Two major concerns were 'filtering'- choosing specific measures to report [40] - and 'clustering' - deciding how to group measures into 'perspectives'.

Considering the prompt questions of the 1st generation BSC, Kaplan and Norton [37] brought idea of 'strategic objectives' distributed on a "strategic linkage model" the strategic objectives are spread across the four perspectives, so as to form a visual presentation of strategy and measures.

To develop a strategic linkage model, managers select a few strategic objectives within each of the perspectives, and then define the 'cause-effect chain' among these objectives. 'Cause effect chain' is the second improvement of those second generations BSCs; they improve the initial causality relation in the first generation BSC.

The impact of these changes was characterized by Kaplan and Norton as enabling the Balanced Scorecard to evolve from "an improved measurement system to a core management system" [40]

3rd Generation Balanced Scorecard

The 3rd Generation Balanced Scorecard model is based on a refinement of 2nd Generation design characteristics and mechanisms to give better functionality and more strategic relevance [41]

The major change is a design element; the 'Destination Statement'. It was initially used to estimate the consequences at a particular future date of implementing the strategic objectives previously selected for the strategic linkage model. However, it was found that by working from Destination Statements, the selection of strategic objectives were much easier. The process was so inverted to start with destination statements to explore the strategic objectives.

Strategy map

A strategy map is a diagram that links the Balanced Scorecard with a strategy. The strategy maps show manager's objectives arrayed across BSC's perspective. The maps also show relationships between objectives thank to causal relation.

2.2.5. Business Model Ontology

BMO describes the logic of a business system for creating value which lies behind involved processes. Therefore, the business model is understandable as "the conceptual and architectural implementation of a business strategy and as the foundation for the implementation of business processes" [9].

This framework (based partially on the balanced scorecard) is useful to bring a way to sort out resource's properties in an elegant and structured way. BMO has been selected instead of BSC because its aspects are better suited with our problem.

This framework is composed of four pillars with a certain level of granularity and described in details in [9, 10, 11]. The figure 10 describes how those fourth are linked.

Offering – product innovation

- *Value proposition:* It concerns cost elements, role of the customer and the performance of the value proposition.
- *Target customer segment.* It should answer the following questions; which customers? Which geographical areas? What product segments?
- *Capabilities*: The set of resources and skills which are necessary to implement the proposition (translated from [10]).

Infrastructure management

- *Activity configuration:* The activities to create and deliver value, and the relationship between them.
- *Resources and assets:* "Stable inter-organizational ties which are strategically important to participating firms. They may take the form of strategic alliances, joint-ventures, long-term buyer-supplier partnerships, and other ties" [9].
- *Partner network:* It consists in the partners that have been assigned to an unaffordable task (or value proposition) for the firm (translated from [10]).

Customer relationship

- *Information strategy:* It concerns the gathering of customer information and how to use them to excel in customer relationships.

- *Channels:* It concerns the internal and external channels by analyzing 4 aspects: the awareness, the evaluation, the purchase and the after sales.

- *Trust and loyalty*: The outcome of the customer's trust and satisfaction.

Financial aspects

The financial aspect is modeling the firm's profit and therefore its ability to survive among the competition.

- *Revenue model:* This element measures the ability of a firm to translate the value it offers to its customers into money and therefore to generate incoming revenue streams.

- *Cost structure:* This element measures all the costs the firm incurs in order to create, market and deliver value to its customers.

- *Profit model:* This element is the outcome of the difference between the revenue model and the cost structure.

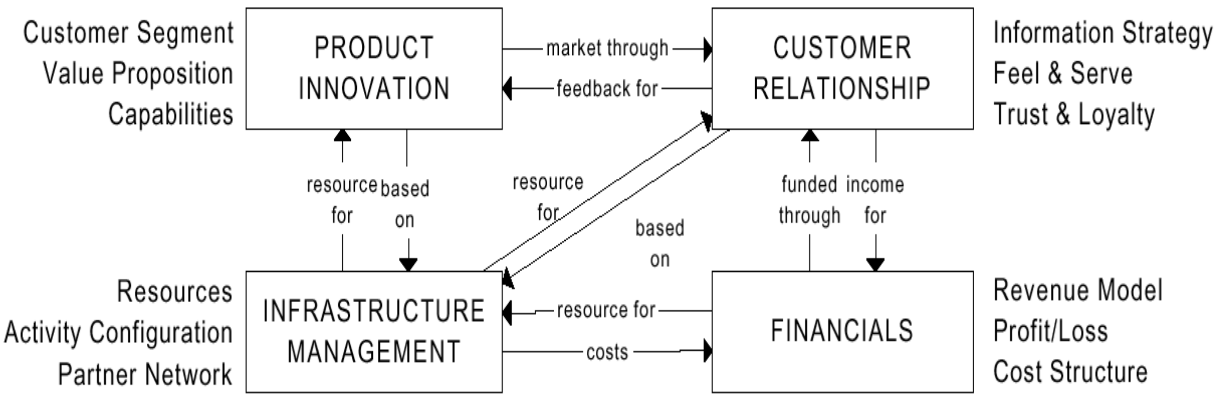


FIGURE 10 THE BUSINESS MODEL ONTOLOGY FRAMEWORK FROM [9]

2.2.6. RESOURCE BASED VIEW

The Resource Based View (RBV) is an economical theory that argues that firms possess resources. A subset of those resources can provide a competitive advantage and a further subset (named strategic resources) can lead to the sustainable competitive advantage of the firm whenever they are well utilized. The following explanation is based on [12, 13, 14, 15].

The Sustainable Competitive Advantage is the protracted benefit of implementing some unique value-creating strategy based on unique combination of internal organizational resources and capabilities that cannot be replicated by competitors [58].

Resources "are assets and capabilities that are available and useful in detecting and responding to market opportunities or threats." [16]

Resource's attributes allow determining which resources are strategic. RBV's theorists approached the identification of those attributes through a set of criterions. A resource that responds positively to all the criterions is considered as strategic. The commonly used criterions are described by Barney [14]. He suggested that resources must possess all the following attributes: value, rareness, inimitability and non-substitutability. We use a framework based on those attributes, the VRIO (Valuable, Rare, Inimitable, Organized).

The VRIO framework is used as an internal tool of analysis and has been developed in [15]. VRIO is an acronym of four questions around the studied resources with the following ideas:

- *Valuable* – A resource must enable "a firm to employ a value-creating strategy, by either outperforming its competitors or reduce its own weaknesses" [15].
- *Rare* – To be of value, a resource must be by definition rare. In a perfectly competitive strategic factor market for a resource, "the price of the resource will be a reflection of the expected discounted future above-average returns" [15].
- *Inimitable* –If a valuable resource is controlled by only one firm it could be a source of a competitive advantage. This advantage could be sustainable if "competitors are not able to duplicate this strategic asset perfectly" [15].
- *Organized* - A resource is organized if the firm is able to actually use it.

If a company manages to get a competitive advantage thank to its resources, this company must be able to make those attribute durable by keeping the resource valuable, rare, inimitable and exploitable to transform the advantage onto a sustainable competitive advantage.

2.2.7. INTENTIONAL STRATEGIC ACTOR RELATIONSHIPS MODELING (I*)

i* is a goal and an agent oriented framework developed to model the goal layer from an organization [17], [18], [19], [20] and [21]. The main idea of i* is that actor are intentional. By intentional the authors mean that agents act on the basis of concepts such as goals, beliefs, abilities, commitments. The representation of those goals allows "motivations and rationales to be expressed" [17]. The model is oriented for actors and goals modeling.

The model is used as a standard of comparison for the rest of the research. The model has been selected among other because it has already been studied in other alignment researches [1, 20, 21]. Moreover, it contains interesting notions which, coupled with the Business Motivation Model (5), cover a large scope of concepts from the strategic layers. Those interesting notions are the intention elements and the dependencies.

i* model is based on two sub-models: the Strategic Dependency and the Strategic Rationale.

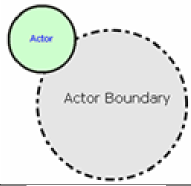
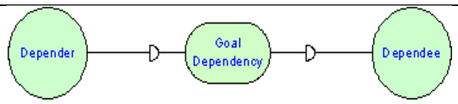
The Strategic Dependency (SD): It focuses on the intentional relationships among organizational actors [18]. The model intends to model the reasons why items are embedded into the system and so focuses on the relationship between actors.

The Strategic Rationale (SR): This model provides an inbox view of the intentional relations that are proper to one actor. It introduces the notion of elements as goals, tasks, resources and softgoals. It also describes the alternatives that are considered by an actor and the criterions to evaluate them [19].

SYNTAX AND SEMANTIC:

The table 3 describes the syntax and the semantic of the essential components of i*.

TABLEAU 3 SYNTAX AND SEMANTIC OF I*

Object	Syntaxes	Semantics
Actor		An actor is a semi-autonomous entity with intentions that have to be achieved with the intervention of other actors on the basis of the considered level of dependency.
Goal		Something to be achieved that is clearly defined. Note that some alternatives may exist to fulfill the goal.
Softgoal		Something to be achieved but that is not defined with a clear-cut criterion.
Task		A course of action to be carried out. It specifies a particular way of doing something, typically to achieve some goals [20].
Resource		A physical or informational entity needed to achieve some goals or to perform some tasks [20].
Means-end links		They are arcs between a node and a goal that explain how to achieve a goal (usually called end-goal) and what the alternative possibilities are. If the out-node is achieved, the 'end-goal' is considered as achieved too.
Decomposition links		It reveals sub-elements that are needed for the achievement of tasks. If the sub-elements are softgoals they should be considered as quality criteria [19].
Contribution links		Describes how an element contributes to another depending on the label attached to the link (Help, hurt, +, -, or, and…).
Dependency link		Dependency links present dependence between actors. The intermediate node gives the meaning of the dependency: Resource to be furnished, task to be performed, goal that depend on other actors.

EXAMPLE:

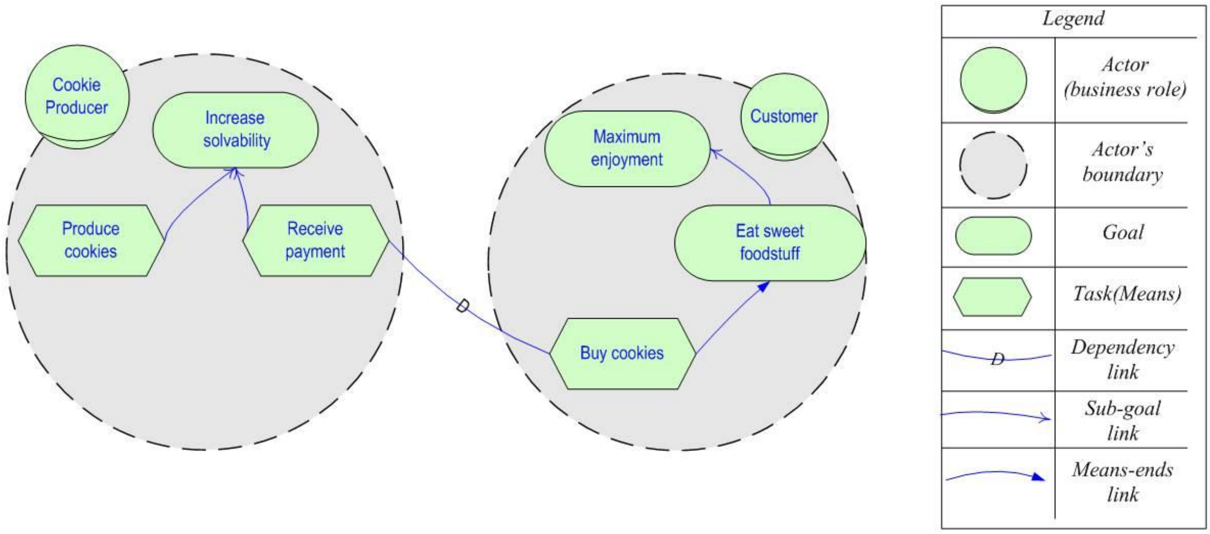


FIGURE 11 I* INSTANCE OF THE COOKIES CASE

The figure 11 describes the cases where the cookies producer has the goal to increase its solvability. It means having the following tasks; producing cookies and receiving payment (in payment for the cookies). The customer wants to maximize its enjoyment (a goal) by eating sweet food (another goal). His goals can be fulfilled by the task that consists in buying cookies.

MAIN NOTIONS:

- Strategic Dependency; dependency among actors [18]
- Strategic Rational; intentional relations [18]
- Goal's achievement thank to tasks or resources (means-end)
- Alternative solutions for goal's achievement (means-end)
- Causal effects (contribution links)
- Multiple actors exchanges (dependency links)
- Resource exchanges (Resources)

META-MODEL:

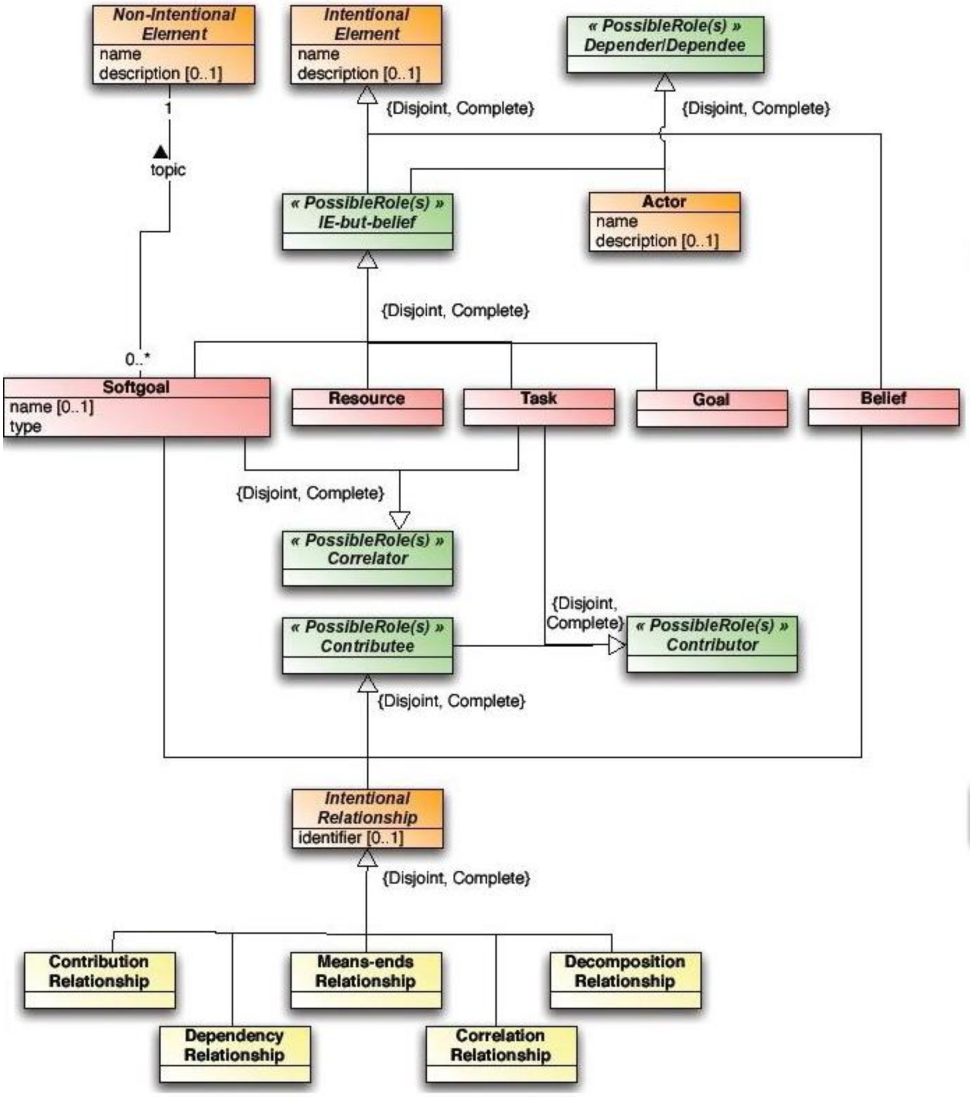


FIGURE 12 META MODEL OF I* FROM [25]

POSITIONING THE MODEL INTO LAYERS

The figure 13 shows the positioning of i*'s main concepts among layers. This figure is based on the definition of layers, on the description of i*. The idea is that i* expresses an agent through dependencies. The dependencies concern tasks or goals. Tasks are a way to achieve goals. Dependencies are also influenced by external actors which can possess some resources. Resources are theoretically belonging to the business layer (see figure 3). Tasks are defined at a tactical[4] level.

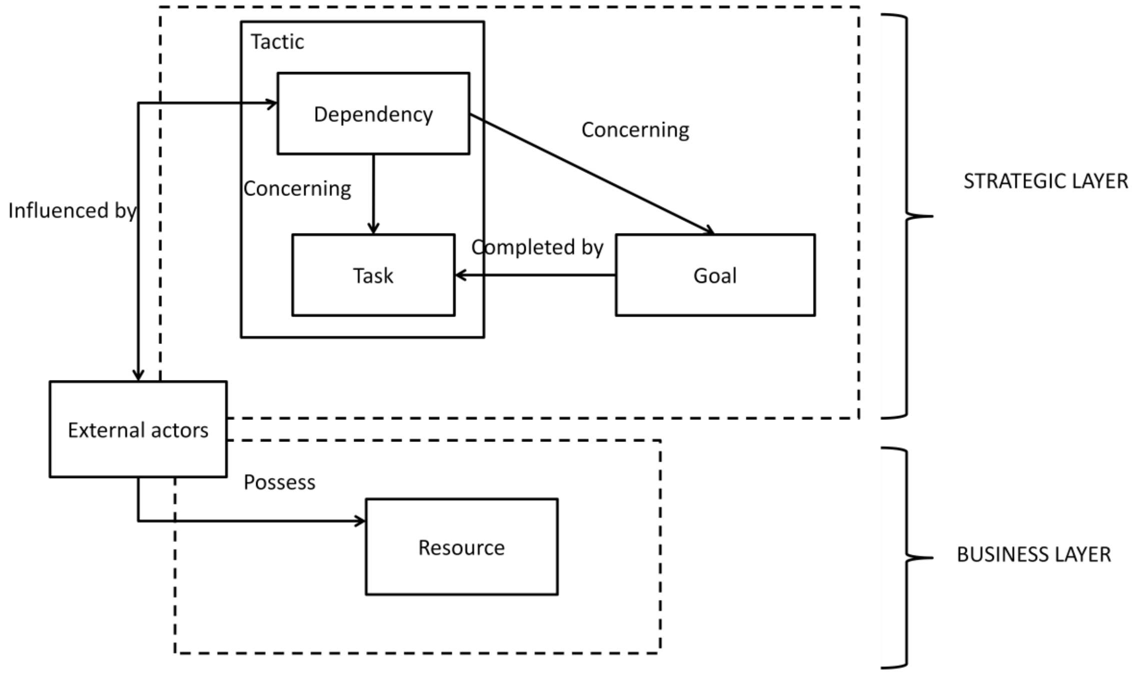


FIGURE 13 CONCEPT OF I* AMONG LAYERS.

2.2.8. BUSINESS MOTIVATION MODEL (BMM)

The business motivation model is a goal oriented model focused on means to achieve the fixed goals or objectives. The following summary is based on [24]. This model has been selected for its completeness considering the strategic layer. Additionally, it is a recognized standard from the Object Management Group.

The BMM answers the following questions [24]:

What is needed to achieve what the enterprise wishes to achieve?
Why does each element of the business plan exist?

SEMANTIC:

End: is something the enterprise seeks to accomplish, without any indication of how it will be achieved. The End concept is arranged into two subtypes: the vision and the desired result. The desired results are composed of the goals and the objectives.

- Vision describes the desired future state of the enterprise.
- Goal is a long term desired state or desired condition described in a qualitative way.
- Objective "is a statement of an attainable, time-targeted and measurable target that the enterprise seeks to meet in order to achieve its Goals." [24]

Means: represents any capability or instrument that may be used to achieve Ends. Means are detailed by the mission, the course of actions and the directives.

- A mission is a long-term approach that has the purpose to achieve the vision. "The Mission describes what the business is or will be doing on a day-to-day basis. » [24].
- A course of action "is an approach or plan for configuring some aspect of the enterprise involving things, processes, locations, people, timing, or motivation" [24]. There are two subtypes in the Course of action; the strategy and the tactic. The tactic is a short term course of action implementing strategy, whereas the Strategy is a long term course of action with broader scope than tactics.
- Directives "indicate how the Courses of Action should, or should not, be carried out." [24]

Influencer: They are all the internal (habit, resource, prerogative…) or external (customer, supplier…) entities that have the capability to influence the used Means or the achievement of Ends.

EXAMPLE:

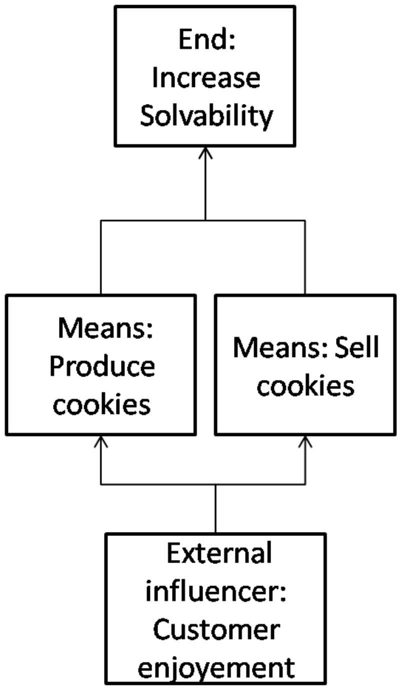


FIGURE 14 EXAMPLE OF BMM ON THE COOKIES PRODUCING CASE

This example (figure 14) is based on a syntax inspired on an example from [1] and is not official. This syntax will be used in further cases.

The syntax is simple; a box represents a type of concept (End, means or influencer). The box possesses a title that shows the type (it can be more accurate than just End, Means or Influencer; as Objective or Goal…) and an attribute that expresses the subject of the box.

Relations are represented through simple arrows.

This example shows the goal (End) of the cookies producer; increase the solvability. The means to reach that goal are to produce cookies and to sell them. Finally, a constraint (external influencer) is the customer enjoyment.

MAIN NOTIONS:

- Strategy/tactic oriented
- Vision/mission oriented
- Goal/objective oriented
- Resource (internal influencers)
- Influencing external actors (external influencers)
- Causal effects (assessment and potential impact)
- Intention (Means)
- Desire (End)
- Belief (external and internal influencers)

META-MODEL:

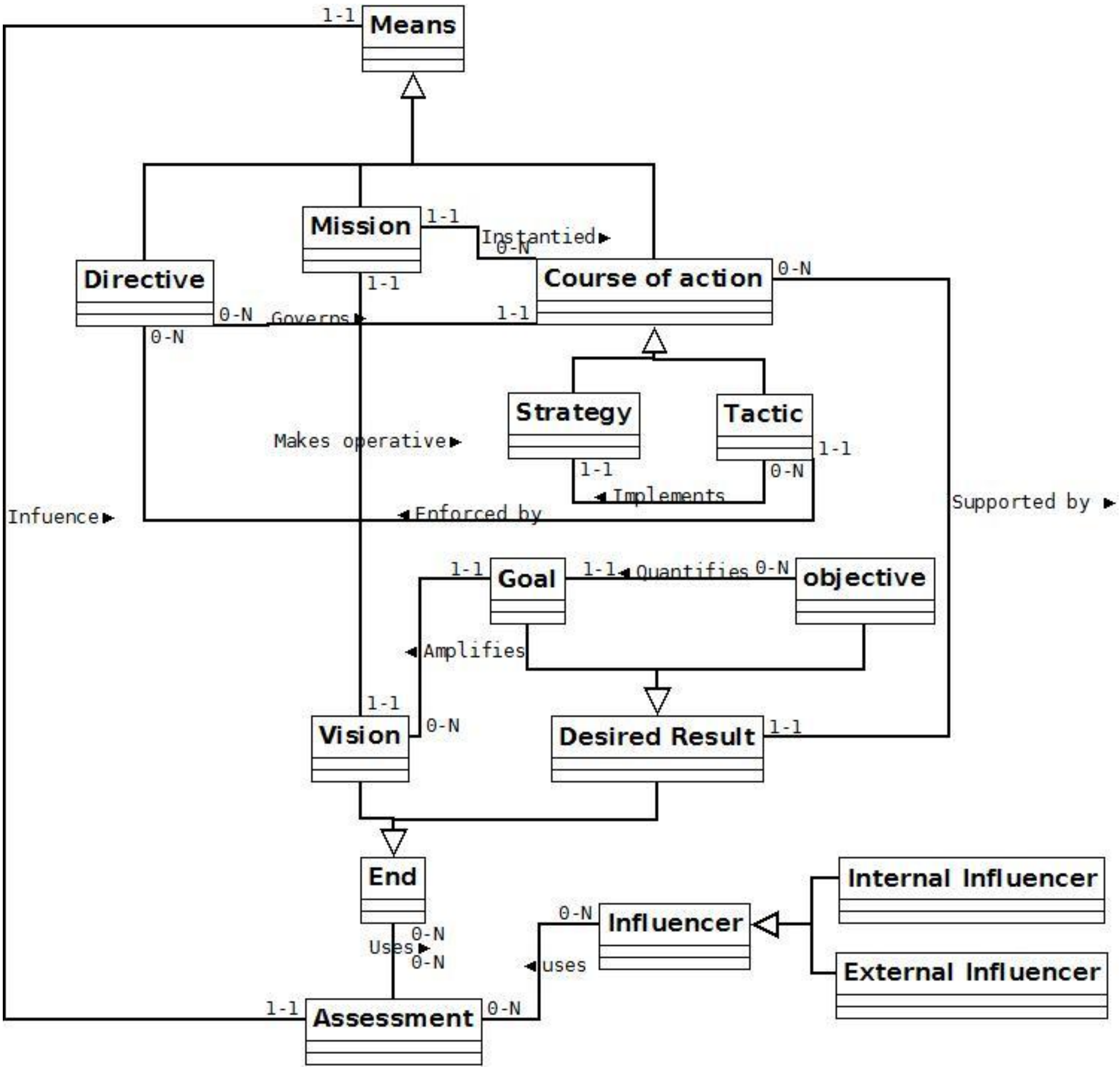


FIGURE 15 BMM META-MODEL INSPIRED ON [24].

POSITIONING THE MODEL INTO LAYERS

The figure 16 shows main concepts of the BMM within the strategic layer (the business layer is empty). This figure is based on the semantic of concepts. It is also possible to draw the external actor and the resource concepts at the boundaries of the strategic and the business layers (as defined for the figure 3); it has been done in order to preserve the readability. Note that the motivation as defined in the objectives section (figure 3) is embedded in the concepts of End.

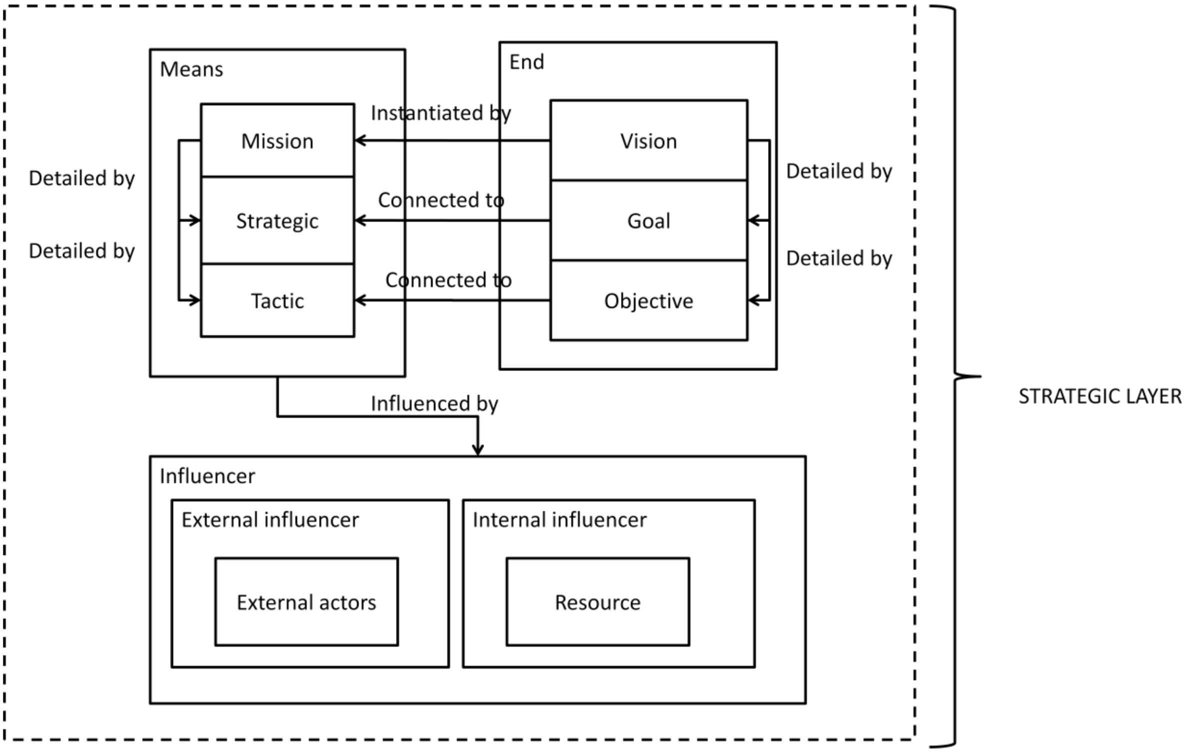


FIGURE 16 THE MAIN CONCEPTS OF BMM WITHIN LAYERS

2.2.9. E³VALUE

e³value is a value model focusing on the analysis of a value proposition. It also focuses on the exchanges of economic values among the actors and underlines the expected outcome of those exchanges [20, 21, 22, 23]. This model has been selected among other because it is often cited in alignment papers [21, 1, 20, 51]

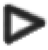
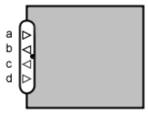
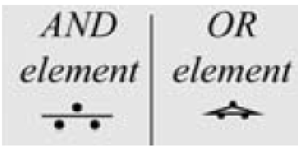
e³value provides modeling concepts for showing which parties exchange things of economic value with whom, and what they expect in return.

The model is also extended with notions from a scenario technique called Use Case Maps (UCMs). It concerns additional concepts that help to model scenarios from a ‘start’ stimulus to an ‘end’ stimulus through a scenario path with alternative possibilities.

The table 4 summarizes the syntax and the semantic some elements of e³value.

SYNTAX AND SEMANTIC

TABLE 4 SYNTAX AND SEMANTIC OF E[3]VALUE

Object	**Syntax**	**Semantic**
Actor		An independent economic entity that has the capacity to generate profit and utility.
Value object		Goods or services which have value for at least one of the actors.
Value port		A *value port* is in/out receptor for value objet from/to other actors.
Value interface		A *value interface* is a set of value ports
Value exchange		A *value exchange* is a pair of value ports of opposite directions belonging to different actors. It is consisting in what an actor offers to or requests from his/her environment (i.e.; a value object)
Value activity		Those nodes described how the business is carried out in the company.
	UCM extension [23, 27]	
Scenario path:	/	It consists in a set of segments beginning with a start stimulus and finishing with an end stimulus. One path indicates via which value interfaces objects of value must be exchanged. More generally it shows the necessary exchanges to fulfill needs.
Start-stimuli:		The consumer initial needs (a consumer is an involved actor in the process)
End-stimuli:		Pointing out the end of a scenario path. No more value exchange are needed
Segment:	- - - - - - - - -	They are used to link value interfaces with each other to show that an exchange on one value interface causes an exchange on another value interface. [23]
Connection:		Those nodes are used to link segments together. They are composed of the two following elements; AND, OR with different meaning depending on the direction (in or out). IN-AND elements collapse segments into one segment. OUT-AND splits a scenario path into two or more sub-paths. OUT-OR forks the scenario path into one alternative sub-path. The IN-OR merges paths into one path. [23]

EXAMPLE:

The figure 17 shows the necessary value activities to start the production of cookies; the production aspect and the financial aspect (receive payment). The figure 17 highlights the exchange with the customer; cookies for money.

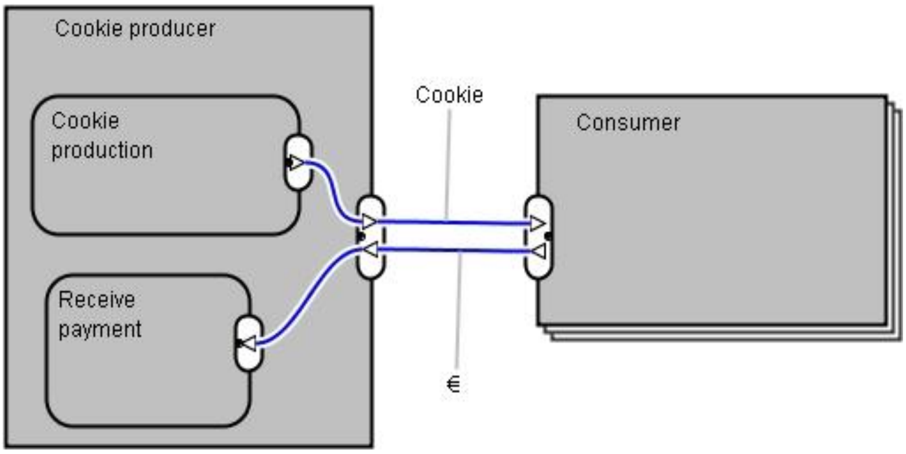


FIGURE 17 E³VALUE INSTANCE FOR THE COOKIES CASE

MAIN NOTIONS:

- Alternative solutions with UCMs [22, 27]
- Multiple actors exchanges (Value interface)
- Economic value generation (Value activity)
- Resources exchanges (Value object)
- Profit and utility oriented (Actor) [22]
- Configuration of activities (Value activity)

META-MODEL:

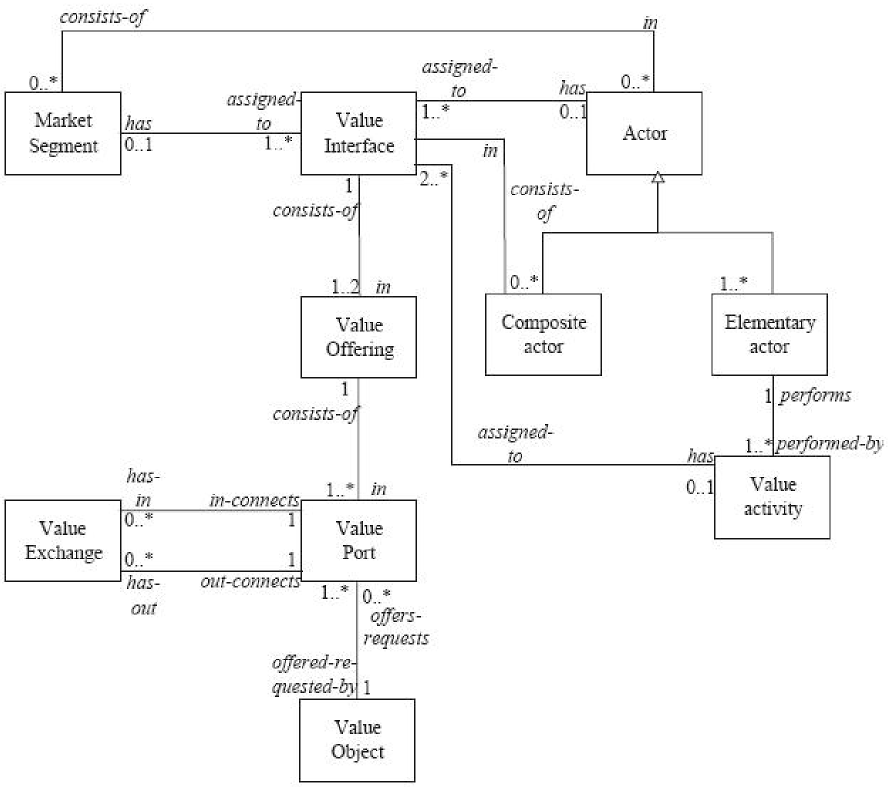


FIGURE 18 META MODEL OF E³VALUE FROM [22] (WITHOUT UCM)

POSITIONING THE MODEL INTO LAYERS

The figure 19 shows the main concepts of e³value. The value proposition embeds exchanges and value activities. Value activities generate resources. Exchanges are made with external actors for resources. Value activities and exchanges are dependent; value activities are influenced by exchanges and exchanges need some value activities to be done.

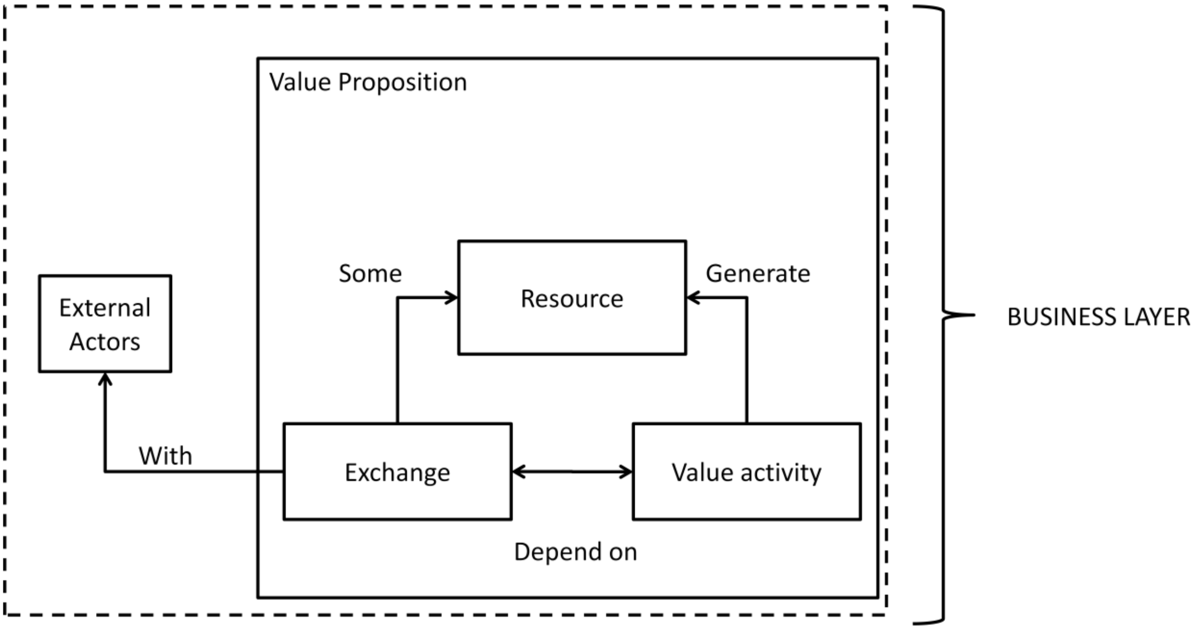


FIGURE 19 THE MAIN CONCEPTS OF E³VALUE WITHIN LAYERS

2.3. DISCUSSION

This section discusses the situation in the state of art considering two aspects; the flow of information, and lacking concepts and opportunities. The first aspect compares the flow of information when using the studied models with the flow of information this thesis aims to improve in figure 3. The second aspect explores lacking concepts in studied theories (mainly in models) and some opportunities in other theories.

2.3.1. THE FLOW OF INFORMATION

This flow of information is crucial for the alignment; if the flow is not consistent from one layer to another, both layers work on different information. To observe the flow of information we consider that a decision maker has to make models for both layers. We studied i*, BMM and e³value. Therefore, those models are the standards for the flow. The idea is to regroup the concepts from those models to verify if some flows exist between layers.

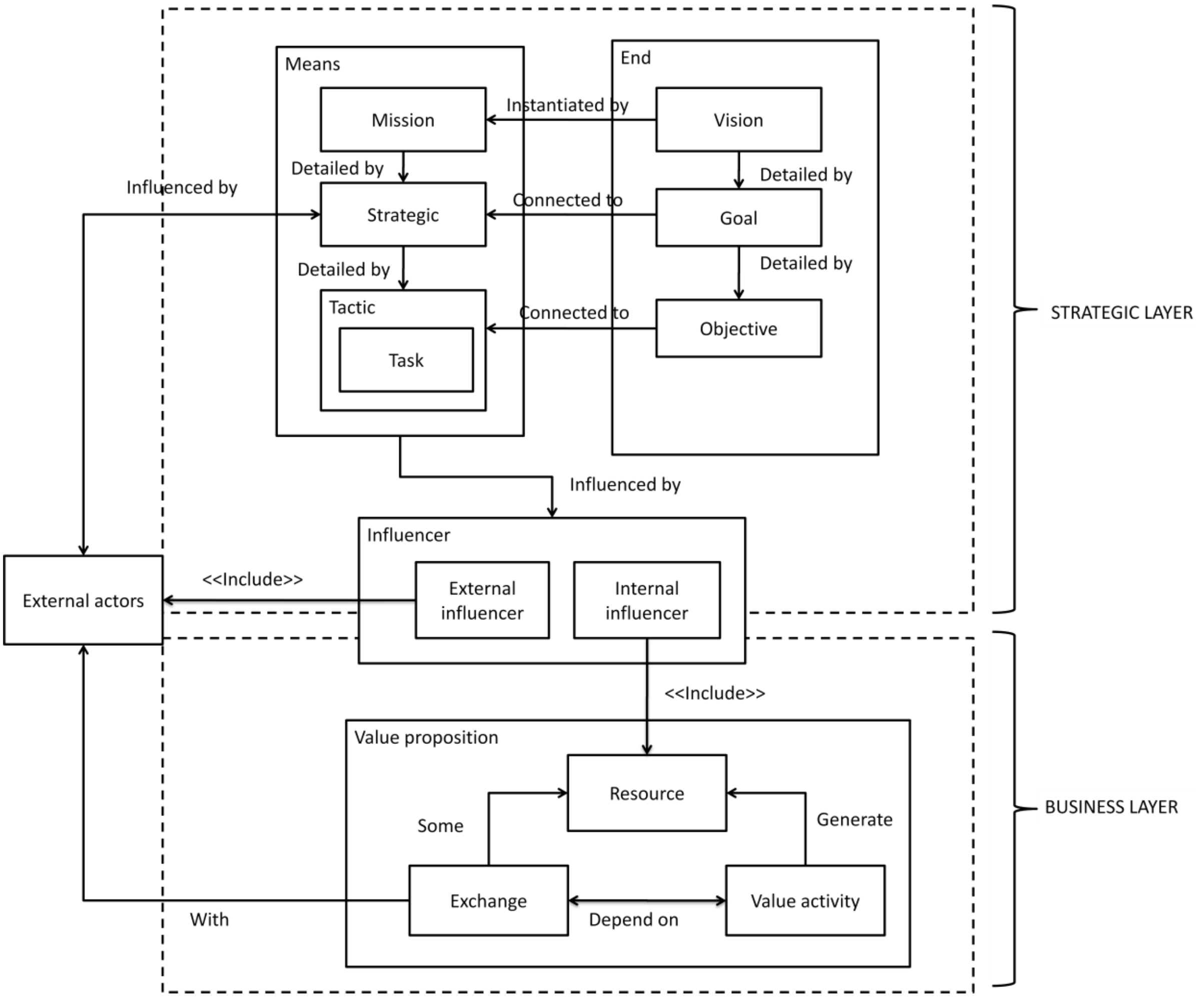


FIGURE 20 THE MERGING OF MAIN CONCEPTS FROM E³VALUE, I*, AND BMM

This figure 20 is the synthesis of the observed concepts for all studied models. The Influencer concept of BMM regroups some other concepts that appear also in the business layers (resource, external actors), for that reason, influencers are at the edge of both layers. Including relation (<<include>>) have been added to underline the concepts that are also included in those influencers. The dependencies from i* are not modeled as they are observed in other concepts; influencers, relations with external actors and the influences from the strategic concept.

First, an issue appears considering the studied models' concepts (figure 20) and the concepts in figure 3; there are no decisions. The fact is that decisions are included in the concept of tactic and strategy (see Appendix I for definition). The same problem occurs for the motivation which is included in the concept of End. Goals are effectively observable and for the business layer, we have the exchanges, the actors that exchange, and a rough approach of resources.

However, considering the figure 3 and the figure 20, no relation between the business and the strategic layers are observable. The only relation is made by the intermediation of external actors that influence the Means and the exchange of resources. There is nothing about the implication of the decisions into the business layer or even about the impacts of the motivation for the value propositions. There is no sufficient flow of information when considering those concepts.

2.3.2. LACKING CONCEPTS AND OPPORTUNITIES

The first observation is that studied models do not express the expected main concepts for layers (goal-decision-motivation and agent-exchange-resource) prominently. In i*, motivation is not expressively present, and decisions must been guessed in Means-end links relations. BMM does not possess explicit decision – present through Means' semantic. Finally, e³value expresses clearly the agents and the exchanges. However, resources are barely detailed.

Now, considering the rational agent theory, some important concepts of the BDI framework are missing in those models. i* does not express explicitly the desire of the actors. e³value does not express the Desire in its semantic (it lies in the optimization of the outcome on the value proposition) nor the Intention (that is partially present in Value Activity).

At this point, another issue has to be tackled: resources are not detailed enough. Considering the Resource Based View theory [13] it is important to achieve a sufficient level of granularity to determine whether the resource is strategic or not. Finally, the resource based view does not possess any language and is not integrated into a rational agent perspective.

A last remark can be added for BBM, it covers too many concepts. It makes the modeling difficult.

The table 5 summarizes the problems in the studied models.

TABLE 5 SUMMARY OF THE OBSERVED PROBLEMS. THE BDI FRAMEWORK IS ONE OF THE FACTORS

Source	Problems
i*	• No explicit Desire (BDI) • No motivation • No explicit decisions • Information on resource is incomplete
E³value	• Information on resource is incomplete • No explicit Desire (BDI) • No explicit Intention (BDI) • No motivation • No explicit decisions
BMM	• No evaluation of alternative solution • No explicit actors • No syntax • Resource are spread among different elements (internal influencer) • Too large
RBV	• No model • No integration in the Rational Agent Theory

Considering the table 5 and the issues in the flow of information (figure 19) some problems have to be solved. A better flow of information is necessary to improve the alignment problem. Moreover, having a consistent perspective of the BDI framework among layers would provide a complete Rational Agent Perspective. Finally, for extra-contribution, integrating RBV inside a language would allow helping having sustainable competitive advantage.

At the opposite, the state of art also reveals some interesting concepts that could be integrated in a unique solution. The causal graphs possess a syntax that can achieve good decision modeling (ID are purposed to model decisional problems). Moreover, those causal graphs are the basis for several modeling. As explained the RBV may provide ways to a sustainable competitive advantage, therefore including resources that can answer RBV exigencies is a must have. The BMO possess a framework that can structure component in a good business perspective. The BDI framework can structure the decision process of an agent (as described in the rational theory) – something to be included in an agent-oriented model. Finally, the contribution model explores some methods to align the two layers considering e^3value and i*.

3. SECTION: THE BUSINESS BEHAVIOR LANGUAGE

3.1. INTRODUCTION

The developed model is named the Business Behavior Model (BBM). It aims at modeling the behavior[6] of actors in a business environment. By behavior we mean; the way the agent could interfere with his own organization and environment considering constraints and motivations[5]. The model is composed of a language and of a methodology. This section is about the language.

The business behavior model is a model which describes the impact of the participation in a valued business for involved actors. The language of BBM based on the decision theory and the resource based view integrates the BDI framework (BDI) and resource perspective into a system of valuated causality relations which is influenced by decisions and driven by motivation (see Business Behavior Model 3.3.12).

Additionally, this model aims to fulfill the SEQUAL framework for quality semiotic [52]. The framework presents aspects that have to be respected for quality modeling. This quality exigency is one of the sub-goals for the language artifact (section I.3). Here are the aspects that we aim at;

- Empirical quality: readable
- Physical quality: understandable
- Pragmatic quality: Interpretable - the human interpretation of the model is correct relative to what is meant
- Language quality: The language is appropriate to the domain

The idea is to obtain a model that can answer the two major problems that were observed in the state of art. The first one concerns the inexistent flow of information from one model to another. The second is about the lacking of important concepts in the analyzed models.

As this research is about a language, developing syntax is necessary. This syntax is based on Causal Graph as it has the necessary concepts to analyze resources, decisions, and motivations. Additionally, causal graphs are classic bases for modeling and are understandable for a large audience (Physical quality).

Considering the domain of this research – at the edge of two layers – involved concepts have to be adapted consequently. The language of BBM contains elements that have a meaning at the edge of strategic and business perspectives. It is a major requirement to bring a consistent flow of information.

This section is structured as follows. The first point concerns the introduction. The second concerns the method that has been used to develop the language (based on the design science). The third describes the language concept by concept but also some additional constructs. The description is composed of the semantic, the syntax, a comparison with other theories, and of examples. The fourth point discusses the obtained results. A last point details some interesting improvements for the language that have not been validated.

3.2. METHOD

There were two major problems in the state of art (section 2); the flow and the lacking concepts. The idea is to bring a flow of information based on a proven theory. However, this issue is only partially answered in this section. The flow of information's improvement has to be coupled with the methodology (section 4) to be effective. Yet, to improve the flow, we analyzed the observed schema of flow in the state of art. From that point we determined how to bridge concepts from layers. The structure of the solution is inspired on the Rational Agent Theory [44].

Concerning the lacks in the state of art, we focus on opportunities in other theories to cluster interesting concepts that fill the lacks. Those concepts are inspired from the Contribution Model [1], the causal graphs [4] and from the RVB [13]. The language also picks up ideas from existing models and integrates them into a unique structure.

As well, the language has been improved through several evaluations. Those evaluations were realized thank to tested cases.

3.3. DESCRIPTION

Every concept of the developed language is detailed in this section. A global overview is available in appendix IV. Concepts are described through their semantic, their syntax but also with their relation with concepts from other theories described in the state of art (section 2). Relations between concepts are defined on different levels:

- Equivalent: the two concepts in the two theories share a same semantic.
- Embedded: the concept in the theory is a sub-concept of the other theory.
- Related: some concepts or sub-concepts of one theory can be used to represent other concepts or sub-concepts of another (but there is no inclusion).

A small example (almost the same than in section 2) is given to help understanding the concepts. Elements of the example will be added in the model whenever a related concept is explained. Note that the example is not integrated in the alignment problem. The examples in section 5 focus on that matter.

A biscuit factory wants to expand its customer segment by producing a new product; cookies. The factory hopes to improve its solvency which was short at the term of the year. The manager wants to know if the new product will effectively improve its solvency.

3.3.1. ACTOR

The definition of the actor is based on the Rational Agent Theory's definition of an agent. An agent is a complex subject that reacts accordingly to the context. The theory analyzes three attributes of the agents; Belief, Desire and Intention (BDI). The Belief is assigned to the idea of the knowledge of the environment. Desire is about the motivation of the agent. Finally, Intention is about states that the agent deliberately chooses. Hence, a rational agent has clear preferences and aims at performing actions that result in the optimal outcome from among all feasible actions.

The actor definition that we derived from this theory is the following; an actor has motivations[5] (intention) that are fulfilled by decisions[7] (desire) considering an environment (belief). The environment is based on properties and relations. Links (see Links 3.3.5) and properties (see Resource 3.3.2) act as constraints and opportunities for the organization (i.e.; the environment). Note that links also include inter-actors constraint (relations among actors). Our actor perspective is focused on resource[8] (see Resource); an action of the actor is a modification on resources that has an impact on the motivation.

The figure 21 merges the meta-model from the BDI with related concepts in BBM. Note that the concept of causal links – observable in figure 21 – is defined in the Links (point 3.3.5).

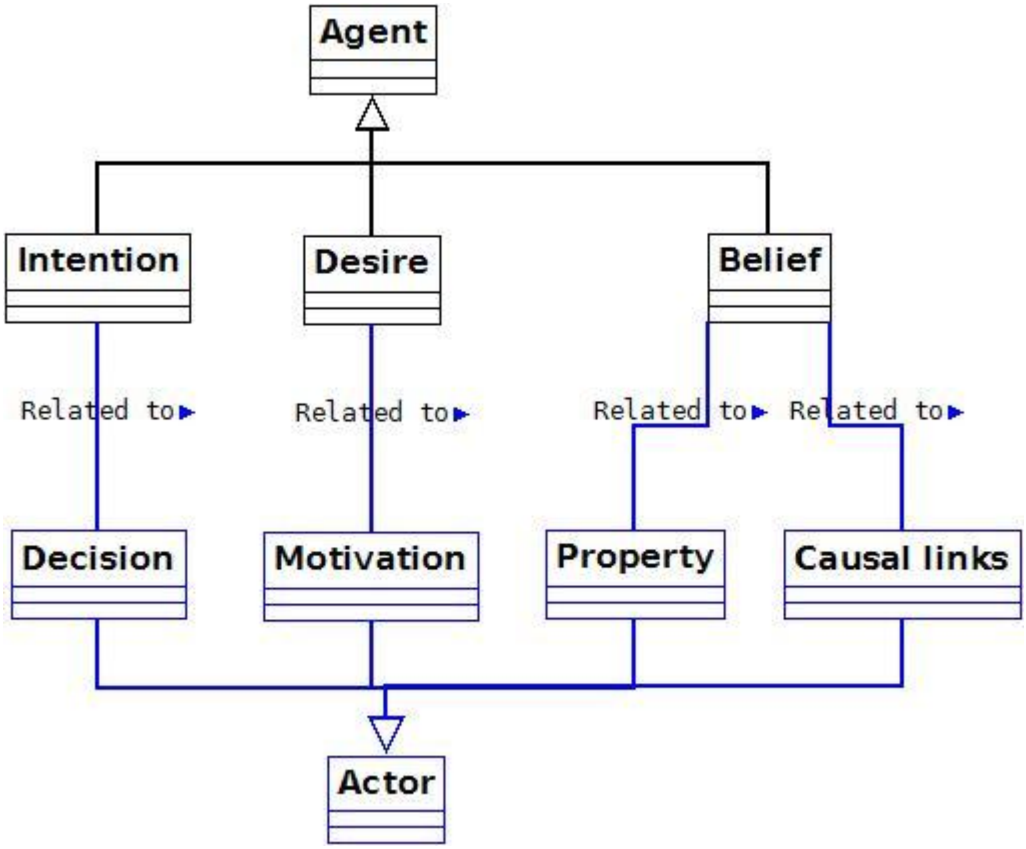


FIGURE 21 THE ACTOR FROM BBM (IN BLUE) AND ITS CONCEPTS WITH THE RELATED CONCEPTS FROM THE RATIONAL AGENT THEORY (IN BLACK).

Every actor is presented through his own model – one instance of BBM per actor. The reason why there is one instance of BBM per actor is the following; each actor has its own vision of a same problem with a different motivation and different solutions to fulfill its motivation. Having those other perspectives modeled is beneficial to understand the vision of those actors and better answering their needs.

ACTOR IN OTHER THEORIES

Rational Agent Theory: The Actor is embedded in the concept of agent from the rational agent theory; the constraints in BBM are more specific (based on resources and exchanges) and actions of the BBM actor are led on resources.

i*: i* expresses actors through their intentions and their dependencies. The two actor concepts are related; they both include the intention but on different perspectives. Belief is also present in both concept but under different forms (dependencies for i*) and the Desire is not explicitly present in i*.

e³value: Actors from both models are related. The notion of actor in e³value does not refer explicitly to Intention; the intentions are present in Value Activities. However, the model involves a certain environment (Belief) in the presence of other actors and exchanges. The Desire lies in optimizing the value proposition.

BMM: The BMM does not express explicitly the concept of actor. Yet, as an instance of the business motivation model corresponds to one actor's perspective, a BMM instance describes one actor. End nodes embed the Desire, Influencers embed the Belief, and Means are related to the Intention. End is about objectives the actor wishes to achieve – the desire. Means describes how to reach those objectives – related to the intention. Finally, influencers include entities that influence the organization – the beliefs.

The concept of actor from BBM is embedded in BMM; they both have the three attributes but BMM covers more aspects of those attributes.

3.3.2. RESOURCE

Resources are “assets and capabilities that are available and useful in detecting and responding to market opportunities or threats” [16]. In our context we focus on two types of resources; economic and non-economic resources.

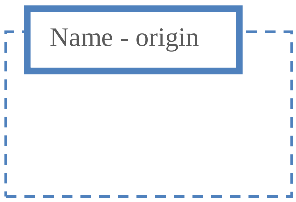
Resource Based View is a widely used theory to analyze the strategic resources and therefore a sustainable competitive advantage if well used. Resources stem as a must that has to be modeled at this level of the organization. Considering the state of art (section 2) for resources in other models, it is interesting to bring a better insight of this element into the model. The exploration of strategic resources within BBM is discussed in point VII as it requires additional concept to be explained.

ECONOMIC RESOURCES

Economic resources[10] are transferable resources that have value for at least one actor. The actor has legal rights on the economic resource. They are in our case, defined by their properties. Resources are classifiable onto the following categories [43, 57]

- Goods (or products), which are physical objects.
- Information, which is data in a certain context, referrals, and customer databases.
- Services, which are economic resources that encapsulate other resources and are used to increase the value of some other resources.
- Money, which is a medium for exchange.

Note that assets (infrastructure, shares…) are also included in the definition of our economic resources [12].



Resources are described by a certain amount of properties – but at least one. One economic resource is modeled in an actor instance of BBM if the actor rents or owns the resource. They are business value object (goods, knowledge, money or services) for the actor. A resource possesses a name, a set of properties (depicted inside a doted square) and an origin.

The Origin is optional and defines the source of the resource. The source is another actor from whom the resource is coming. As an example, the resource can have been rented to a tierce company and therefore, the origin will be the name of that company. The origin should be modeled whenever the resource is bought or rented to another actor to model the transfer (see 3.3.9 for more details).

The idea of having resources detailed through properties is inspired on the Contribution Model.

ECONOMIC RESOURCES IN OTHER THEORIES

i*: The Resources from i* are equivalent to Economic resources; they are both resources which are transferable. The origin of the Economic resource is equivalent to the concept of dependency between actors (in i*) when those dependencies concern resources; the origin is embedded into dependencies.

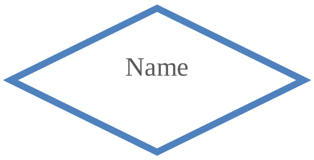
e^{3}value: Resources are present in the value model e^{3}value within the Value Object. The Value Object itself is embedded in the notion of resource. The Value object does not content information resources.

BMM: The set formed by the following concepts inside Influencer; resource, infrastructure and corporate value is equivalent in the concept of Economic Resource without the properties and the origin.

Resource Based View: Economic Resource is embedded in the concept of resource of RBV. Resources from RBV cover also non-economic resources.

NON-ECONOMIC RESOURCES

Non-economic resources[9] are non-transferable and are valuable only for the studied actor. Resources are concerning inner value of the actor; the health, the pleasure, the investment power…



The syntax is composed of diamond with a name. The non-economic resources description could be deepen (see Perspective in point 3.4)

The motivation for non-economic resources is that the world is not only about profit and money [26]. It is also about various feelings (security, pleasure, integrity…) or 'states' (health, sustainability, survival…). Even for an organization (a specific agent) the profit is not the major concept, it is the survival (that benefits from the profit) [26].

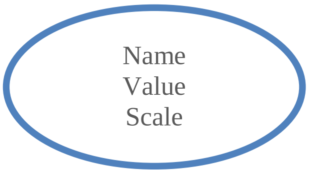
Note that non-economic resources are deeply connected to the notion of motivation; improving the non-economic resources is the motivation (see Motivation 3.3.4)

NON-ECONOMIC RESOURCES IN OTHER THEORIES

Causal Graph: The non-economic resource's syntax is the one from Utility node in Causal Graph. They are both the expected utility of the outcome of decisions.

PROPERTY

A property of a resource can be evaluated on a qualitative or quantitative scale. Properties concern a large scope of aspects related to the resource; the quality, the cost, the quantity produced…



A property possesses a name, a value, and a scale. The Name indicates the object of the property. The value indicates an estimated approximation of the value of the property. The value's domain is indicated by the scale. The scale is qualitative or quantitative.

In this thesis, the value and the scale are not explored but are interesting for further research (see Perspective in point 3.4).

Those nodes can be influenced (positively or negatively) by other property nodes and by decision (3.3.3) nodes. Some properties are also considered with a fixed value; the actor has no control on it, it is therefore a constraint. Properties are considered as constraint in the following cases;

- The property is attached to a resource that initially not belongs to the studied actors; the resource is rented or bought.
- The property concerns some specific structural aspects of the organization that are not modifiable without high cost
- The property is imposed by external factors; law, ethics, corporate rules…

In the other cases, the property is considered as a variable of the problem; the value of the property can be modified by the actor along its scale.

As we do not model the value expressively in this thesis, we always consider that properties have a positive value on their scales. As example; for the cookies producer, the quality is estimated positively and therefore it influenced consequently the sales amount (figure 27).

In some context, an analyzed element can be understood as a resource or as a property. For our cookie example, we will consider that we produce cookies that use biologic ingredients. Biologic ingredients could be modeled by Resource nodes instead of Properties (the property 'green quality'). The choice depends on the expected level of granularity. The more resources, the more complex the model will be. If a simple value (a scale for green quality) provides enough information for the considered element, then a property can be used. The modeler can also base the resource decomposition on a VRIO [15] analysis to determine which are the strategic resources and models only on those resources – other resources are modeled as properties if necessary (see Strategic Resources 3.3.8).

PROPERTY IN OTHER THEORIES

Rational Agent Theory: Properties are embedded into the concept of Belief as they act as an environment the actor must deal with.

Causal Graph: Property's syntax is the one from the chance nodes in causal Graph. They are both variables from the problem and can be measured on a scale.

RESOURCES IN THE EXAMPLE

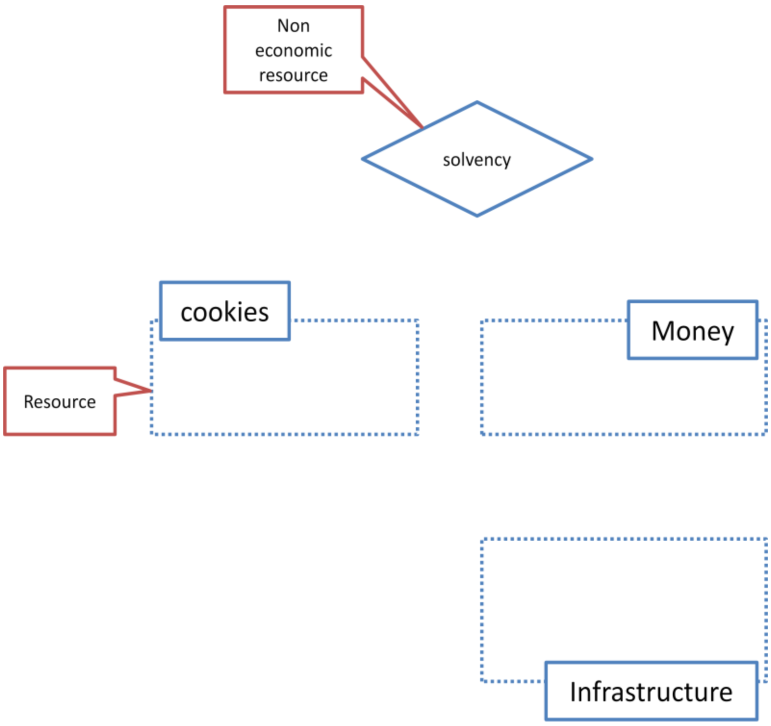


FIGURE 22 COOKIES PRODUCTION CASE- RESOURCES

For this example we have the following properties;

- The money is determined by the amount
- The infrastructure by its cost
- The cookies by their quality, their production quantity, their price and their sales amount.

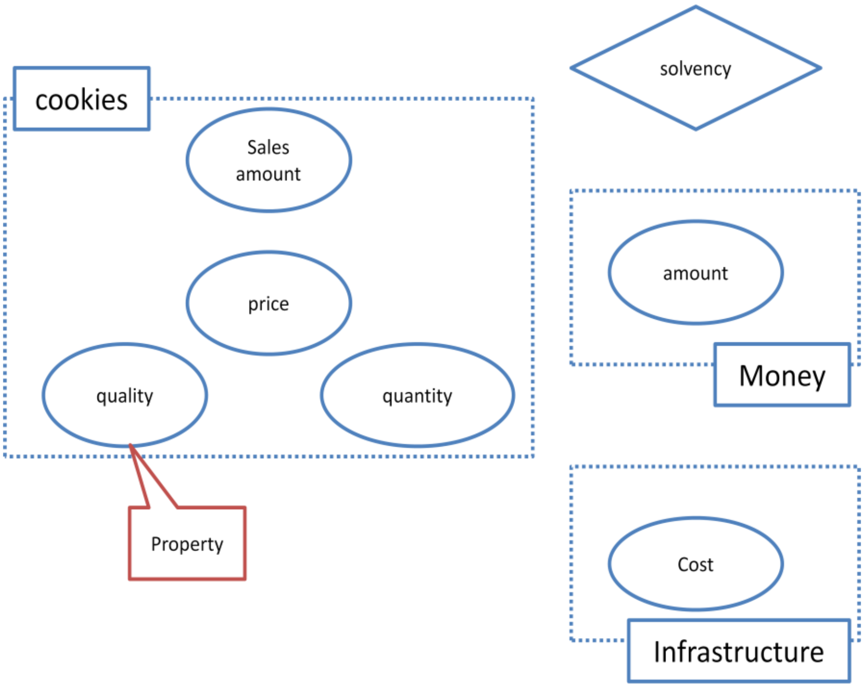


FIGURE 23 COOKIES PRODUCTION CASE - RESOURCES AND PROPERTIES

3.3.3. DECISION

Decisions "are the act of making up your mind about something" [58]. Decisions are, in our context, influencing interventions that are envisaged to provide a way through the improvement of the driving motivation. They are opportunities that have to be evaluated; alternatives as described in causal graphs. A decision is included in a tactic[4] or a strategy[3] (depending on the perspective- short or long term).

Decisions are modeled through a square box that contains a name. The name indicates the object of the decision.

Those nodes are not influenced by other nodes but they can be decomposed into details or be preceded by other decision nodes. This is inspired on causal graphs. Decision can influence properties (see Resource) of resources and also 'create' them (see Links 3.3.5).

As decisions are opportunities, they are the envisaged solutions to improve the motivation. Through decisions, the actor hopes to achieve an outcome that is beneficial for its motivation. This is based on the Rational Agent Theory with decisions related to Intention (figure 21).

Decisions do not act directly on the motivation, they act on an intermediary; economic resources. This is supported by the BDI; the intentions (decision) must consider the belief (in our cases properties) to achieve the desire (motivation).

A decision is about various aspects. It can be about;

1 Creating, buying or renting resources
2 Exchanging resources
3 Varying properties of resources (production capacity, cost, price…).
4 Steps to be firstly achieved to progress to other decisions.

It is important to notice that the concept of decision (as described in the four points) is not that different from the concept of Value Activity. Value activities describe how the value proposition is carried out in the company.

Whereas decisions describe what can be decided to carry out a value proposition. The difference lies in the level of the organizational perspective that is concerned. A decision describes what is envisaged in the strategic layer, whereas a value activity describes what is envisaged in the business layer.

In fact, the exact semantic of the decision depends on the usage that is made of the developed model. Two factors can vary. The first factor concerns the placement of the model into the layers; more strategic or more business. The second factor is temporal; the decisions are considered as already fixed up or still under evaluation.

The first factor (position in layers) changes the nature of the decision in the sense that if the model is positioned in a strategic perspective, the decisions are embedded into a tactic or even into a strategy. If the model is more in a business perspective, the decision is more likely to be dependent of the value proposition. In that case, the decisions are quite similar to the value activities.

The second factor (temporality) changes the usage of the model in the sense that decisions that are yet to be evaluated can be integrated into a process of simulation[15] (section 4) with alternativities. If we consider that decisions are taken, the simulations on the model are less interesting. Therefore, the model depicts a factual situation.

DECISION IN OTHER THEORIES

Rational Agent Theory: Decisions are embedded in the notion of intention (see Actor). Decisions are specific types of states the agent chose.

i*: Decisions are not directly observable in i*. This model focuses on another subset of the Intention (BDI) which is based on goals and tasks [17].

e³value: There is no decision (even if value activities are partially similar but in another context). Yet, the semantic of the start stimulus is included in the semantic of decision (the fourth point for the decisions definition). Start stimulus are considered as the initial need for the considered value proposition. A decision without in-link that matches the fourth point of its definition is a step that includes the notion of initial need.

BMM: Decisions are embedded into Means. Means represent any capability or instrument that may be used to achieve Ends (the motivation). A Means “Buy quality chocolate” is also a Decision. However, Means does not only concern tactic and strategy (in which Decision are included) but also the mission and directive (figure 15)

Causal Graph: Decision syntax is based on Decision’ syntax form Causal Graph – both about decisions. The two concepts are equivalent

DECISION IN THE EXAMPLE

At least one decision is modelable; the decision to produce cookies.

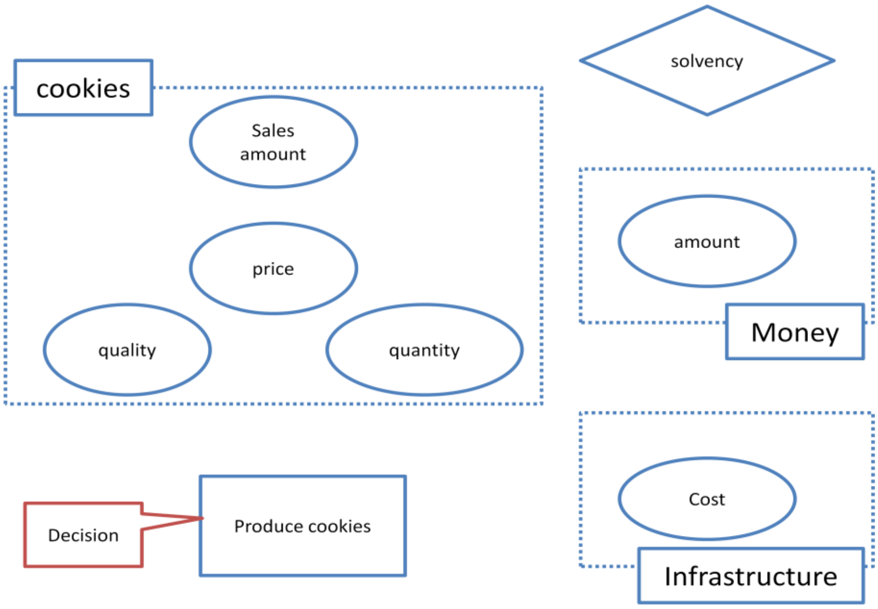


FIGURE 24 COOKIES PRODUCTION CASE - RESOURCES, PROPERTIES AND DECISIONS

3.3.4. MOTIVATION

Motivation is not precisely observable in the developed language. However, considering the nature of the non-economic resources, the motivation is present in the improvement of those non-economic resources. Indeed, the motivation is a state that is wished to be improved (increase or decrease); the feeling of security, the health... The object of the motivation is the non-economic resource; agents are selfish and the money is not an end in itself. For example, you want money in order to have a high level of investment power (which has value only for you). Hence, with a relation (causal link, see Links 3.3.5) that reveals the desire of improvement (increase or decrease the value) of a non-economic resource (personal and therefore, selfish) we obtain the motivation. The motivation can be about personal business achievement (solvability, survival, image…) or about more ethical achievement (Ecological achievement, non-lucrative achievement…)

As for decisions, the motivation's meaning depends on the usage of the model; if the model is more strategic, then motivations are more likely to be associated with the Vision of the actor. At the opposite, if the model is more about business then the motivation can be associated with goals or even to the value proposition's objectives.

Making the link with Utility node from Causal Graphs and Non-economic resources is easier with the notion of motivation: they are both the expected utility of the outcomes from decisions.

We can use a simple example to understand this notion of motivation. The pleasure of a customer is a non-economic resource: it is valuable only for the customer and we can estimate the amount of pleasure on a qualitative scale (see Resource 3.3.2). Moreover, it is non-transferable (non-economic). Now, the customer wants to improve his pleasure by buying video game. The increasing of the customer's pleasure is the motivation for the purchase of a video game. An example of motivation is shown in figure 25.

MOTIVATION IN OTHER THEORIES

Rational Agent Theory: The motivation is equivalent to the notion of Desire (see Actor).

i*: There is no explicit motivation. Yet some goals can be seen as the motivation depending on the position of the model in the layers (related).

e³value: There is no modeled motivation. The motivation in e³value lies in the process; optimize the value proposition.

BMM: Motivation is embedded in the concept of End. End is about vision, goal and objective. The vision is equivalent to the notion of Motivation.

3.3.5. LINKS

We exposed previously the nodes (resource, decision, and property) of the developed language. However, this language has to be extended with links. For reminder, in the Rational Agent perspective, the intentions are purposed to improve the desire through actions that are made considering the beliefs. In BBM concepts it is translated into; decisions (intention) are purposed to improve the motivation (desire) through action on resources that are made considering the properties and relations (belief). There is a specific direction for links; they start from decisions and end in the non-economic resource (related to the motivation).

Four links are defined in the model; Causal link, definitional link, precedence link, and creational link. The two first links belong to the causal graphs [4, 8, 35].

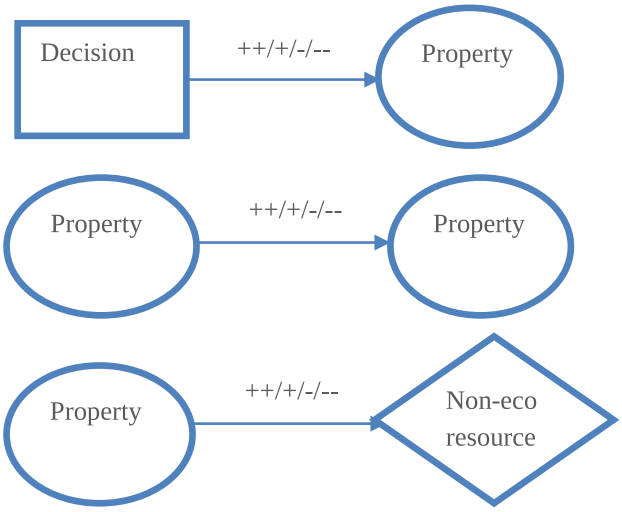
DEFAULT AND

Whenever there is more than one link going out or going into a node, there is a default (not schematized) AND relation between those links. This AND relation means that all links affected by that AND relation have simultaneous effects. Note that in presence of a Select (see Select 3.3.6) among links, there is no default AND relation.

CAUSAL LINK

Causal links are relations with a causal[11] meaning between one out-node (the affecting) and one in-node (the affected). Those causal links can have different impacts (effects) on the in-node considering the Value Indicator of the link which can be positive or negative with a two levels scale (strong or light impact).

The causal link can connect two nodes of different kinds;



A decision influencing a property

A property influencing another one

A property influencing a non-economic resource

Here are the value indicators which are inspired on [4]

- Strongly positive ++
- Positive +
- Negative -
- Strongly negative --

Causal links are equivalent to causal links in the causal graphs described in [4].

Precedence link

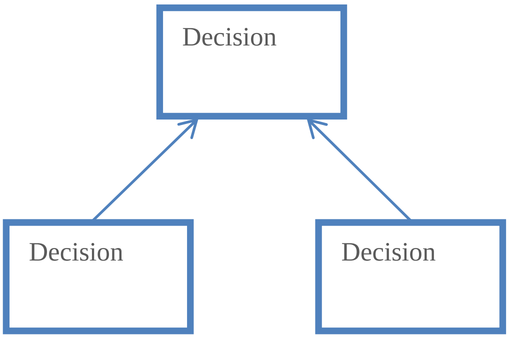
Those links have a temporal meaning. They connect a decision to another decision and express that a first decision (origin of link) is made prior to the second (target of link). An adaptation from the initial EID has been made in the sense that EID possesses informational links. An informational link between two nodes means that the information from the out-node must be available before considering the in-node. Precedence links mean that a decision has to be achieved to progress to the next decision.

The motivation for those links is to present the necessary decisions that must be made before having results (example in figure 26).

The syntax of precedence links is an arrow without value indicator.

Definitional Link

Purpose is to use other decision nodes to improve the description of a decision by detailing the aimed decision with other sub-decisions. The motivation is to provide clearer information on involved decisions.



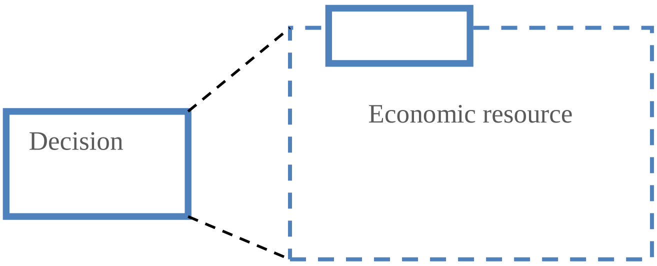
The syntax from definitional link is a link with a hollow arrow. The top decision is the one who is more detailed through the sub decisions.

Note that accordingly with the default AND definition, both start decisions define the end decision.

Definitional links are equivalent to definitional links in EID.

Creational Link

Some modeled resources can be projects (not actually owned by the company) that the company wants to evaluate. Those specific cases are modeled through Creational links – if the company decides to create (involve) that resource, what are the effects? A creation link implies a decision and an economic resource. In the example with the biscuit company, the cookie is the new resource that is evaluated for the business. This new resource is pull out by the decision to produce cookies.



The Creational link (in black) is composed of two doted lines making the junction between a decision and an economic resource.

Those links allow determining whether a resource is already present in the organization; a resource without a Creation link is one of them.

Note that if a decision 'creates' an economic resource (the economic resource was not present at all in the actor perspective before this 'creation'), then the decision should not influence the properties from that resource. Indeed, the decision creates the economic resource and therefore gives a first value to all properties present in the resource.

Creation links can be used whenever it is envisaged to buy, rent or create a resource.

If the Economic resource aimed by the creational link is actually bought or rented to a tier, then the origin of the economic resource should be modeled (by adding the name of the tier)

LINKS IN THE EXAMPLE

As well some relations exist among properties in the example;

- The quality and the quantity influence negatively the asked price for the customer but positively the sales amount (without consideration for the price)
- The price decrease the sales amount but is positive for the earned money
- The sales amount is also positive for the earned money
- Deciding to produce cookies requires adjustment on the infrastructure and therefore some extra-cost
- The cost of the infrastructure is negative for the amount of money.

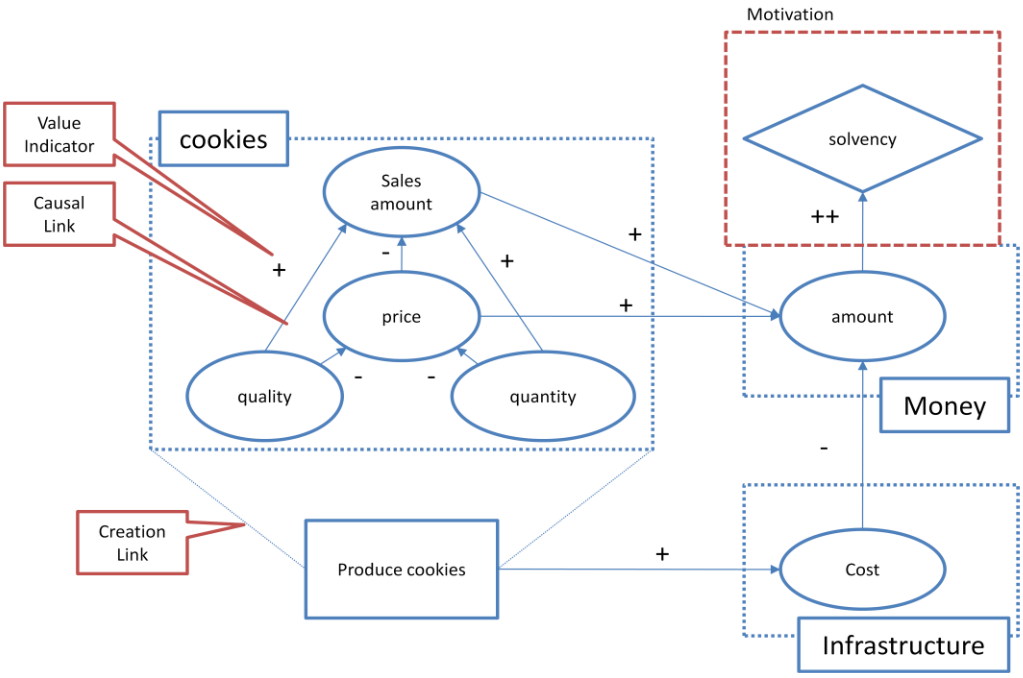


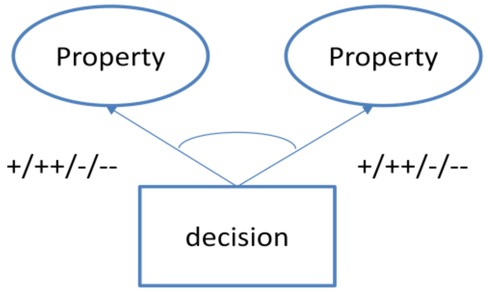
FIGURE 25 COOKIES PRODUCTION CASE - LINKS AND MOTIVATION

3.3.6. SELECT

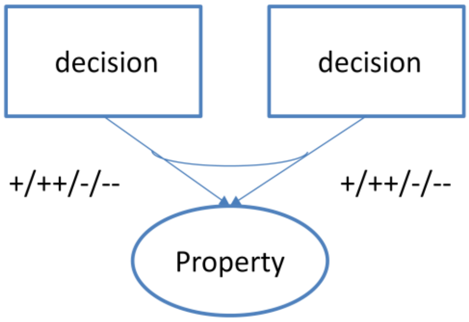
The Select is a connector between (it connects) two or more links. It means that only one of the connected links can be selected; links are exclusive – the other links are not evaluated (the meaning of that evaluation depends on the involved kinds of nodes). The select only affects causal links and precedence links and has priority on the default AND.

This concept is motivated by the desire to represent alternative influences and alternative decisions.

The meaning of the select depends on the nature of the links and the origin of the links (same or not). The type of the involved nodes does not influence the semantic of the select. Therefore, nodes can be of different natures; refer to the semantic of the link to check possibilities. The explanation comes with examples.

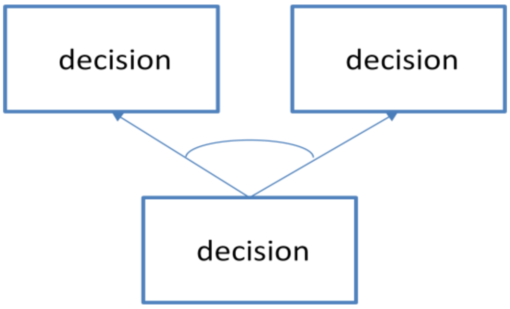


The Select (curved line) applied on causal links with the same origin (start-node) means that the origin only influences one of the destination nodes (end-nodes). The other end-node will not be influenced (the start node can be a property).

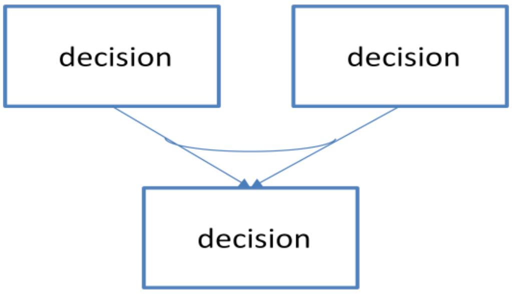


The select (curved line) applied on causal links with different origins (start-nodes) means that the destination (end-node) is only influenced by one of the origin nodes (the start nodes can be properties).

The same idea can be applied on Precedence links (for decision nodes). In that case, the meaning of the select varies; it is about precedence and not about influence.



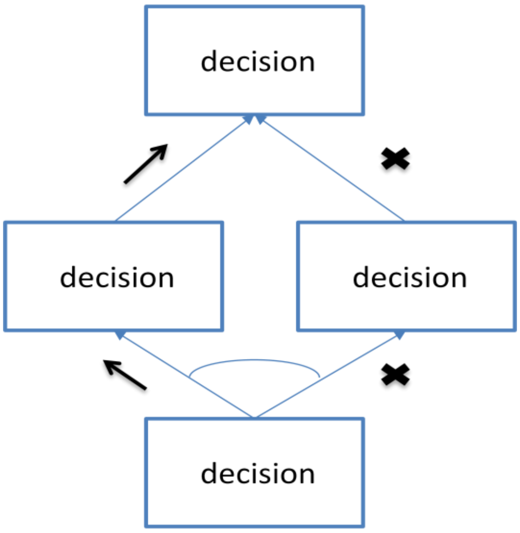
The Select (curved line) applied on causal links with the same origin (start-node) means that the origin only precedes one of the destination nodes (end-node). The other end-node will not be evaluated at all in the process.



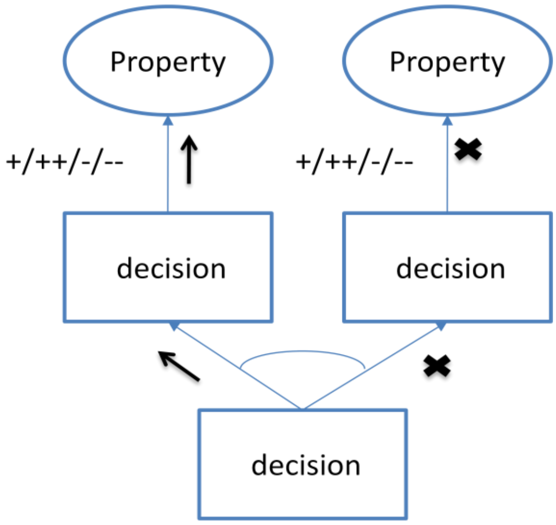
The select (curved line) applied on causal links with different origins (start-nodes) means that the destination (end-node) is only preceded by one of the origin nodes.

An important point to mention is that the Select has also effect on the following links in the instance (not on previous links and without consideration for their nature) if the Select affect precedence links (and not causal links).

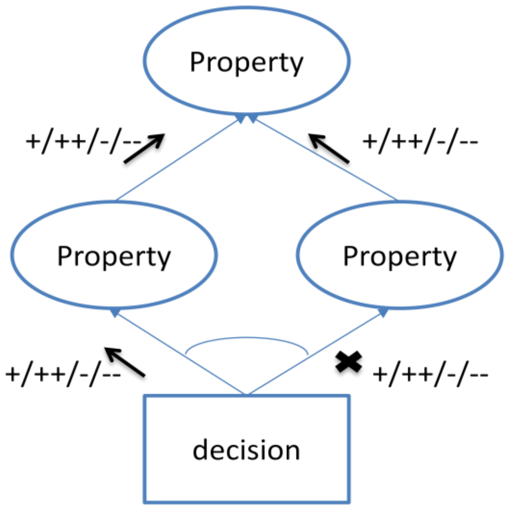
In the example below, if the left node is selected (bold black arrow), then the right node has no impact (black bold cross) on the following nodes. The right decision can be suppressed from the instance; a choice has been made between two alternative decisions.

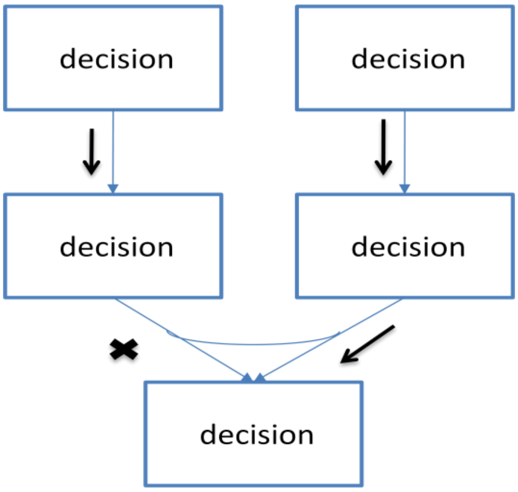


Or



But a select on causal link has no effect on other following links, nor than a Select on previous link.





The figure 26 integrates an instance of select in the cookies production example.

Select in other theories

e³value: UCM embeds selects within its connectors.

i*: Means-end links is equivalent to the Select; they provide ways to model alternative possibilities.

Select example

In the figure 26, we modeled the situation where the cookies producer wants to improve its advertisement (a decision) on the new product – the cookies. Two alternative choices are available:

- Asking for a professional; a better impact on the sales amount but possibly more expensive.
- Making a home-made campaign; a lesser impact on sales and possibly less expensive.

The difference of cost depends on the capacity of the company to promote marketing operation.

The select is made on the Precedence link. It means that the decision 'Make a marketing operation' has to be made before progressing to the next decisions (Ask for external marketing operation / Make own marketing operation).

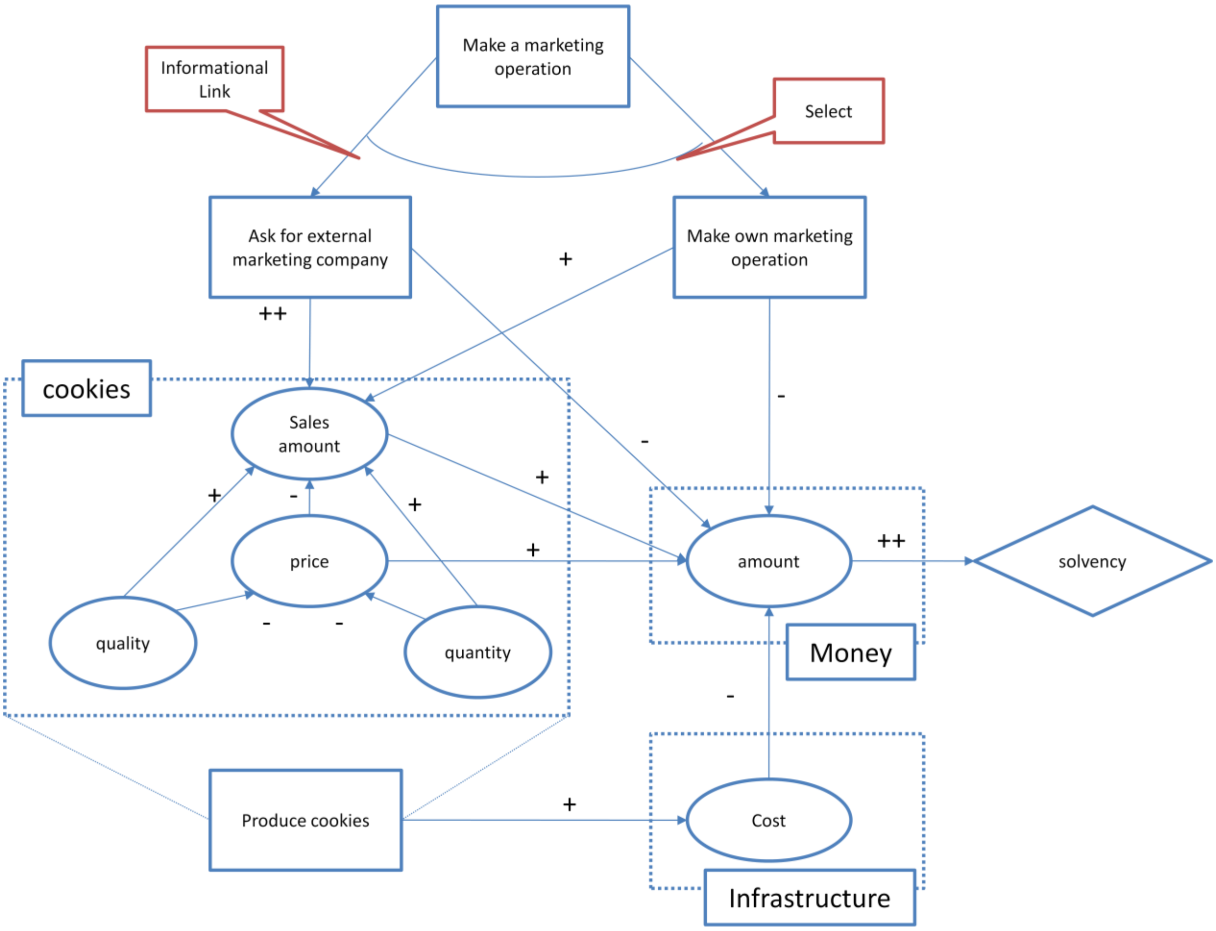


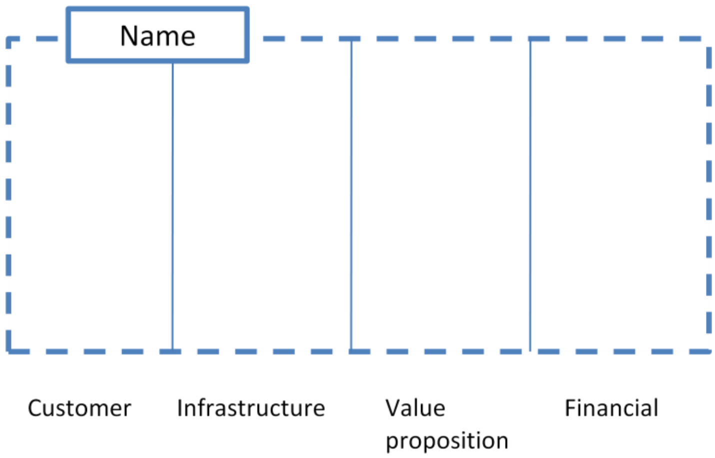
FIGURE 26 COOKIES PRODUCTION CASE - SELECTS AND PRECEDENCE LINKS

3.3.7. CATEGORIZATION

Property of resource is a vast notion. The idea is to keep the widest range of modelable properties to not restrain the action of the modeler. Which properties to represent in the model depend on the nature of the problem as only relevant properties should be modeled. But in order to guide the user, we advise to use founded theories that help sorting out organizational elements. The proposed theory is the Balanced ScoreCard that provides a four perspectives vision of the business. However, those perspectives are not adapted to resource issues. Hence the use of Business Model Ontology (BMO) that provides, in a similar idea, a four aspects framework focusing on the value proposition, the customer relationship, the infrastructure management and finance.

The sorting that we propose is adapted from those aspects;

- Value proposition: inner qualitative and quantitative properties of the studied resource (amount of sugar in the cookies).
- Infrastructure aspect: properties that are linked to the management of infrastructural resources (the quantity as it depends on infrastructural aspects – storage, production capacity…).
- Financial aspect: properties that concern financial flux and cost (cost of the cookies)
- Customer aspect: properties that concern marketing and channeling (attractiveness of the packaging)



Visually, the four aspects in an economic resource look like a table of four columns in which properties are sorted out. In the rest of the document, we use the term '*categorization'* to refer to this sorting.

The benefit of using the categorization in an instantiation lies in the obtained readability (physical quality). Mainly when used on numerous properties. The categorization should be used whenever it is necessary to obtain a clearer view of the resource. It is not advised for resources that have less than a certain amount of properties as it increases the workload.

Whenever a property can belong to more than one of the proposed aspects, refer to more accurate definitions of the aspects that are available in literature [9]. If it is not sufficient, separating the property onto sub-properties that represent the possible aspects may be required.

We would also like to point out that BMO does not approach some important aspects in its framework as the ethical and the legal aspects. Those aspects have not been introduced in this research yet; their relevancy has to be validated first.

CATEGORIZATION EXAMPLE

The figure 27 is an example of categorization for the cookies production case. For the example, we added the 'Packing Quality' which is about the aspect of the packing. This property is related to marketing and customer relationship (Customer aspect).

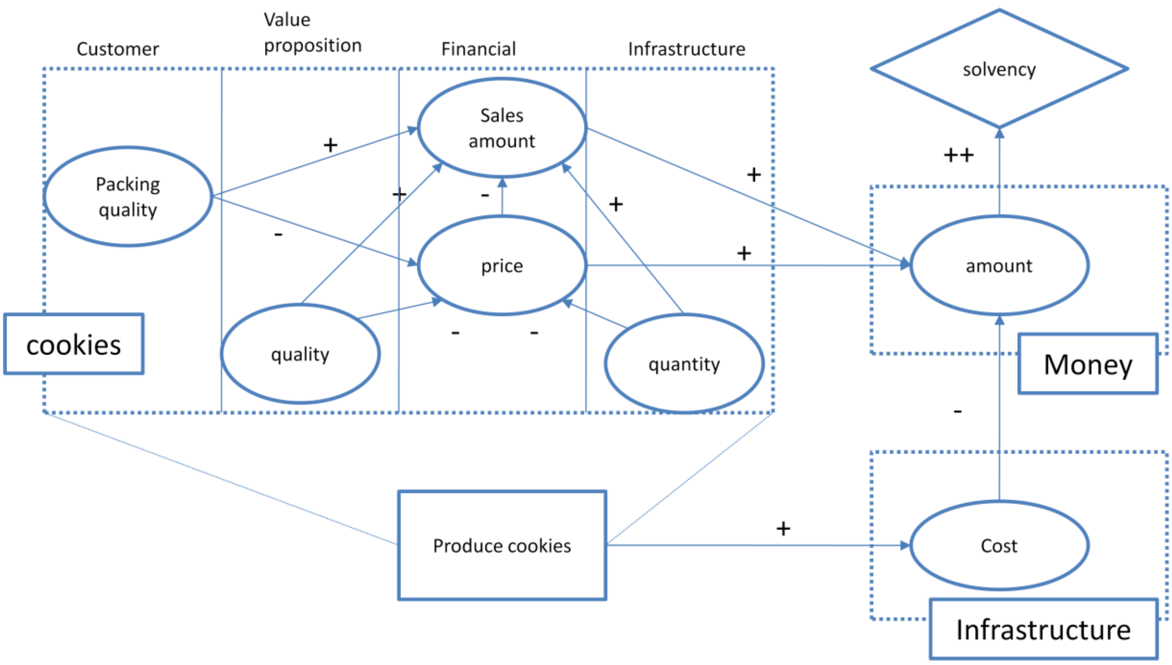


FIGURE 27 COOKIES PRODUCTION CASE- CATEGORIZATION

3.3.8. STRATEGIC RESOURCES

Considering the context of the research – business and strategy - and the Resource Based View, the Business Behavior Model also proposes to help finding strategic resources. Being able to handle strategic resources provides competitive advantages; therefore the usage of BBM can be turned around strategic resources.

Strategic resources possess some attributes that are described by the VRIO (valuable, rare, inimitable, and organized) framework. The following explanation considers an integration of the VRIO evaluation wihtin BBM.

The first attribute, Valuable, evaluates the capacity of a resource to outperform the company's competitors or to reduce the company's weaknesses.

- The desire to outperform competitors is a motivation. Therefore, it can be modeled with non-economic resources (a non-economic resource that concerns the competitiveness). The resource's capacity to fulfill this motivation is evaluated through the Value Indicators on Causal Links that involve the resource.
- The desire to reduce weaknesses requires to firstly knowing where they are; a non-economic resource the company wants to improve or a property that has to be optimized considering its own value and the incoming causal links. In both cases, this requires to analyze the effect of the resources (out-going causal links).

The rareness of a resource is a property of a resource that results from offer and demand analysis. The offer and demand analysis is related to other actors' needs and productions. This property is linked with the price thank to causal links.

The third attribute regroups several properties of resources: the funds involved in the researches and the necessary materials to produce the resource. It also involves other resources; patents on the product or on the manufacturing process.

The last attribute is modeled considering several aspects;

- Infrastructural aspect: does the company possess the capacity to handle the resource? (categorization, properties or economic resources)
- Customer aspect: is the company able to promote the resource? (categorization or properties)
- Legal aspect: can we use it in respect with the law? (properties or non-economic resources)
- Ethical aspect: can we use it ethically? (properties or non-economic resources)
- Financial aspect; is the company able to raise the necessary funds? (categorization or properties)

The figure 28 shows the modeling of the VRIO framework thanks to the developed language. The ethic and the law hold a qualitative property 'constraint' - the lower is the value of the property, the lower is the constraint. The patent holds a property term that represent the duration of the validity of the patent.

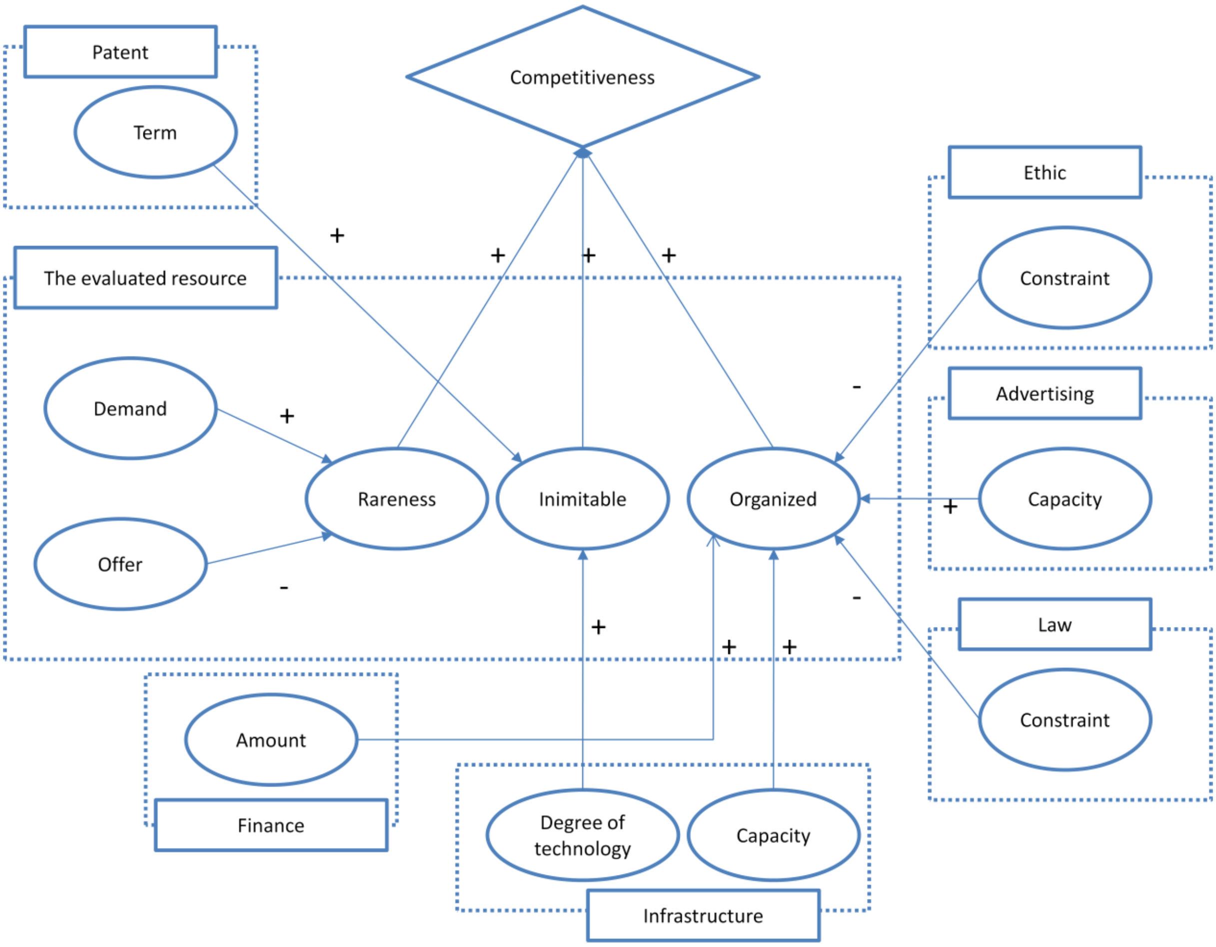


FIGURE 28 THE INTEGRATION OF THE VRIO FRAMEWORK

3.3.9. TRANSFER OF RESOURCES

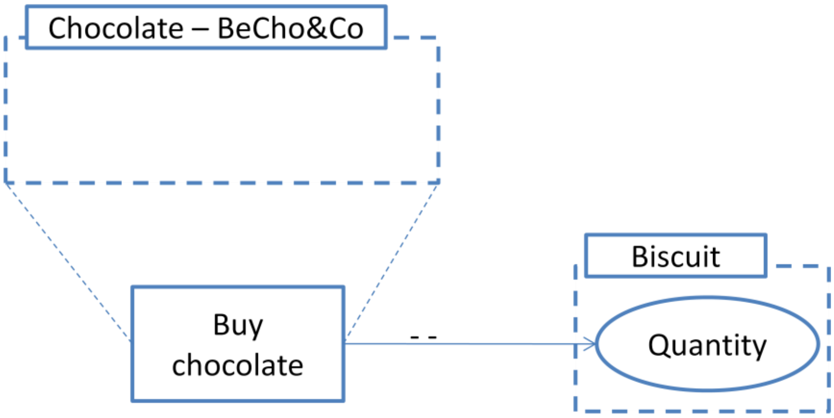
There are different ways of modeling transfer of resources among actors (i.e.; exchange) within the language of BBM. This point inquires those possibilities.

The first possibility is to use decision without any other information. The decision contents the indication of a transfer but we do not know with whom.

The second possibility is to model the transfer with the origin of resource. The origin point out to an actor with whom the exchange occurs, but not what is exchanged in return.

Yet the two first possibilities do not present the whole exchange; what is exchanged in exchange of what. To obtain the complete view it is necessary to use decisions, origins and properties.

The example below shows an example where the company barters chocolate from BeCho&Co for biscuit. This provides a complete view on the exchange. Note that this example is not a BBM instance; there is no property in the Chocolate resource and no motivations (see Business Behavior Model 3.3.12).



TRANSFER OF RESOURCES IN OTHER THEORIES:

e³value: The value exchanges are equivalent.

i*: Dependencies about exchanges are equivalent.

3.3.10. SCENARIO

The idea of making scenarios is to model possible solutions to evaluate their impacts. A scenario is composed of at least a decision, of some links, of some properties and of a motivation. The decision must be connected to the motivation through causal links that pass by properties.

If more than one scenario is evaluated in the model then use the select to emphasize that there are alternative possibilities.

The figure 25 possesses the following scenario; the producer of biscuit makes a decision – producing cookies. The decision brings a new resource (the cookies) that has finally a positive impact on the motivation; it improves the solvency with a certain degree (++). Now, the producer can decide if the improvement is sufficient to effectively apply the scenario in its organization.

Thank to the select, it is possible to model some alternative scenarios within the developed language; one alternative scenario by involved informational links within the selects. In the figure 26, there is two scenarios modeled - one for the decision where the company makes its own advertising operation and one for the decision where the company asks to external companies for the advertising operation. The producer can decide which scenario applying considering the outcome for the motivation.

3.3.11. META MODEL

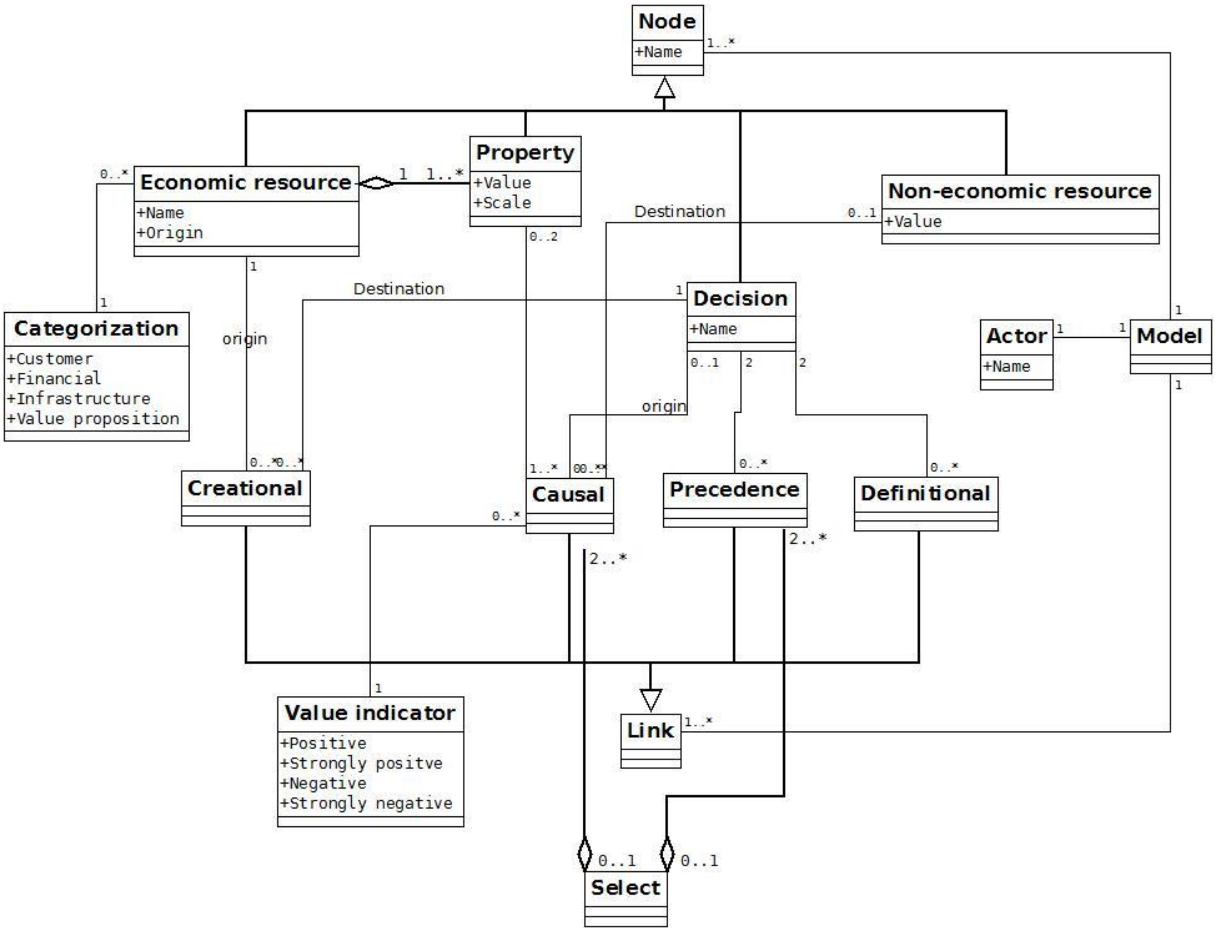


FIGURE 29 META-MODEL OF THE BUSINESS BEHAVIOR LANGUAGE

The meta-model in figure 29 shows that one actor is defined by links and nodes. A link can be causal, of precedence, definitional or creational. Nodes are properties, decisions, economic resources and non-economic resources. A property can be evaluated through a value, a state and /or a scale.

Possible relations are described in the following list:

- A decision creates (creation) one or more economic resources
- A decision can influence (causal) one or more properties.
- A decision defines (definitional) one or more decisions
- A decision must be made (precedence) before progressing to others.
- A property can influence (causal) on one or more non-economic resources or on other properties

The origin of those specific relations for the causal links is the Causal Graphs; the properties of resources are variables (Chance nodes) that the decisions (Decision nodes) vary. The modification on variables produces an effect that influences the motivation (Utility node). Those possible relations are also supported by the BDI framework; decisions (intentions) influence the motivation (desire) considering the properties and the causal links (beliefs).

Here is a list of link' directions that are not allowed (an arrow represent a direct link between two kinds of nodes);

- Non-economic resource → Decision; A choice had to be made; either it is the decisions that have effect on the motivation or it is the motivation that drives the decisions. Having both would just bring loops in the model. As the model is oriented through the optimization of the motivation, we opted for the first possibility. It makes sense when considering that we do not know how to fulfill the motivation; some trial have to be made to find the optimizing decisions. It is supported by the BDI framework and by the causal graphs (as explained earlier).
- Non-economic resource → Property: The motivation does not affect properties
- Decision → Non-economic resource: Decisions only influence non-economic resources through resources. The intentions (decisions) fulfill the desire (motivation) through actions (Rational Agent Theory); those actions are made on resource.
- Property → Decision: The taken decisions are evaluated on to their results on the motivation through their influence on properties, but no formal shows the influence of a property on a decision (see perspective 3.4.5).

3.3.12. A BUSINESS BEHAVIOR MODEL

A business behavior model is composed of a scenario; at least a decision, a resource with a property, a motivation and causal links (see the blue elements in figure 21) that connect the decisions to the motivations through the properties. The BBM is consistent with the meta-model (figure 29) and the described possible relations. Furthermore the BBM is used in a methodology (Section 4).

The figures 22, 23, 24 and 28 are not BBM instances.

If the modeler wants to schematize an actual situation (no decisions and eventually no motivation), he can use a simplified version of the BBM – that could be named the Business Resource Model. This version should be focused on resources and causal links with eventually an insight on the motivation. This possible version is not the subject of this thesis.

A Business Behavior Model possesses the following notions;

Causal effect: This notion belongs to Causal Graph. This is modeled through Causal Link.

Multiple actor exchanges: If all the actors are not present in one model, they are resources that are exchanged among those actors (Transfer of resources 3.3.9).

Alternative scenarios: The BBM allows proposing alternative scenarios (Scenario 3.3.9), thank to the Select (Select 3.3.6).

Economic value generation: The BBM allows developing economic value generation with economic resources.

Non-economic value generation: The BBM allows developing non-economic value generation with non-economic resources.

Motivation: Improving the non-economic resources is the motivation (Desire from BDI) of the actor (Motivation 3.3.4).

Decision: Decisions (Intention from BDI) are explicitly modeled (Decision 3.3.3).

Detailed description of resources: Resources are studied, thank to their properties. Properties can be sorted out in categorization to improve the insight on resources (Resource 3.3.2).

Strategic resources: It is supported by the integration of the VRIO framework (Strategic Resource 3.3.8).

Inter-resources relation: Causal links between properties from different resources bring the notion of the inter-resources relation (Links 3.3.5).

Belief: The environment is modeled through variables and causal links (Actor 3.3.1)

Desire: Thank to motivations.

Intention: Thank to the decisions.

3.4. DISCUSSION

This section discusses the obtained results considering the objectives that were fixed and the problem we aim to solve (improving the alignment, section 1.3). The first point discusses the improvement for the flow of information in comparison with the figure 3. The second point discusses the capacity of the developed language to fill the lacks that were observed in the state of art. It mainly focuses on the complementarities of using BBM with the other studied models. The third point is about the extra-contributions of the language for the domain. Afterward, a fourth point evaluates the language in respect with the objectives. Finally, a fifth point explores some perspectives for further researches.

3.4.1. BUSINESS BEHAVIOR MODEL AND THE FLOW OF INFORMATION

Having concepts that are consistent with some theories is obviously not sufficient to improve to alignment. The way concepts are selected and structured has to be done in such a way that the flow of information is effectively improved.

The figure 30 shows that some direct relations between the two layers have been created (considering the figure 3). We have the decision linked to resources (Creation links and causal links) and those resources possess properties that influence the motivation. Note that exchanges are not the major focus of the developed model, hence exchanges are not covered by BBM.

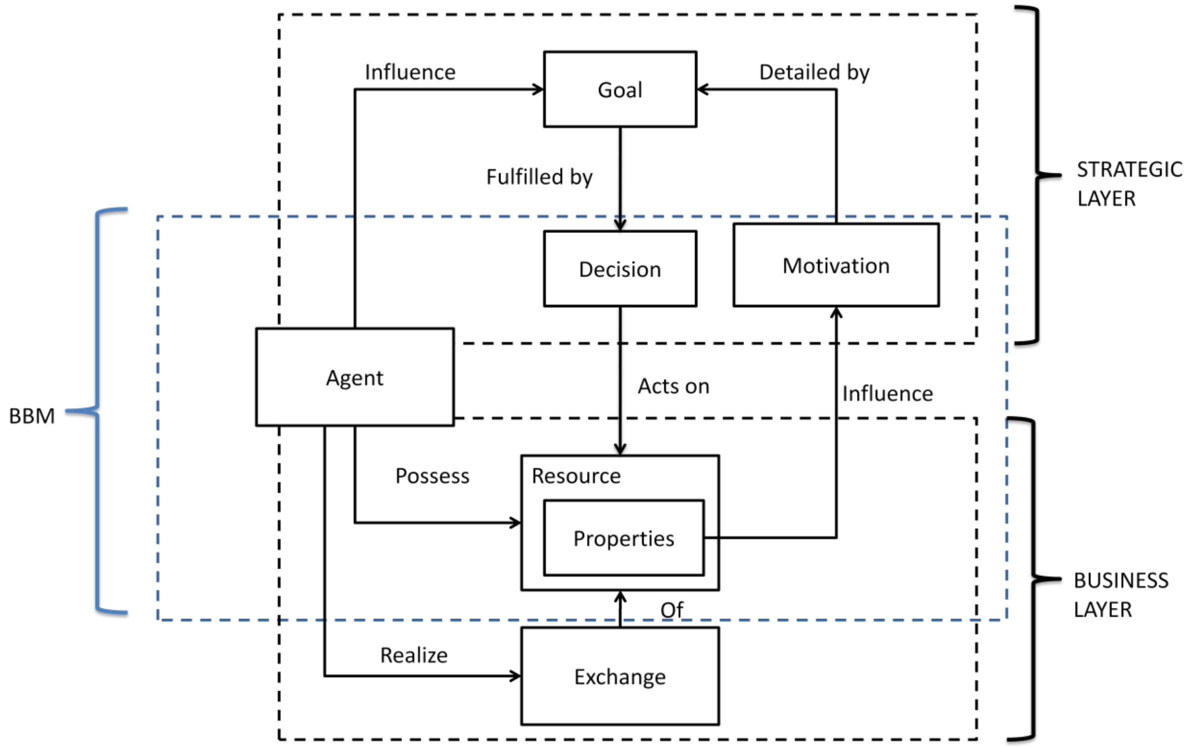


FIGURE 30 BBM MAIN CONCEPTS (INSIDE THE BLUE DOTED SQUARE) WITHIN THE TWO LAYERS.

The flow of information is more consistent as at least two connections have been created between the two layers. These are the expected results. Moreover, the connection between the layers is structured consistently with the Rational Agent Theory.

3.4.2. COMPLEMENTARITIES

In the state of art, problems were observed (table 5). The point is to know if BBM can fix those problems and then be valuable when coupled with other theories. The table 6 presents the observed problems in the state of art and shows the proposed solution in BBM. The table shows good results for the observed problems.

TABLE 6 PROBLEMS FROM THE STATE OF ART WITH THE RESPECTIVE BBM SOLUTION

Source	Problem	BBM solution
i*	• No explicit Desire (BDI) • No motivation • No explicit decisions • Information on resource is incomplete	• Desire through the motivation • Motivation • Decisions • Good view on resources
E^3value	• Information on resource is incomplete • No explicit Desire (BDI) • No explicit Intention (BDI) • No motivation • No explicit decisions	• Good view on resources • Desire through the motivation • Intention through decisions • Motivation • Decisions
BMM	• No evaluation of alternative solution • No explicit actors • No syntax • Resource are spread among different elements (internal influencer) • Too large	• Alternative decisions • A better view on attended actors • / (it does not provide a syntax for BMM) • Better view on resources • /
RBV	• No model • No integration in the Rational Agent Theory	• A model for resources thank to the contribution model and causal graphs • RBV integrated in a Rational Agent Theory

FOR THE FLOW OF INFORMATION

The developed language also contributes to improve the flow of information when coupled with the studied models. This point shows the Business Behavior language's concepts merged with other models' concepts. Reminder; studied models were not able to bridge both layers when used together (figure 20).

The merging of flows is coupled with the observed relation among theories (related, embedded, equivalent). It is important to highlight those relations in the flow as they are the cement of the connection between models.

Some specific remarks concerning the concepts from BBM can be pointed out for the figures 31, 32, and 33. The resource concept includes economic resources and non-economic resources. And it is the value from non-economic resources that influence the motivation; as explained, the non-economic resource is the object of the motivation, but the motivation also integrates an expected improvement on its value. Therefore, non-economic resources and motivation are separated in those figures (31, 32, and 33).

With i*;

The complementarities of using i* with BBM is direct. BBM brings a business dimension and links those business concepts with strategic concepts that are observable in i*. The link is made thank to decisions that are related to the dependencies but also to the tasks (they are both tactical) and thank to the motivation which is related to goal. Note that it is consistent with the figure 3; we have the goals, the motivations and the decisions for the strategic layer and we have resources, exchanges (origin) and agents that exchange (external actors). And in this case, a connection between the two layers is observable.

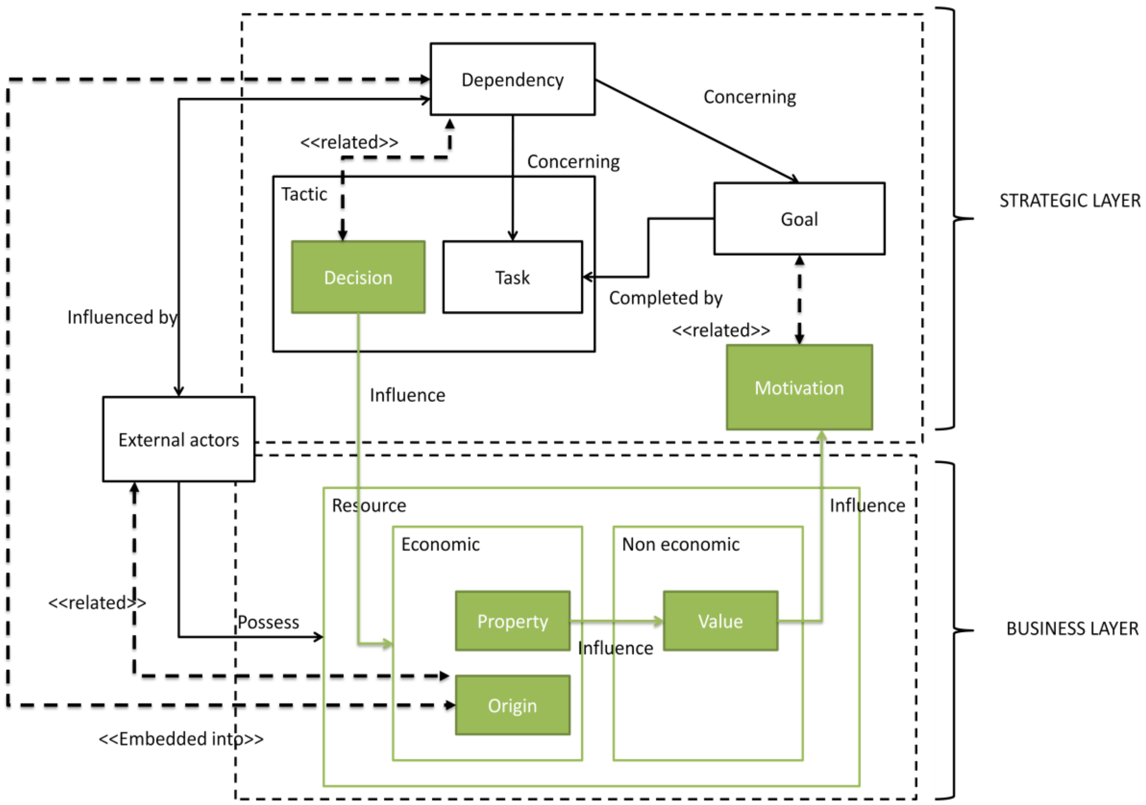


FIGURE 31 I* CONCEPTS MERGED WITH BBM CONCEPTS (IN GREEN). DOTED ARROWS SHOW RELATED CONCEPTS.

For BMM ;

The BMM model is quite complete for the strategic layer. Yet using BBM with BMM allows having a good perspective on both layers; BBM provide the insight on the business layer and BMM a complete view on the strategic layer. Moreover, BBM makes the bridge between the two layers thank to the motivations and the decisions. Again we do have the expected components for the figure 3 with some connection between the layers.

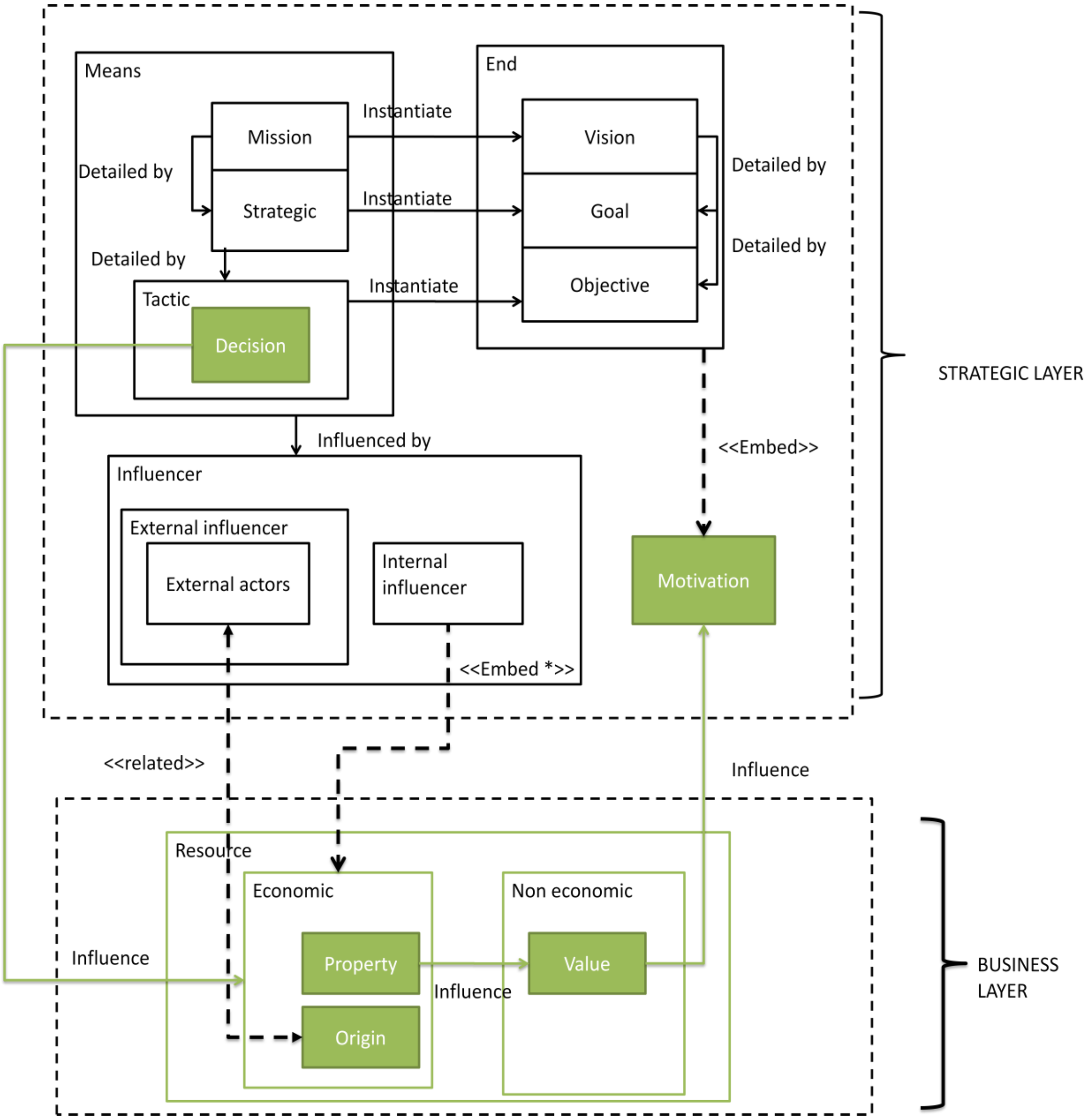


FIGURE 32 BMM CONCEPTS MERGED WITH BBM CONCEPTS (IN GREEN). DOTED ARROWS SHOW RELATED CONCEPTS. * INTERNAL INFLUENCERS EMBED ECONOMIC RESOURCES BUT NOT THEIR PROPERTIES AND THEIR ORIGINS.

For e³value

The e³value focuses on the business layers. The BBM provides some insight on the strategic layers, yet goals (for the figure 3) are missing with this merging. Therefore, using only those two models is not sufficient to have a complete view on the strategic and business layers. Nevertheless, the BBM links the business layers with some strategic elements (decision and motivation) and improves the insight on resources whereas e³value provide a better modeling for exchanges and value activities.

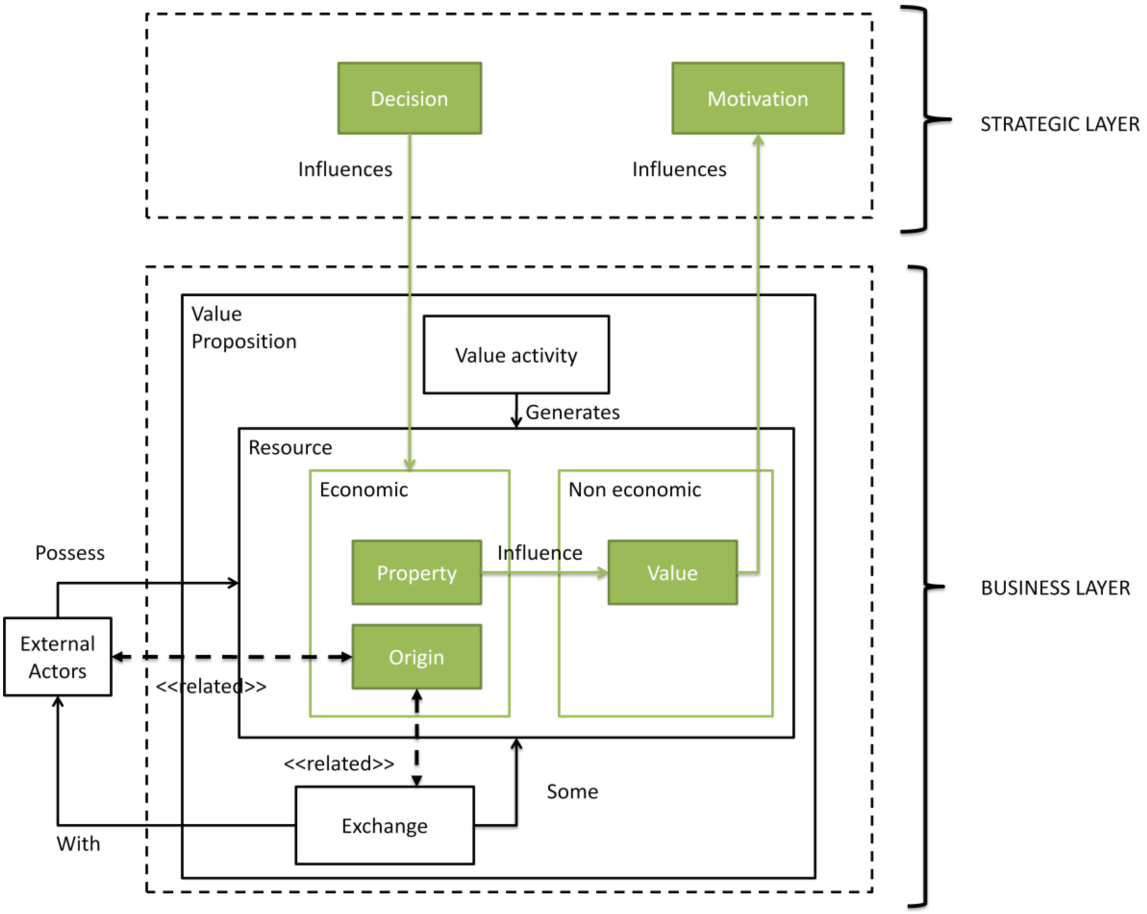


FIGURE 33 E³VALUE CONCEPTS MERGED WITH BBM CONCEPTS (IN GREEN). DOTED ARROWS SHOW RELATED CONCEPTS.

3.4.3. BUSINESS BEHAVIOR LANGUAGE'S CONTRIBUTION FOR THE STATE OF ART

The table 7 synthesizes the observed notions in the four models. Some notions are embedded into others:

- Influencing external actors is embedded in Multiple actors exchanges
- Decision is embedded into Tactic/Strategy
- Alternative scenario is embedded in UCMs

TABLE 7 COMPARISON OF NOTIONS FROM STUDIED MODELS WITH THE NOTIONS FROM BBM. A 'X' IN ONE ROW MEANS THAT THE MODEL POSSESSES THAT NOTION.

Notions	E3Value	i*	BMM	BBM
Strategic Rational		X		
Strategic Dependency		X		
Strategy/tactic integration			X	
Vision/Mission integration			X	
Goal/Objective integration		X	X	
Goal's achievement thank to tasks or resources		X		
Alternatives solution for goal's achievement		X		
Causal effects		X	X	X
Influencing external actors	X	X	X	X
Multiple actors exchanges	X	X		X
Resources exchanges	X	X		X
UCMs	X			
Economic value generation	X			X
Non-economic value generation				X
Profit and utility oriented	X			
Configuration of activities	X			
Alternative scenarios	X			X
Motivation				X
Decision			X	X
Resource	X	X	X	X
Detailed description of resources				X
Inter-resources relation				X
Strategic resources				X
Belief	X	X	X	X
Intention		X	X	X
Desire			X	X

THE IMPORTANCE OF THOSE ADDED NOTIONS

Some notions are present only in the BBM. This point discusses their value for the domain.

Motivation: The motivation is present in BMM and i* but not explicitly. Yet this point does not discuss the importance of modeling the motivation but the importance of the way the motivation is modeled; the way the motivation is modeled in BBM is unique and value-added. It uses non-economic resources as object of the motivation. It allows having motivation that is not about financial aspects and to model psychological aspect (feelings). Moreover, the concept of motivation is directly related to business aspects through properties (of resources).

Non-economic value generation: The business is not uniquely about profit [26]. It is also about survival, company's image, strong belonging feeling… Having non-economic resources offers a non-profit oriented view of the business and allows generating value that improves them.

Detailed description of resources: Modeling resources as a set of properties gives insights about the weakest and the strongest points of resources. It also helps to understand the relations between properties. The categorization of resource's properties improves the understandability of the resources but also sort out resource's elements for a better analysis. Having a resource oriented model also provide a language for the Resource Based View.

Strategic resource: The analysis of strategic resources supported by the integration of the VRIO framework is valuable for the competitiveness. Finding strategic resources provides ways to handle a sustainable competitive advantage

Inter-resources relation: Modeling inter-resource relations gives a wider and a sharper view of the studied system. It is also interesting to obtain a detailed description of property's dependencies.

3.4.4. EVALUATION

The proposed language is promising for improving the alignment; it bridges the two layers, it offers complementarities with other languages (for the flow and for lacking elements), and finally it contains valuable contributions for the domain.

The objectives for the language were to obtain a clear definition of the artifact; it is done thank to the description of the syntax and the semantic and thank to the meta-model. Additionally, the language aims to respect quality criterions (SEQUAL), yet the respect of this criterions has to be evaluated thank to unbiased investigations.

The extra-contributions are the possibilities to investigate strategic resource and to obtain a detailed insight on resources.

The validation of the language is extended in the section 5 (application).

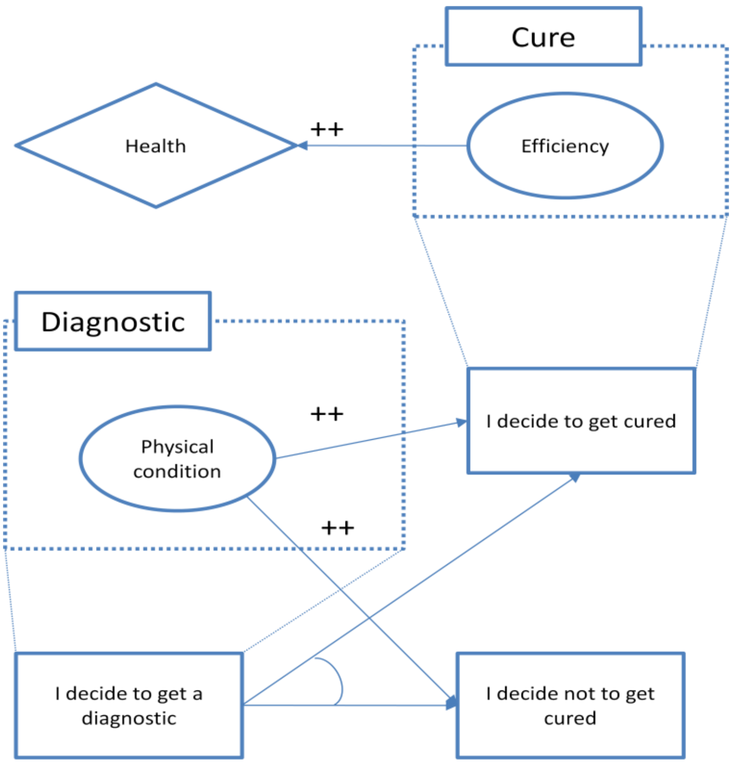
3.4.5. PERSPECTIVE

The actual language can be improved in many ways. While evaluating the BBM we pointed out some interesting added-value concepts that have to be validated. Here is a list of them;

DECISIONS INFLUENCED BY PROPERTIES

Considering the tested cases, it seems useful to possess some properties that can influence (in a causal standpoint) decisions. It makes sense as some variables in the environment (properties of resources) can affect the decisions that are made. Yet those specific relations have not been validated in this thesis. Nevertheless, it is not consistent with the causal graphs (as explained in 3.3.11) and an influence between the decisions and the properties already exists in a way. Decisions are evaluated thank to their capacity to deliver improvement for the motivation. This improvement is delivered through properties. Therefore, properties are constraints for decisions.

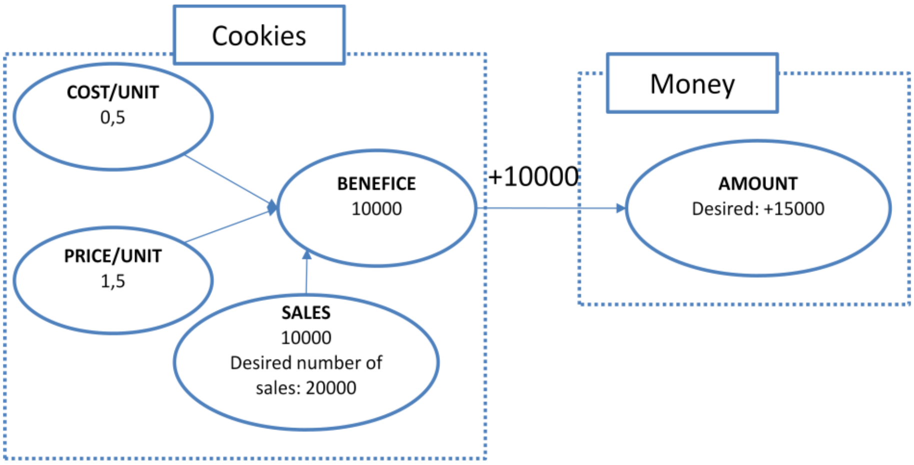
The example below shows a case involving an actor that gets a diagnostic to examine whether or not he will decide to get a cure.

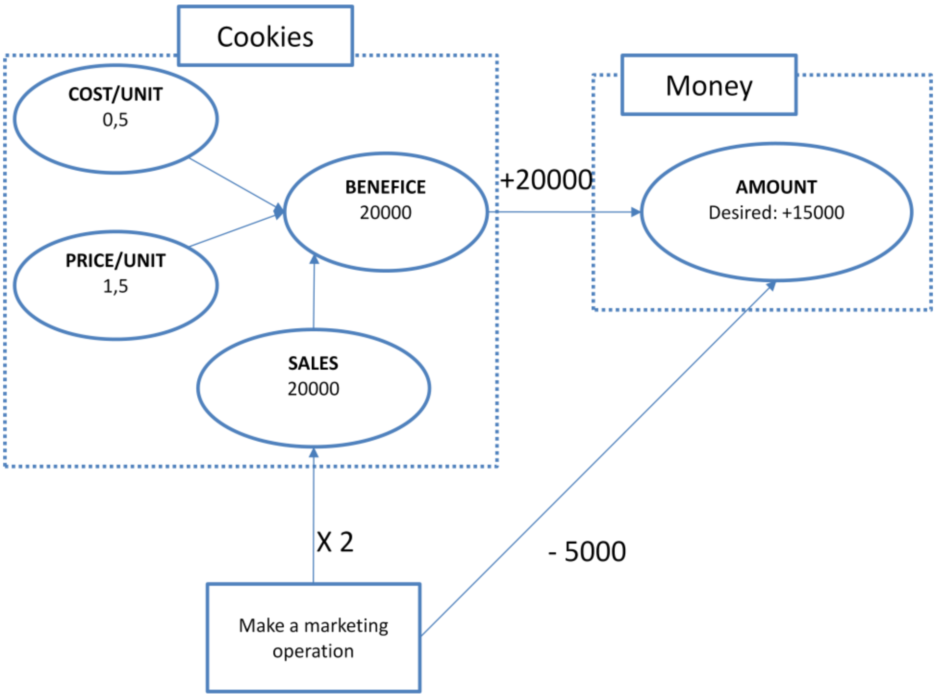


CALCULATION

A major improvement can be made on causal links. To improve the added value of the model, causal links have to be more detailed through real values or operations (minus, plus…) that highlight the expected effect of the causal relations[11]. Those values coupled with valued properties will give the opportunity of making calculation of ROI (Return On Invest), of Cash flow…. Properties could also possess some expected states that have to be reached and even upper and lower boundaries that acts as constraints.

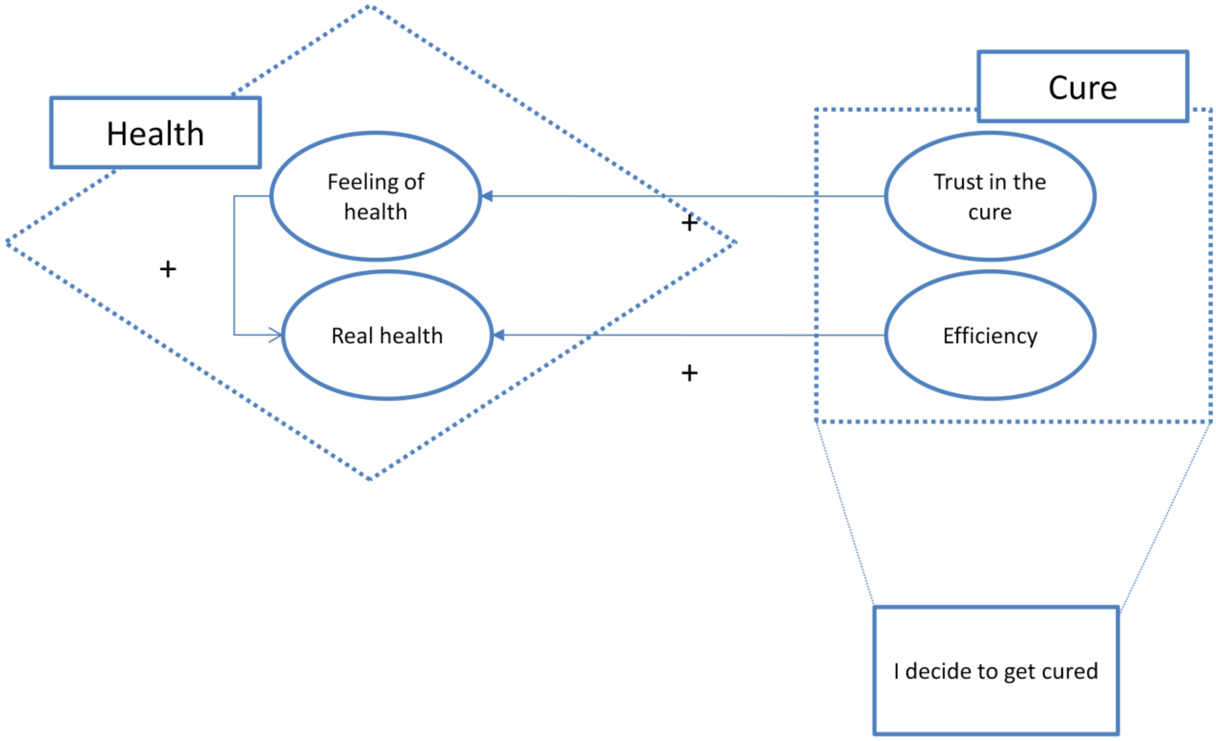
The examples below show the situation where the cookies producer wants to reach a desired level of total benefit (+15000). In the first example, the producer also wants to improve its sales from 10000 to 20000. The second example shows the impact of making a marketing operation; it is doubling the sales (x2) for a cost of 5000. Both desired state are reached thank to those operations. Note that both below examples are not BBM instances. They are lacking a motivation. The first example also lacks a decision.





DETAILING NON-ECONOMIC RESOURCES

Non-economic resources could be detailed as economic resources. The utility of detailing non-economic resources has to be inquired. The example below shows a case where an actor decides to get cured. The cure has a real effect and a placebo effect (the trust in the cure) that both influence the health of the actor. The trust in the cure is benefic for the feeling of health and the efficiency of the cure is benefic for the real health. Moreover, the feeling of health (from the placebo) is benefic for the real health status.



SUPPRESSING LINKS

A last element that could be significant for the language is the suppressing link. At the opposite of Creational links, those links emphasize the action that tends to stop considering an economic resource. The idea is that some decisions are about dropping off some resources to allow achieving some objectives of competitiveness (which could be linked to the motivation).

4. Section : Methodology

4.1. Introduction

The second artifact that has been developed is the methodology for using the language described in section 3. The methodology is composed of processes that suggest different ways to improve the alignment or to analyze a system. Those processes are based on techniques. Hence a second point defines those techniques. The third point is about the processes themselves. A final point concludes and discusses the results.

The purpose of the methodology is to describe how to use the developed model in different contexts and with different complementary sources.

4.2. Techniques

The methodology relies on available data. Those data are the constraint in which the BBM must be consequently developed. Various sources of data might be available considering our context; models, texts, interviews... The commonly used source to describe a problem is a text description that clusters various data concerning both strategic and business perspectives; we named it the problem description. However, we may also have to deal with other tools as models. The two layers have their specific models: i* and BMM for the strategic layer and e^3value for the business layer. Therefore, the following techniques are oriented in solving problems involving those models and problem descriptions.

The first technique is the Construction Technique. The idea is to collect information from various sources and to integrate them directly in the Business Behavior Model. Collecting information from the problem description may be easier as it is about finding relevant data in the text. However, a text might be interpreted in various ways and the resulting BBM might not represent the real situation. With models as sources, the problem is to indentify matching semantic with the Business Behavior language. Ideally, a precise mapping of concepts from BBM to other models has to be done. But due to the complexity of such a mapping, we only provide an insight of the mapping (via meta-models merging) and translation tables (one by model) that allow translating one concept into another.

The second technique is based on the same translation table and mapping than the construction technique. It consists this time in transcribing the content of the Business Behavior language into other languages; the derivation technique.

The third and last technique is the analysis technique. It is based on comparing various instances with a Business Behavior Model instance of the same problem. This technique does not require to transcribe one model into another, but to obtain complementary information or to find missing one.

But firstly, as both the construction and derivation techniques use transformations, a first point describes the possible translation from one model to another through meta-model mappings and translation tables.

Translation Tables and mapping

The provided translation tables and mapping are based on the relations (equivalence, embedded or related) between concepts from BBM and i*, BMM and e^3value (section 3). However, some of the aimed techniques are purposed to transform one language into the type of another. Therefore, additional translations are required to allow complete transformations. A mapping shows direct transformations between elements of two languages. Elements are represented into a meta-model that clusters the meta-models from the two languages. The meta-model of BBM is partially presented in blue into the mappings (figure 34, 35, and 36).

It is important to understand that the following transformations work in a specific context using BBM. Those transformations are not validated for other contexts.

INTENTIONAL STRATEGIC ACTOR RELATIONSHIP MODELING (I*)

i* focuses on intentional elements. The idea is to give them a business meaning through resources. The table 9 gives the possible translations. The figure 34 shows the merging of the meta-model of i* and the related concepts from BBM.

Motivation and goals;

Considering that BBM presents the motivation and that i* does not express the vision[1], the classic translation of the vision into motivation is not possible. Therefore, the translation uses goals instead of the vision, but not random goals. Only top goals - goals that do not influence other goals- are transformed into the motivation. Note that with that transformation, the motivation's meaning is lower in the strategic layer (3.3.4).

Properties and goals;

Properties are also related to the goals that focus on resources. Those goals are directed in the improvement of valuable properties of resources for the companies (in our vision). As an example we can take our company that produces cookies. The company could have various goals like "increase the wealth of the company" or "increase the quality of the chocolate" that is introduced in the manufacturing process. In the first case; the company wants to increase the economic resource 'wealth' and so the property 'amount' of the wealth , and in the second one, the company want to increase the property 'quality' of the economic resource 'cookies'. By this transformation we give a business meaning to the goals of i*.

The transformation also requires modeling the expected improvement on the property (i.e.; the goals) with a causal link and a value indicator.

Decision and tasks;

Some decisions can also be related to tasks; something to be achieved to achieve some desire. A task that is integrated in a means-end links is alternative as a decision integrated in a scenario. In addition, both concepts are embedded in the tactic[4] concept. Yet a necessary task may pre-exist the decisions.

Decisions + causal links and Means-end links;

Decisions coupled with causal links are related to the notion of means-end link. Means-end links are envisaged solutions that influence goals. Decisions are envisaged solution that influences (thank to causal links) properties (which are transformed into goals).

Decisions and dependencies;

As i* contains dependencies between actors, their effects have to be translated in BBM effects. Those dependencies affect the strategy[3] and then the tactic[4] (i.e.; the decisions). Therefore, the information contained in the dependencies can be reflected into decisions

At the opposite, decisions involving two actors are replaced by dependency between actors in i*. For example, if the producer of cookies decide to buy chocolate (instead of making it itself), the decision that models this buying is related to a new dependency between actors. Yet, some dependency may pre-exist any decision; not all dependencies can be derived from decisions.

Origins and dependencies;

As BBM focuses on one actor in a instance, external actor are modeled with the origin of the economic resources. The origin also represents dependencies related to transfer of resources (a rental or a purchase).

Definitional links and decomposition links;

Decompositions links on tasks (transformed into decisions) are transformed into definitional links.

TABLE 8 TRANSLATION TABLE FOR I*. THE TWO LAST COLUMNS SHOW THE CARDINALITIES OF THE TRANSFORMATION. THE LAST ONE SHOWS CARDINALITIES FOR TRANSFORMING I* ELEMENTS INTO BBM ELEMENTS. IT IS THIS OPPOSITE FOR THE PREVIOUS COLUMN.

BBM	i*	Explanation	BBM – i*	i* - BBM
Decision	Task	Something to be achieved.	0-1	0-1
	Dependency	Some decisions bring new dependencies.	0-n	0-n
Decision + causal link	Means-end	Both envisaged solution.	0-1	1-1
Property + causal link+ value indicator	Goal	Applied goal in business solution.	1-1	0-1
Property	Resource	Resource can be assimilated to a property.	0-1	0-1
Economic Resource	Resource	Both resources, but the granularity may vary from one concept to another.	1-n	1-n
Motivation	Goal	Top goals can be related to the motivation	1-n	0-n
Origins	Dependency	Actor's dependencies (exchanging resources) are modeled through the origins.	1-1	0-1
Causal link	Contribution	Both links are about influencing other nodes.	0-1	0-1
	Dependency	Causal link between resources can reveal a dependency.	0-1	0-1
Definitional link	Decomposition link	They both decompose entities.	1-1	0-1

Meta-model mapping;

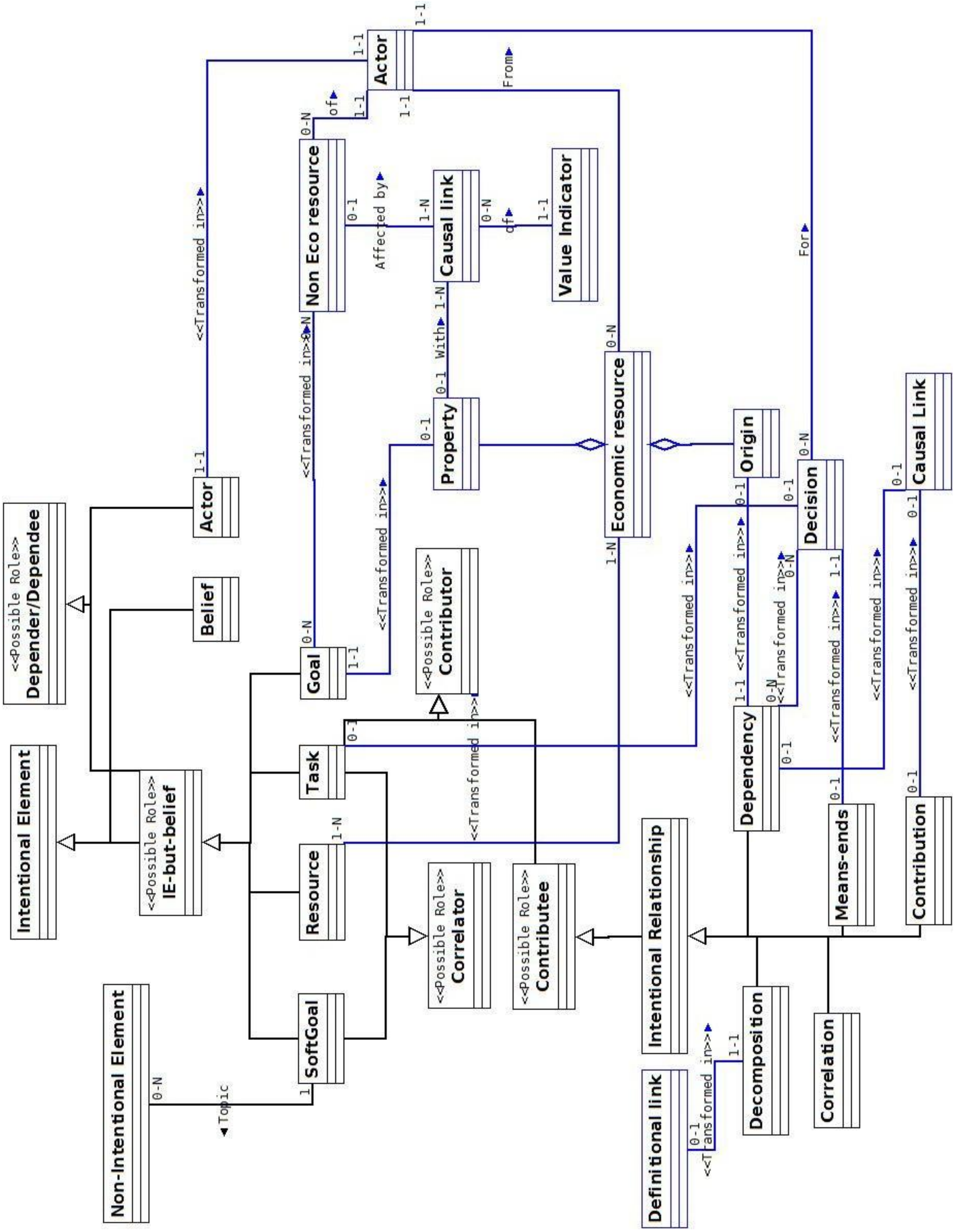


FIGURE 34 MERGING OF THE I* META-MODEL AND THE RELATED CONCEPTS FROM BBM

BUSINESS MOTIVATION MODEL

Decisions and means;

Decisions are embedded in the Means's definition; decisions are tactics or strategies (see Decision in section 3.3.3) which are embedded in the notion of means. Therefore, decisions can be translated in Means but only a small subset of Means are translated in Decision; the subset about tactical and strategic decisions. Moreover, a tactic and a strategy can be composed of more than one decision for BBM, the opposite is also true.

Properties and Desired results;

As for i*, the idea is to show the business meaning of the objectives and of the goals through resources. Therefore, the translation of desired results into properties is possible when desired results concern resources. The translation requires modeling the expected improvement on the property (i.e.; the desired results) with a causal link and a value indicator.

Motivation and the vision;

As the motivation must initially be aligned with the vision, a translation is possible. Yet the motivation can also be connected to other kind of end nodes depending on the position of the model within layers (see Motivation in section 3.3.4).

Properties and influencers;

Properties are influencing the organization as internal influencers. Properties are internal influencers that concerns resources. Yet if the property belong to a resource that is not owned (a rental) by the concerned actor, then the property is an external influencer.

Origins and external influencers;

A subset of external influencers concerns actors involved in the business; partner, customer, supplier. Those actors are possibly exchanging resources and therefore present in the origins.

Translation table for BMM;

TABLE 9 TRANSLATION TABLE FOR BMM. THE TWO LAST COLUMNS SHOW THE CARDINALITIES OF THE TRANSFORMATION. THE LAST ONE SHOWS CARDINALITIES FOR TRANSFORMING BMM ELEMENTS INTO BBM ELEMENTS. IT IS THIS OPPOSITE FOR THE PREVIOUS COLUMN.

BBM	BMM	Explanation	BBM – BMM	BMM - BBM
Decision	Means	Decisions are a subset of means.	1-N	0-N
Property+ causal link+ value indicator	Objective	Applied objectives at in a business solution.	0-1	1-1
	Goal	Applied goal at in a business solution.	0-1	1-1
Property	Influencer	Properties are variables and constraints.	0-1	0-1
Motivation	Vision	Aligned concepts.	1-1	1-1
Origin	External influencer	Actors exchanging resources are modeled with the origins.	1-1	0-1
Economic resource	Internal influencer	Resources are embedded into internal influencer (3.3.2).	1-1	0-1
Value indicator	Assessment	Assessment describes the intensity of relation.	1-1	1-1

Meta-model mapping;

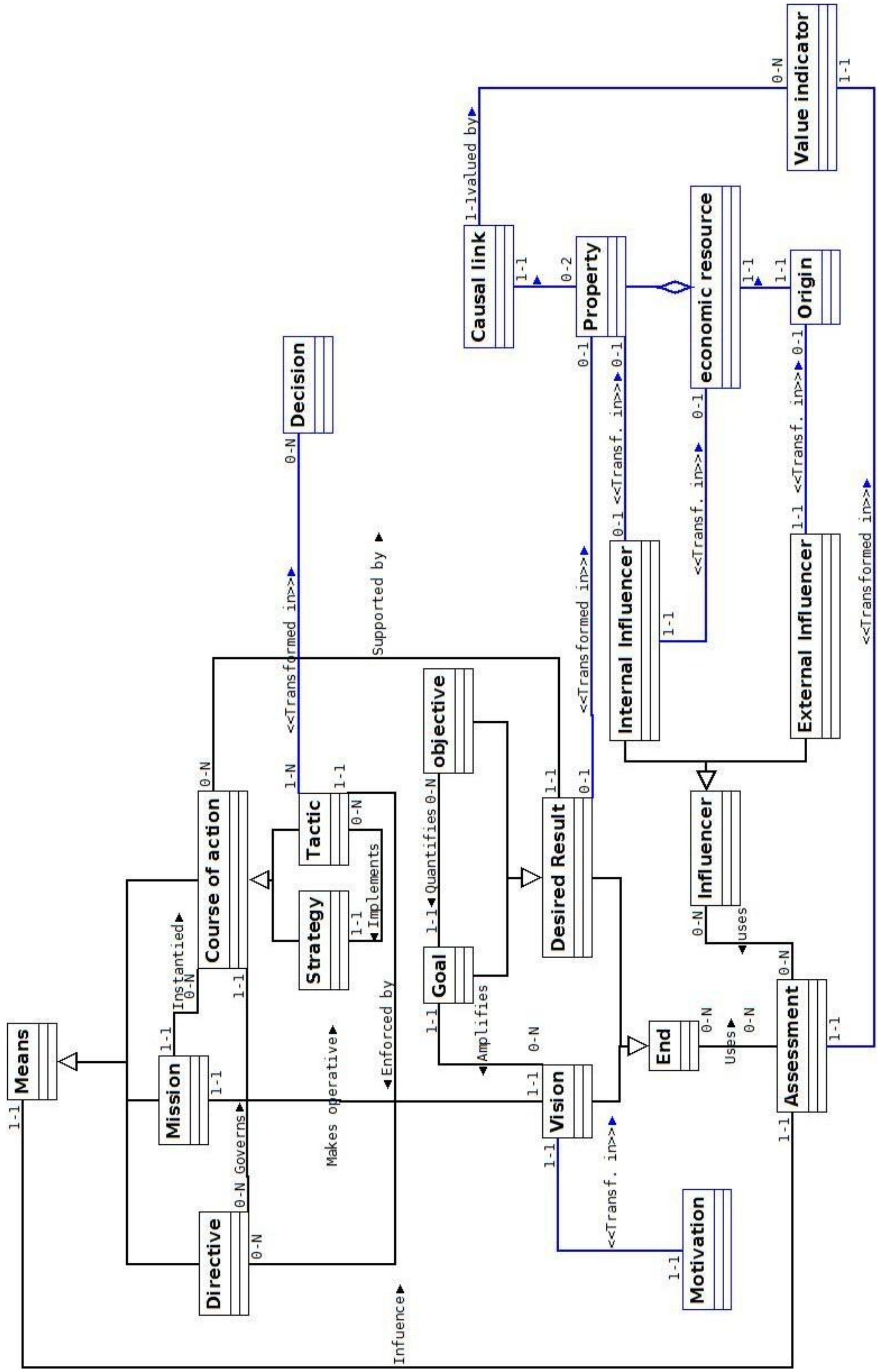


FIGURE 35 MERGING OF THE BMM META-MODEL AND THE RELATED CONCEPTS FROM BBM

E^{3}VALUE

Decisions and value activities;

Value activities and decisions share a common interpretation; there are both evaluated solutions. The difference is that value activities are evaluated solutions at the business layer whereas decisions are for the strategic layer. As the context is precisely the flow of information, decisions can be translated in value activities. Yet the opposite is not true; not all value activities are translatable into decision. Value activities can pre-exist the evaluation of solutions – of decisions.

With the UCM extension and their connectors, value activities can also be alternative (as decisions).

Origins and exchanges;

The origin of resources shows at least one side of the exchange per actor; the actors with whom the actors exchanged the resources. With more complex structures (using decisions and properties), it is possible to reveal the complete exchange (section 3.3.9).

Precedence links and value interface;

Whenever value activities from a same actor are transformed into decisions, value interfaces that connect those value activities are transformed into precedence links. The transformation provides the relation between decisions.

Translation table for e^{3}value;

TABLE 10 TRANSLATION TABLE FOR E^{3}VALUE. THE TWO LAST COLUMNS SHOW THE CARDINALITIES OF THE TRANSFORMATION. THE LAST ONE SHOWS CARDINALITIES FOR TRANSFORMING E^{3}VALUE ELEMENTS INTO BBM ELEMENTS. IT IS THIS OPPOSITE FOR THE PREVIOUS COLUMN

BBM	e^{3}value	Explanation	BBM – e^3	e^3 - BBM
Decision	Value activity	Decisions are applied through value activities.	0-1	0-1
	Start stimulus	The initial decision.	0-1	1-1
Economic Resource	Value object	Both resources.	1-n	0-n
Origin	Exchange	Exchanges are modeled through origin.	1-1	1-1
Precedence	Value interface	Value interfaces between value activities of a same actor are related to a precedence meaning.	1-1	0-1

Business Behavior Model

Meta-model mapping;

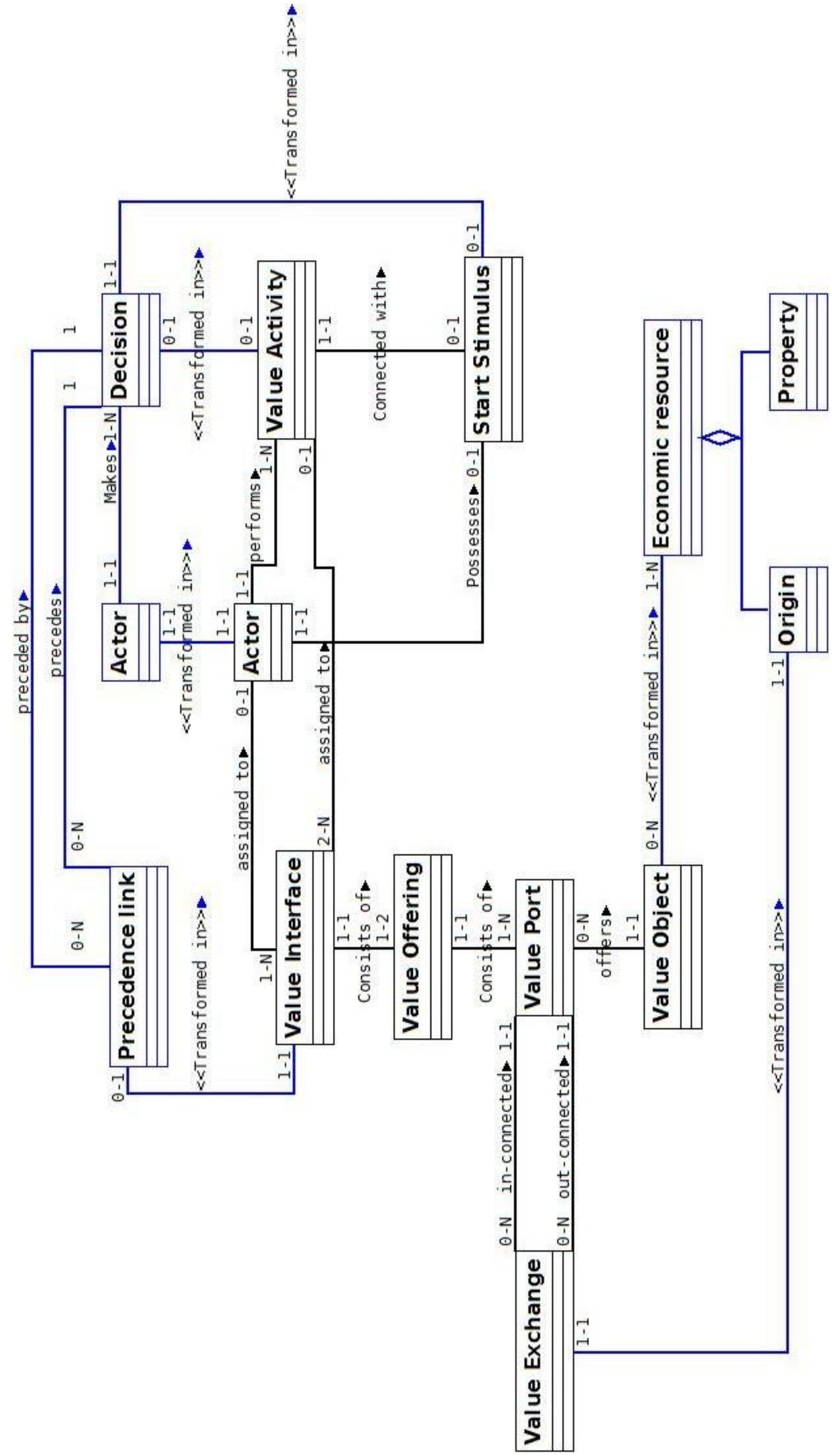


FIGURE 36 MERGING OF THE E³VALUE META-MODEL AND THE RELATED CONCEPTS FROM BBM

The table 11 shows the summary of the previously described transformations. Note that transformations only work with BBM and the other models. This table does not represent the transformations between e³value and i* for instance.

TABLE 11 SUMMARY OF THE POSSIBLE TRANSFORMATIONS DESCRIBED IN TABLE 8-9-10.

BBM	e³value	i*	BBM
Actor	Actor	Actor	
Property	Value object	Goal	Internal influencer Goal Objective
Decision	Value activity Start stimulus	Means-end link Dependency link Task	Means
Motivation **(non-economic resource)**		Goal	End : Vision
Causal link		Contribution link Dependency link	
Value indicator			Assessment
Precedence	Value interface		
Economic Resource	Value object	Resource	
Alternative decisions	UCM extension	Means-end link	
Origin	Value exchange	Dependency link	External influencer

4.2.1. CONSTRUCTION

The construction is a technique that aims to transform a source (a model or a problem description) into an instance of BBM that contains the same information.

The construction process is based on the translation table (table 11). The point is that the construction is preferably oriented in the usage of a step-by-step process whatever the source is. The technique for construction is therefore described through the following steps;

1. The first step is to sort out the involved actors.
2. The next step consists in finding relevant information; the possible decisions, the economic resources involved, and the motivation that drives the business.
3. Afterward, the modeler must define the economic resources with their properties.
4. With all the nodes in the model, the modeler[14] must start to link nodes with causal links. Properties should be grouped together onto an oriented graph with few top nodes (the most general nodes) that are influencing non-economic resources.
5. After that, the modeler[14] has to add the value indicators on the causal links. There are only four possible values; ++, --, -, +. The ++ and the -- should be used for the primary causes (major effect). The - and the + are about secondary causes that have light or side effect on the in-node.
6. Finally, the modeler can improve the model by using definitional or precedence link to clarify the understanding of the decisions. If the graph of properties of an economic resource is too complex, use the categorization based on BMO. The modeler can also use the select to represent alternativity.

Some specific remarks can be made depending on the source for the construction.

FROM THE PROBLEM DESCRIPTION

An obvious source for the construction is the problem description. Dealing with a problem description consists in interpreting the language to find relevant elements (figure 37); the involved actors, the motivations, the decisions, and then the resources. Afterward, economic resources have to be defined by their properties. The obtained nodes must finally be linked together considering an accurate analysis of the influence of properties.

A specific remark concerns decisions that can be found directly in the problem description. Yet, they can also be made considering the problem description's issues and the motivations. In the first case, the problem description already contains some possible solutions.

The lowest part of the figure 37 is about some optional adding (categorization and select). Those adding are not present in other figure (figures 38, 39 and 40) to make them more compact. The operation to link elements is about adding causal links but also the necessary selects.

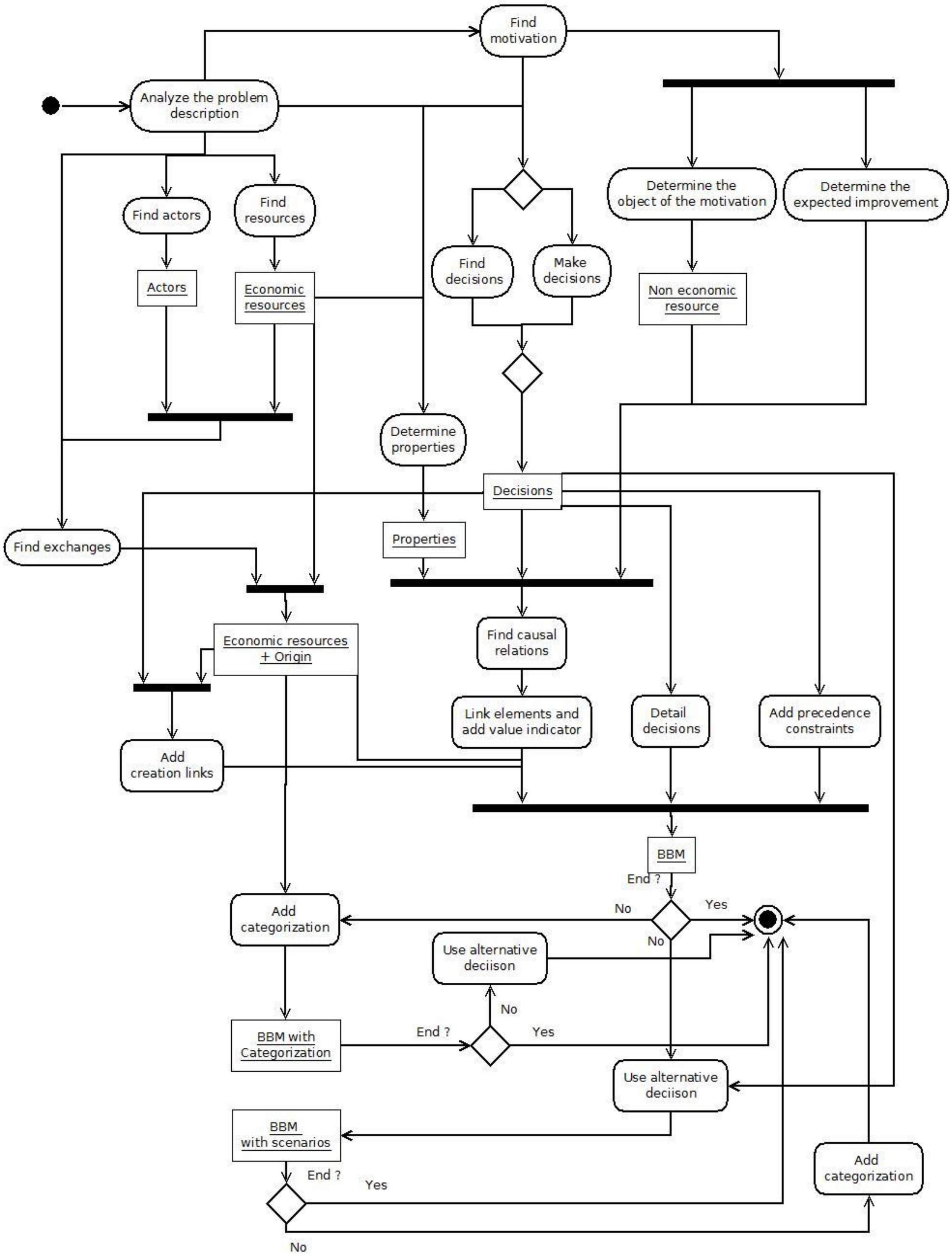


FIGURE 37 THE CONSTRUCTION PROCESS BASED ON THE PROBLEM DESCRIPTION.

FROM I*

With i* (figure 38), the method does not really vary. However, the process is more about transforming and analyzing elements to obtain the BBM at the end. Transforming means that the element can be transformed directly into the aimed one. Analyzing means that the element contains some information for the aimed one.

Additionally, the motivation may have to be found in other sources (as the problem description) and some links can be missing; precedence and definitional links. Ideally, modeled properties have to be supported by the problem description, it increases their validity and some properties can be missing in i* (through the transformation of goals). Softgoals are ignored.

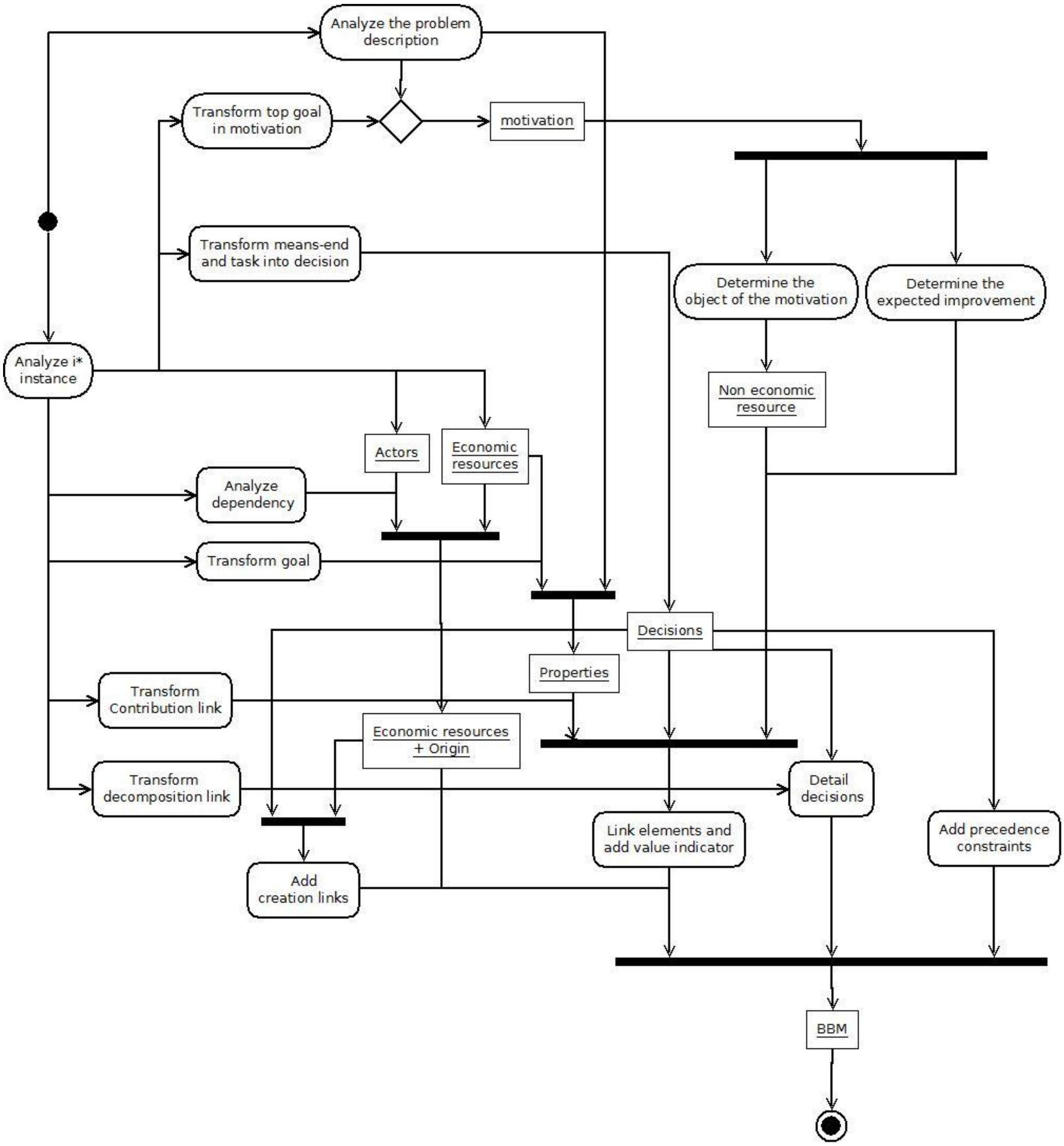


FIGURE 38 THE CONSTRUCTION PROCESS BASED ON I*.

From BMM

Considering BMM (figure 39), the task can be harder. Firstly BMM does not possess syntax. Additionally, BMM covers a large panel of concepts which are not always useful for the Business Behavior Model. Finally, relations between concepts are not presented through syntax; we have to deal with assessments. On the other hand, as BMM covers a large panel of concepts, almost all the required information is present. Some supports from the problem description may be needed to determine who the actors are.

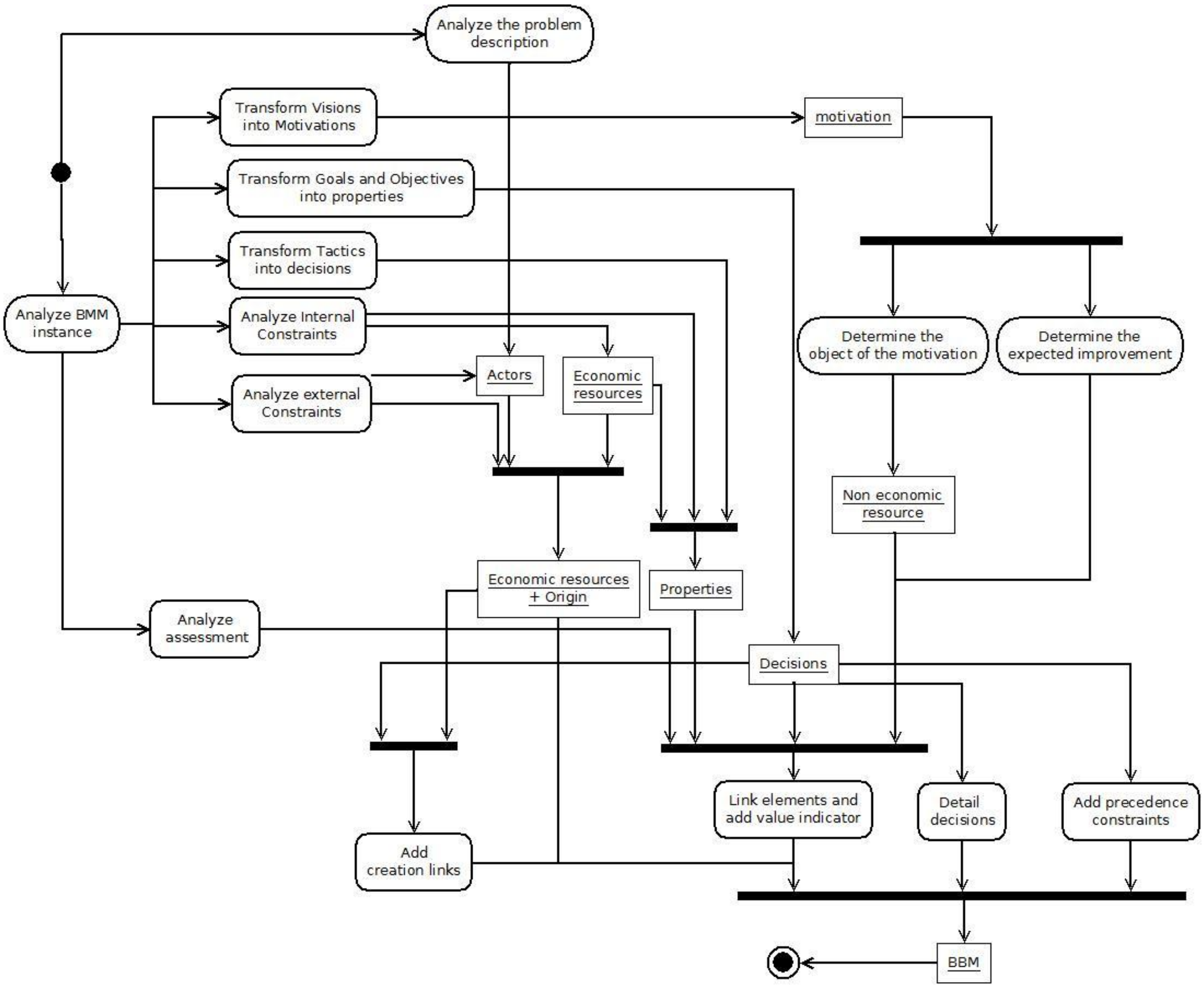


Figure 39 the construction process based on BMM.

FROM E³VALUE

Finally, with e³value (figure 40), properties and motivation are missing as causal links. Those elements must be found in other sources – the problem description. The UCM extension is useful to obtain some additional elements; the selects and initial decisions.

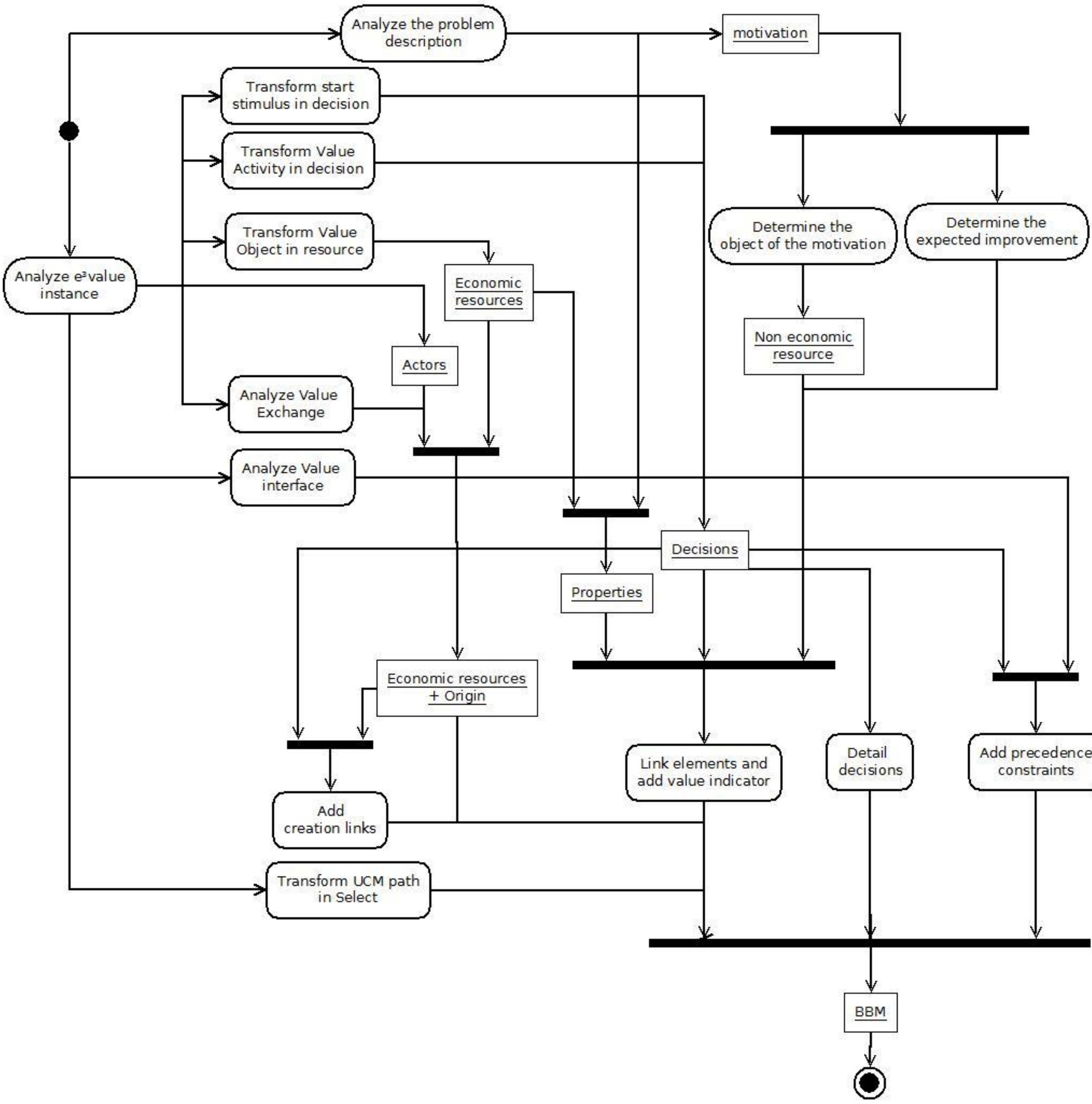


FIGURE 40 THE CONSTRUCTION PROCESS BASED ON E³VALUE.

The table 12 summarizes the observables pros and cons in the different used sources.

TABLE 12 PROS AND CONS OF USING THE VARIOUS SOURCES (PROBLEM DESCRIPTION, I*, BMM, E³VALUE)

Source	Pros	Cons
Problem description	• More complete, more accurate • Alternative decisions. • Not influenced by external design.	• Longer than the other solutions as the process is from scratch. • The interpretation of the language.
i*	• Properties are findable (goals). • Actors are modeled. • Causal links are modeled (contribution links). • Alternatives decisions are findable (Means-end). • Resources are findable.	• The transforming of soft goals depends on the exact semantic of those softgoals which is not precise. • Information on economic resources is hard to exploit out of goals and tasks.
E³value	• Resources are modeled. • Some decisions are findable (Value Activity). • Relations among decision are findable. • Actors are modeled. • Scenarios are modeled (UCM)	• Information on resources is incomplete; no properties. • No motivation.
BMM	• Complete. • Properties are findable.	• No syntax. • Links are difficult to find. • Too complete.

4.2.2. DERIVATION

The technique is similar to the construction but in the other direction; the aimed goal is to derive an instance of a model from an instance of BBM. The Business Behavior Model is the cement for other models in this technique. The proposed technique is similar to the construction technique. Therefore, this section is not detailed as the previous one, it only provide some discussion for the derivable models and for the problem description.

For the transformations, refer to the translation table (8-9-10) and to the mappings (figure 34, 35, 36).

TO OBTAIN THE PROBLEM DESCRIPTION

The utility of such derivation lies in validating the content of BBM. Transforming BBM into a text may be interesting to find erroneous elements as a literal text may be easier to read for some people.

TO OBTAIN I*

An issue concerns the dependencies between actors; they have to be found out from some decisions, from origin of resources (for dependencies concerning exchange) and even from some relations among properties. Yet the relation must concern properties from different resources, and one of the resources is not actually possessed by another actor (this actor may rent the resource to the other).

A good point of using BBM as a basis is that the obtained i* will possess a top goal associated to the motivation (which may be absent in other cases). Some tasks, softgoals, and dependencies may have to be found in other sources.

TO OBTAIN BMM

Deriving a BBM into BMM supposes the existence of syntax for BMM. If the syntax is kept simple (see BMM in the section 2.2.8), the process can be facilitated. Note that the obtained instance of Business Motivation Model will be simplified regarding BMM's real capacities. Decisions are transformed into Means (with a tactic or a strategic meaning). Properties are transformed into End nodes with an objective or a goal meaning. Properties can also be transformed into influencers; internal if the properties belong to an economic resource that is owned by the actors and external otherwise. As well, origin is also transformable into External Influencers. The motivation is transformed into an End node with a Vision meaning. The other elements must be found in other sources.

TO OBTAIN E³VALUE

The derivation of e³value is quite simple; suppress the properties and the non-economic resources to keep economic resources and decisions. Then, transform decisions into Value Activity and economic resources into Value Object. Value exchanges are present in the origin of economic resources.

Additionally, the selects are transformed into connectors for UCM extension and some initial decisions are start stimuli.

4.2.3. ANALYSIS

The analysis technique is a technique that compares some aspects of instances of models (one of the instance is a BBM instance). This technique depends on the language of the analyzed models. The proposed technique highlights differences among the analyzed instance and the instance of BBM. Differences may exist as the source for both instances may be interpreted differently or because some flaws have been introduced in one instance. This technique requires a deep knowledge of the semantics of the aimed model. Therefore, the technique focuses only on some specific aspects which are relevant for the considered model. Those aspects have to be compared in both instances (to improve the two instances).

Here are the guidelines for analyzing aspects of the studied models;

For i*;

Some pieces of information may have been omitted in one instance or may be conflicting with information from other instances. The idea is that the BBM concepts are related to i* concepts (see table 8). This technique is called *discovering of conflict and synergy* as the purpose is to find missing elements that have; instances are complementary (i.e.; synergic) or to find information that is conflicting among instances.

Analyze the fulfillment of goals and the support of decisions. The idea is that goals need to be achieved through the use of means and by taking decisions (see figure 3). As well a decision also needs to be purposed by a goal. A goal which is not supported by any decisions is unattainable and is then a waste of time and means for the strategic management. The BBM aims to emphasize the connection between decisions and goals that are observed in i* language. A goal has to be supported by a decision, and decisions must be supported by goals. Otherwise, what is expected and what is decided are not consistent. The process is called "*analysis of goals fulfillment*". This is adapted from [1].

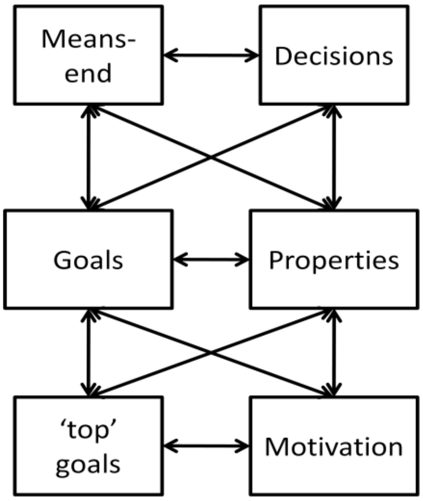
The motivation must also be fulfilled by the goals and aligned with top goals.

Find missing means-end links or missing decisions. The idea is related to the analysis of goals fulfillment. This technique works thank to the relation between means-end links and decisions (table 8).

Find missing dependencies or missing inter-resource causal links. Causal links that go from one resource to another (linking two properties) are related to dependencies if the resources belong to different actors.

As well, some actors could be missing in both models.

Additionally, the relation between goals and properties is interesting as it allow finding information that could have been omitted in one or the other model.



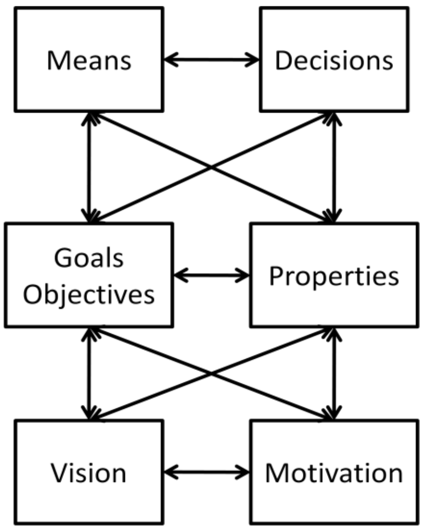
Ideally, at the end of the analysis, all related component should be aligned like in the schema aside (based on table 8).

- Means-end with decision and decision with goals
- Means-end with properties and properties with goals
- Goals with properties and properties with top-goals
- Goals with the motivation and the motivation with top goals

Finally, using such a comparison allows increasing the understanding of exchanged resources among actors in i* and also the impacts of such exchanges. At the opposite, i* would be interesting for the calculation in BBM; the goals would allow fixing some boundaries and expected value for properties.

For BMM;

Use the discovering of conflict and synergy and the analysis of goals fulfillment extended to objectives. Verify that the motivation is fulfilled by goals and objectives and aligned with the vision. Check consistency between assessment and causal links, between goals/objectives and properties, and between means and decisions. Also, check if there are missing actors or resources (in internal influencers)



Ideally, all components (that are related) must be aligned after the comparison (based on table 9);

- The means with the decisions (on the related part)
- Goals and objectives with the properties
- The vision with the motivation
- The decisions with the goals and objectives
- The means with properties
- The goals and objectives with the motivation
- … (see the schema aside)

For e³value;

As the BBM allows proposing alternative decisions, you can check whether the right decisions have been taken in e³value as decisions are related to value activity. The comparison between BBM and e³value also highlights missing value activities (but not decisions as value-activities may pre-exist decisions).

The major contribution of analyzing an e³value instance with a BBM instance is to increase the understanding of the resource exchanged and the impact of such exchanges. It is also interesting to couple the value activities perspective with a resource perspective to fully understand the implication of a value proposition.

Finally, the analysis of the Value Proposition shows if it improves effectively the initial motivation (present in the BBM).

4.3. PROCESSES

This section shows the main applicable processes for optimizing the usefulness of BBM. They are mixable together. There is at least five possible processes; Retro-engineering, Bridging, Merging, Business analysis, and Simulation

4.3.1. RETRO ENGINEERING

When having different models, it is interesting to verify their validity. The idea is to use BBM to compare validity of other models that share a common source for construction (a problem description). Doing so highlights forgotten elements in instances. As the Business Behavior Model possesses shared concepts with other models, comparisons are facilitated. The construction technique provides information on how to construct the BBM and the analysis technique points out some approaches for the comparison.

Using such a process allows improving the alignment as models feature fewer mistakes. It requires having a validated source for the initial construction. Otherwise, BBM can worsen both models.

4.3.2. BRIDGING

The bridging has to be used in the perspective of improving the flow of information between layers. The bridging focuses on analyzing models that belong to different layers. The goal is to improve the consistency between layers. The process requires possessing one instance of models for the layers A and B. Two different approaches are proposed;

1 The first step is to construct a BBM instance C on the basis of one of the model, let’s say A.
2 The instance C is compared (thanks to the analysis technique) with B, and B is improved if necessary.
3 C can also be improved in the comparison with B into a D version
4 D is compared with A and A is improved if necessary.
5 Again D can be improved through the comparison with A
6 If no improvements have been made on models, continue to step 6. Otherwise, go in step 2 to re-make a cycle.
7 No more improvements are realized on the BBM instance; A and B are consistent together and connected through an instance of BBM.

The second approach is similar, but instead of using the analysis technique for the comparisons, the approach derives an instance of the aimed model thanks to the instance of the BBM.

1 The first step is to construct a BBM instance C on the basis of one of the model, let’s say A.
2 Derivate an instance (D) of the type of model of B from C.
3 The instance D is compared with B, and B is improved if necessary.
4 E can also be improved in the comparison with B.
5 An instance E of BBM is constructed on the basis of D
6 Derivate an instance (F) of the type of model of B from E
7 F is compared with A and A is improved if necessary.
8 Again F can be improved through the comparison with A
9 An instance G of BBM is constructed on the basis of F
10 If no improvements have been made on models, continue to step 11. Otherwise, go in step 2.
11 No more improvement are realized on the BBM instance; A and B are consistent together and connected through an instance of BBM.

This second approach is obviously longer and makes more transformations that can introduce some errors in models. However, the comparison is facilitated and more elements can be compared than possible with analysis techniques.

4.3.3. MERGING

Another way of using the developed language is to merge information from various sources into one model. Ideally, the sources should include a business and a strategic perspective. The information could also be supported by a problem description to ensure a quality modeling. The merging provides complete information on a system or on an organization. It is a good basis for making business analysis (4.3.4) or simulation (4.3.5).

The merging process relies on the derivation technique to derive a first BBM instance. Afterward, the instance has to be compared (analysis technique) with other perspectives (models) to add complementary information.

This process is purposed in obtaining the most complete view of the organization in one instance (per actor). The completeness is weakened by the missing goals and the missing value activities (not present in BBM). Yet, the table 10 provides some transformations which highlight the possibility to have those missing elements under the guise of other concepts (decisions and properties).

Regarding the alignment, the BBM instance is the entity that bridges the two layers. Instead of keeping different languages, as for the bridging process, the merging process focuses on one (the Business Behavior language) for improving the alignment. With this process, the obtained instance of BBM contains important concepts from both layers and links them (figure 30).

4.3.4. BUSINESS ANALYSIS

This process is quite different from the others. The business analysis uses the BBM for itself without considering other models. This process is purposed to improve the resource management and the optimization of the motivation.

The managements of resources requires to have numerous and consistent information on involved resources but also on their interactions. The Business Behavior Model synthesizes a view of resources. Moreover, the level of details of resources allows having inner analysis on issues of resources; decreasing stock, inefficient usages… Finally, as the model is integrated in the RBV theory, the management can be led on strategic resources with all the exposed benefits.

The optimization of resources is also related to the simulation[15] and the analysis of the environment. It requires finding the optimal decisions considering the environment in order to get the higher added-value on the motivation. As well, decisions impact on resources. Therefore, a good management of resources is also needed to get a higher outcome. The simulation[15] helps providing optimal outcomes for motivation as it shows various results when selecting one decision instead of another. Varying some properties (variables of the problem) through simulation is also beneficial to the improvement of the motivation.

To realize this process, it requires constructing the BBM on sources that contains precise information on resources. The analysis technique answers the following questions;

- What are the strategic resources?
- How to optimize my outcomes considering my motivation?
- What are the weaknesses and the opportunities among my resources?
- How can I maximize some financial-oriented perspectives? (calculation)

4.3.5. SIMULATION

The other way of using the developed model is to realize simulation[15] on the provided instance of the organization. Generally, models are purposed to simulation, BBM also possess that capacity.

The objective is to optimize the motivation, hence the necessity to improve the non-economic resources. When looking at the model, the improvement comes from causal links emerging from properties which are influenced by decisions. Therefore, to optimize the motivation, it is necessary to optimize the improvement on the causal links till the non-economic resources by selecting the most efficient alternative decisions and by varying efficiently variables (properties) of the problem. By optimizing the improvement, we mean; comparing value indicator on causal link and selecting the one that provides the best end-effect.

The simulation uses principally the select, value indicators and decisions. The idea is to select a set of decisions that are promising. ‘Promising’ means that they are consistent with the environment and that they possibly have a positive effect on the motivation. Afterward, those decisions are modeled into the BBM. They are alternative possibilities, and a choice has to be made. The choice is modeled with the Select concept. Those alternative decisions possess different effects which are schematized with causal links and value indicators. By analyzing causal links and the final expected effect on the motivation, the decision maker can choose one or more decisions which will be applied in effective solutions. Additionally, some modification on value of properties can be made to optimize the outcomes. As an example, the benefit might be higher while increasing the sales volume with lower price tag (a property) than a lower sales volume caused by higher price tag.

The simulation is not fully explored in this research as it relies mainly on the value of properties which are not yet validated in the model.

4.4. DISCUSSION

This section discusses the benefits of the developed methodology. The discussion is led on the benefits for the three models (i*, BMM, e³value) but also on the benefits for the organization itself. A last point discusses the benefits for the alignment.

FOR THE MODELS

The mapping and the translation tables allow having advanced translation. Those translations can be used to analyze models but also to improve them. The BBM also contributes to improve the understanding of some concepts; it deepens the concepts of resources that are used in each model and it makes the connection between decisions, resources and motivation. Finally, it provides different perspectives for a same problem.

An example of improvement is shown in the section 5.

FOR THE ORGANIZATION

The major contribution of the methodology artifacts for the organization lies in the simulation. The simulation is not yet fully exploited but could be developed in an effective way by using calculation (Section 3.4.5) and the scenarios (section 3.3.10). Using the simulation allows optimizing the outcomes of the decision for the motivation.

The analysis technique is also interesting to find weaknesses and opportunities. In addition the analysis of strategic resources is advantageous for the competitiveness.

FOR THE ALIGNMENT

The alignment is directly improved through the described processes. The methodology makes the models more consistent together and allows bridging their ideas. The consistency of models ensures consistent information among layers which are therefore more aligned. Moreover, the adaptation to changing environment as described in 1.2 may be easier when using the methodology, but it has not been validated.

5. SECTION: APPLICATION

5.1. INTRODUCTION

This section provides the instantiation artifacts for the design science methodology. It shows two examples on two different problems with two different approaches. It provides some validations for the Business Behavior Model considering alignment and the instantiation of the developed artifacts (language and methodology) for the design science.

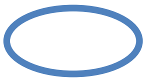
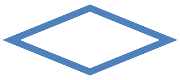
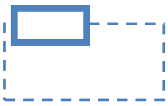
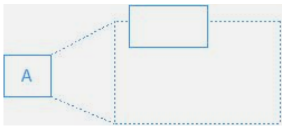
As the BBM is about analyzing resources, the following cases introduce a specific distinction in the type of resources that can be involved. Indeed, some resources are about goods when others are about services. Therefore, testing the model on both kinds of resources is important to verify its capacities to model resources. Hence, the first case is a MMOG case that involves goods and the second is the health care case that involves services.

Each case is ended with a discussion on what we learned from it.

Two different approaches of instantiation are used. For the MMOG case, the bridging process (4.3.2) is used. For the health care case we use the merging process (4.3.3).

For helping the reader, a small summary of the element's syntax is provided in table 13.

TABLE 13 SUMMARY OF SOME ELEMENTS OF THE SYNTAX OF BBM.

<table>
<tr><th>BBM Name</th><th colspan="2">Syntax</th><th colspan="2">BBM Name</th><th>Syntax</th></tr>
<tr><td colspan="3">NODES</td><td colspan="3">LINKS</td></tr>
<tr><td>properties</td><td colspan="2"></td><td colspan="2">Precedence link</td><td>
</td></tr>
<tr><td>Non-economic resource</td><td colspan="2"></td><td colspan="2">Causal link</td><td>
</td></tr>
<tr><td>Economic resource</td><td colspan="2"></td><td colspan="2">Definitional link</td><td>
</td></tr>
<tr><td>Decision</td><td colspan="2"></td><td colspan="2">Creation link</td><td>
</td></tr>
<tr><td>Value indicators</td><td>Strongly positive ++</td><td colspan="2">Positive +</td><td>Negative -</td><td>Strongly negative --</td></tr>
</table>

5.2. CASE ONE: MMOG

For this case, the purpose is to bridge a value model (e³value) with a goal model (i* and BMM). The bridging is realized through the construction of a BBM instance based on the value model. Afterward, the BBM is compared (analysis technique, 4.2.3) with an existing instance of i* in order to improve that last instance. Finally, a BMM instance is derived from the BBM instance – another way of using the bridging process.

As explained, this case is about a product. Therefore, the case is used to validate the capacity of BBM to model problem concerning products.

5.2.1. DESCRIPTION

The following case describes a massive multimedia on-line game (MMOG [16]) provisioning. This case implies exchange of product (the game) and in a lesser extent some exchanges of services (hosting). The figure 41 shows an e³value instance of the case.

The case can be summarized as follows;

A game provided wants to create a new MMO game. Those specifics games require disposing of a hosting capacity to allow players connecting to servers and to join other players. As well, a game must be distributed to customers. The game provider decides to sell the game on a compact disk (CD) format.

The customer is interested in playing MMOG. But in order to play, he must pay a fee for the game subscription and to the internet provider (ISP) to get connected on internet. Additionally, the customer has to buy the game – the CD.

The ISP disposes of hosting capacities and internet accesses that he sells to other actors.

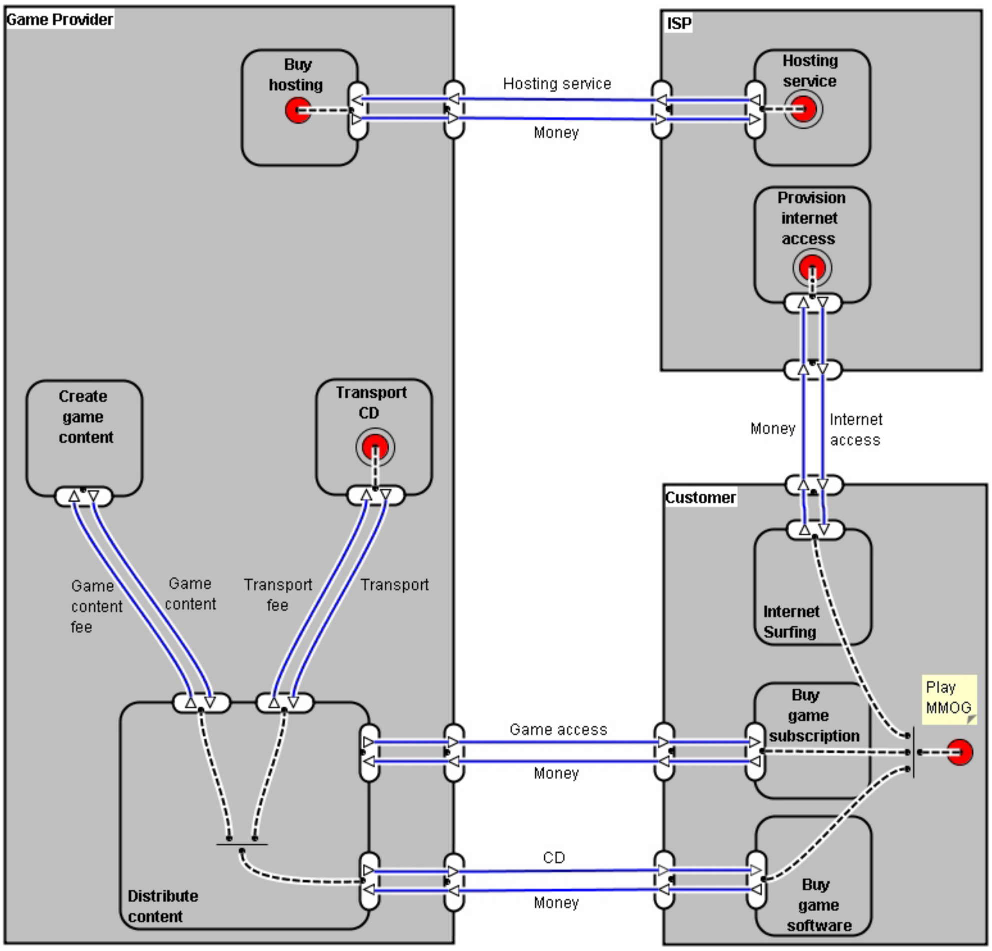


FIGURE 41 E³VALUE MODEL OF THE MMOG FROM [21]

5.2.2. APPLICATION

The first step is to construct the BBM from the e³value instance. The second is to analyze i* and to eventually improve it. Finally, a BMM instance is derived. With that application, we exposed the three techniques; the construction (of BBM), the derivation (of BMM), and the analysis (of i*).

THE CONSTRUCTION OF BBM

By analyzing the e³value instance in figure 41 various elements can be sorted out. The construction of BBM is based on the described process in section 4.2.1.

The e³value instance shows three actors; the game provider, the customer, the ISP provider. Those actors hold some value activities (rounded boxes); Create game content, transport CD… We supposed that the actors made the decision to create each value activity. Therefore, value activities can be transformed into decisions (for BBM) as following;

- Create game content, *he decided to create game content*
- Transport CD, *he decided to transport CD*

The same translation can be applied on every value activities and also on start stimuli. We supposed that the start stimulus - Play MMOG – is something the customer decided; *he initially decided to play MMOG.*

The figure 42 shows the decision graph for the game provider based on the transformation of value activities and start stimulus into decisions. An initial decision has been added to link decision together; 'provide MMOG'. The process is the same for the other actors

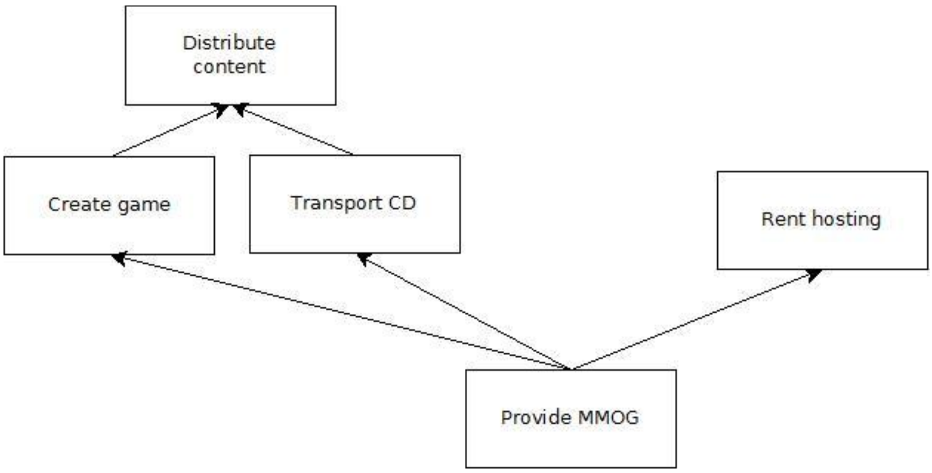


FIGURE 42 DECISION GRAPH FOR THE GAME PROVIDER

The value exchanges in the e³value instance (figure 41) reveal the presence of some resources that are transferred from one actor to another.

- Game provider from/to the ISP provider : hosting service (*hosting*) in exchange of money
- Game provider from/to the Customer: MMOG in exchange of money
- ISP provider from/to the Customer : an Internet access in exchange of money

By combining this information with the decisions the figure 43 is created. The figure represents a partial BBM's perspective of the game provider. The resource 'money' has always the property 'amount'.

The links shown in the figure 43 underline a correlation among those resources; the rent of the Hosting has a negative impact on the amount of money and the selling of the MMOG has a positive impact on that amount.

The hosting renting is related to the MMOG (but the e³value instance does not inform on how). Note that the links are just used for the example and do not have more signification that underlining the presence of relations between resources.

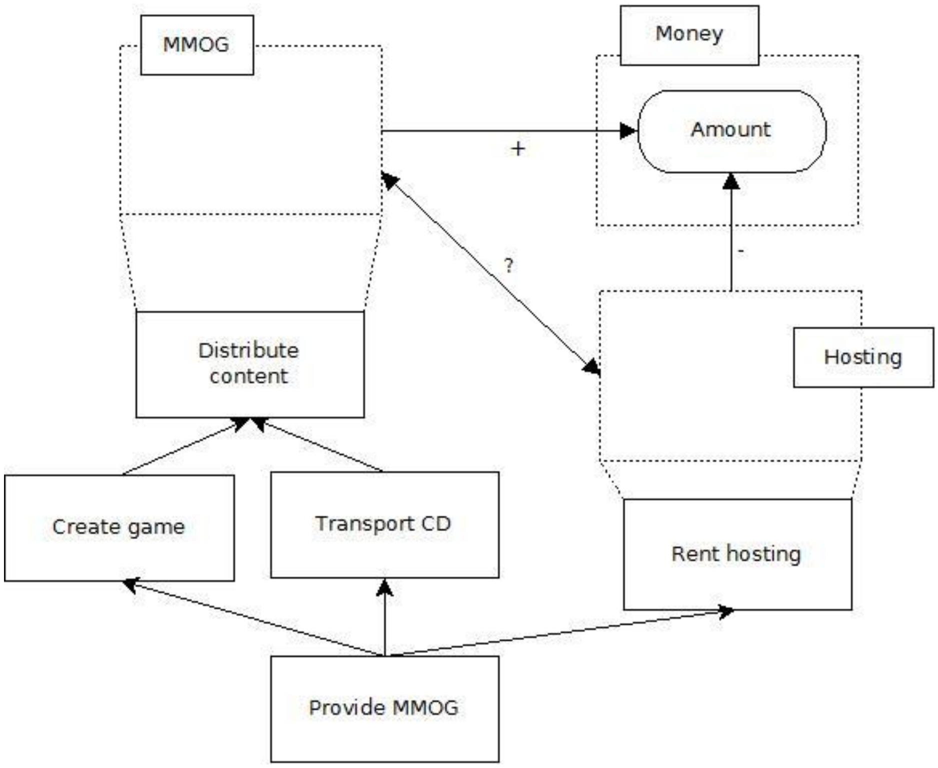


FIGURE 43 RESOURCES AND DECISIONS OF THE GAME PROVIDER WITH RELATIONS AMONG RESOURCES.

The e³value instance does not directly provide any further information. However, the reasons why actors participate in the business (i.e.; the motivations) are findable. We supposed that the customer buys MMOG in order to increase his pleasure. We also supposed that the game provider sells MMOG to improve its investment power. Finally, we supposed that the ISP rents hosting services (internet access included) in order to survive [26].

We have now plausible motivations for the participation in the business and so we can model the non-economic resources as in the figure 44. We can admit easily that the available amount of money (considered in a positive way) has a positive impact on the investment power.

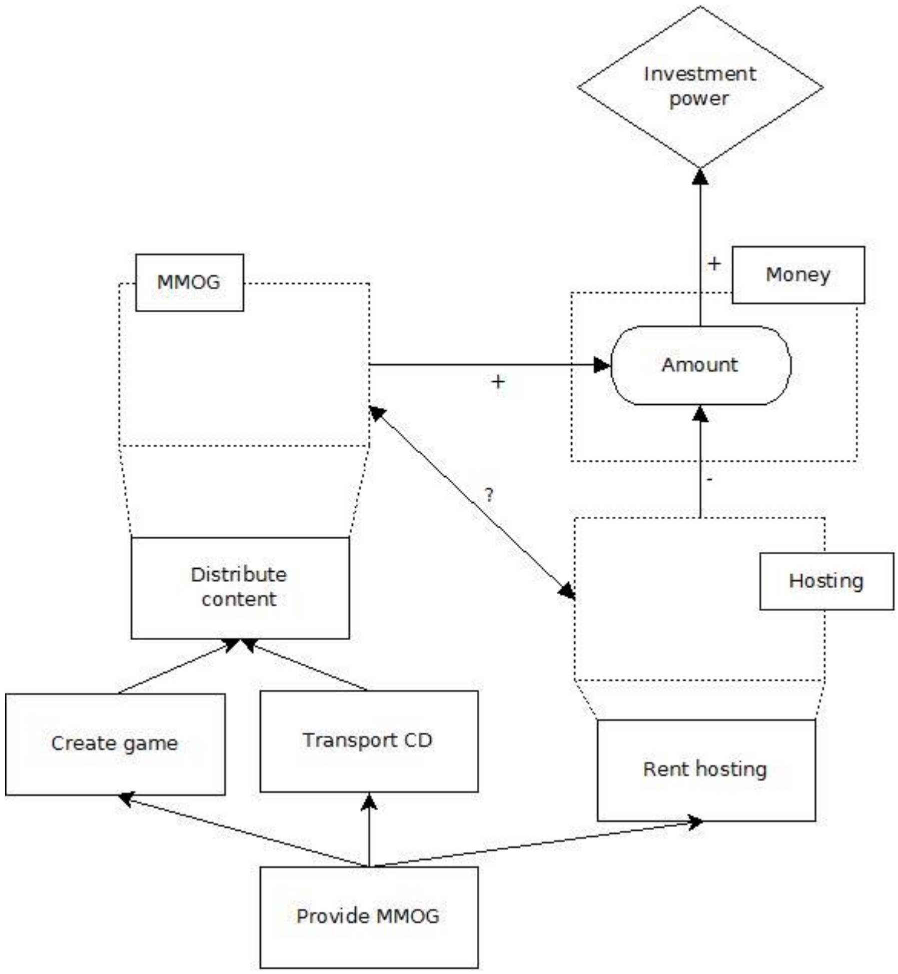


FIGURE 44 THE GAME PROVIDER PERSPECTIVE WITH ITS MOTIVATION

The e³value instance does not inform on any properties. As described in the construction technique for e³value, properties have to be found in other sources (like the problem description). Here is the list of the selected properties for the game provider:

For the MMOG

- *Quality of content*
- *Longevity of the game*
- *Attractiveness*
- *Number of players*
- *Amount of sales*
- *The price*
- *Access cost*
- *Game cost*

For the hosting

- *The capacity*
- *The cost (for the game provider)*
- *The quality*

The next step is to link those properties with causal links and to add the value indicators. The results are observable in figure 45 for the game provide, in figure 46 for the customer, and in figure 47 for the ISP. The game provider instance (figure 45) also presents a categorization of the MMOG resource. For the figure 46 we used the definitional links (empty-ended arrow) to detail decisions.

The following points describe the content of the figure 45, 46 and 47 in more details.

THE GAME PROVIDER PERSPECTIVE (FIGURE 45):

The game provider wants to improve its investment power (its motivation). Therefore, he inquires a new market segment; the MMOG segment – he decides to provide a MMOG. In order to realize the game he must create the game content and decide of the format; a CD (that has to be transported to customers). When the format is decided and the game's content finalized, the game provider can distribute the content (the game). With that last decision, the game provider now possesses a new resource to be distributed; the MMOG.

On the other hand, MMOG are online games that require a permanent hosting on servers. Therefore, the game provider must rent or install hosting services for the customers (the choice is discussed below). When he decided which to choose, the game provider has in his possession an additional economic resource; a hosting service.

The MMOG resource possesses some properties as its price and its attractiveness. The price depends on the cost of the game for the game provider – the cost of the hosting and the cost of the creation of the game (game cost). Note that the price influences badly the expected sales for the game. At the opposite, sales are increased by the attractiveness of the game which depends on the quality of the content and on the number of players (specific to MMO game).

The Hosting also possesses some properties; the effective cost and the quality of the hosting service. Those two properties influence positively the capacity of the hosting – The higher the cost is, the higher the means involved in the resource are (i.e.; a better capacity) and the higher the quality is, the higher the stability of the service is (i.e.; a better capacity). Having a good capacity for the hosting is interesting to increase the number of players that can get connected to the game. Yet a good capacity increases the access cost and therefore, the price of the game.

A positive number of sales increases the money that is earned (the amount). This amount is beneficial for having a better investment power. Additionally, a higher longevity for the game allows pushing away the deadline for creating a new game (to stay present on the market) and therefore, is beneficial for the investment power.

The game provider possesses a choice when deciding whether he wants to install its own hosting or to rent the hosting. This choice has been introduced as an example for the alternative scenarios (and therefore some kind of simulation). The selection of one decision upon another has impact on the final motivation as they influence the cost which is negative for the expected profit but also the attractiveness which is positive for the sales. Note that properties from the Hosting are constraints (non modifiable), the only way to vary them is by the way of the proposed decisions.

When comparing Value Link on both out-causal links from the two alternative decisions:

- They cost the same price; on short term the rent is more advantageous, but on long term, owning is more interesting.
- The quality varies; the renting provides the insurance of experience strengthen by a contract. The installation requires experts that may not be present within the game provider's company, therefore, the quality risks to be lowered.

In this case, the choice is quite easy; the renting seems to be the wisest decision.

The MMOG's properties are sorted out into their respective aspects (categorization). The number of players is an infrastructural aspect as it is connected with the hosting service – a structure related resource. The longevity of the game and its quality are inner properties of the game (Value proposition aspects). The attractiveness regards mainly marketing aspects (customer aspects). The other properties are related to the financial aspect.

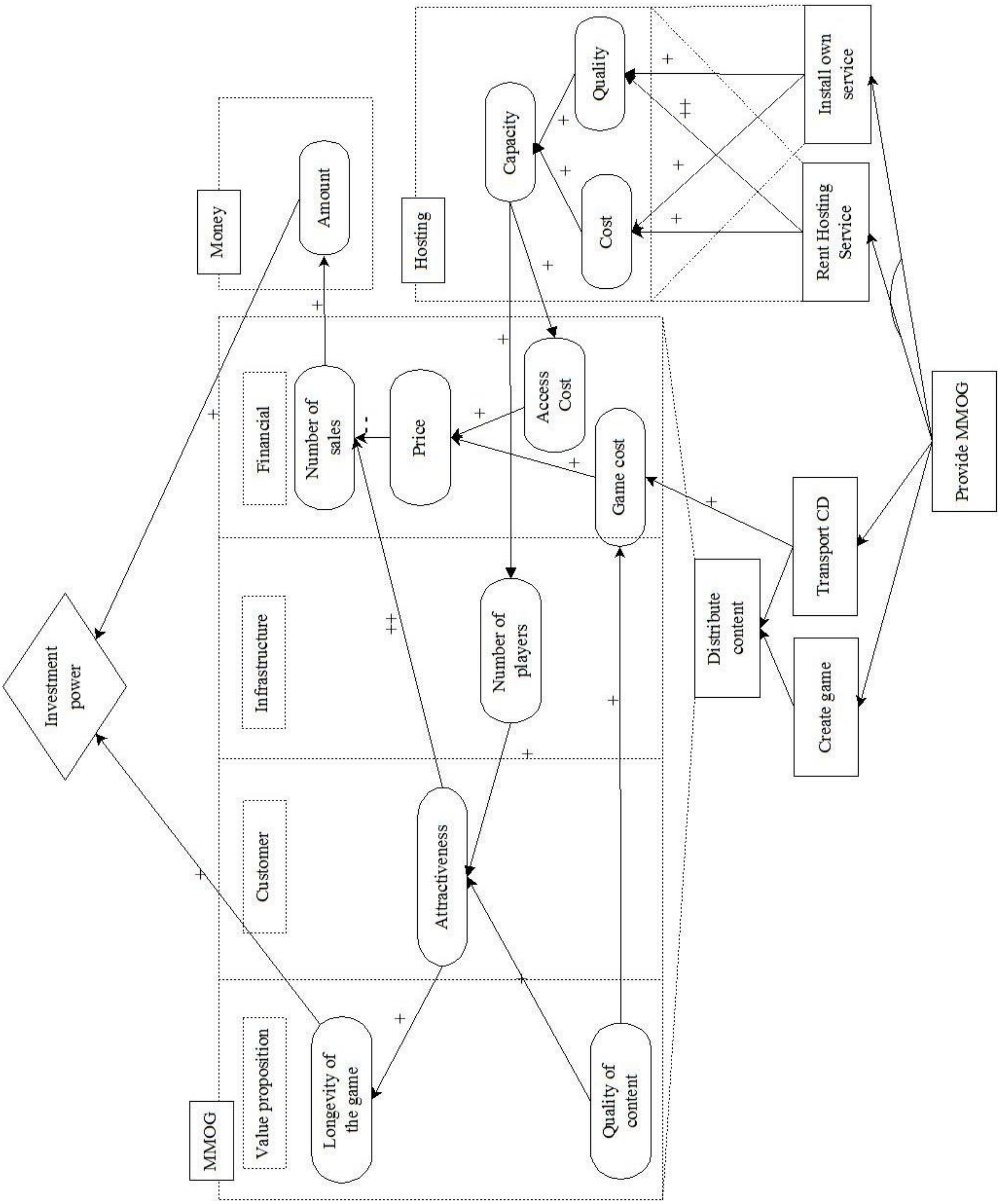


FIGURE 45 THE GAME PROVIDER'S BBM

THE CUSTOMER PERSPECTIVE (FIGURE 46):

The customer wants to increase his pleasure. Therefore, he decides to buy a MMOG (after having decided to play). To buy a MMOG means (definitional links) surfing on internet, buying a game subscription, and buying the game itself. The attractiveness of the game (depending on quality factors and on the number of players) improves the customer pleasure. Yet the customer must possess the money (amount) to buy the game.

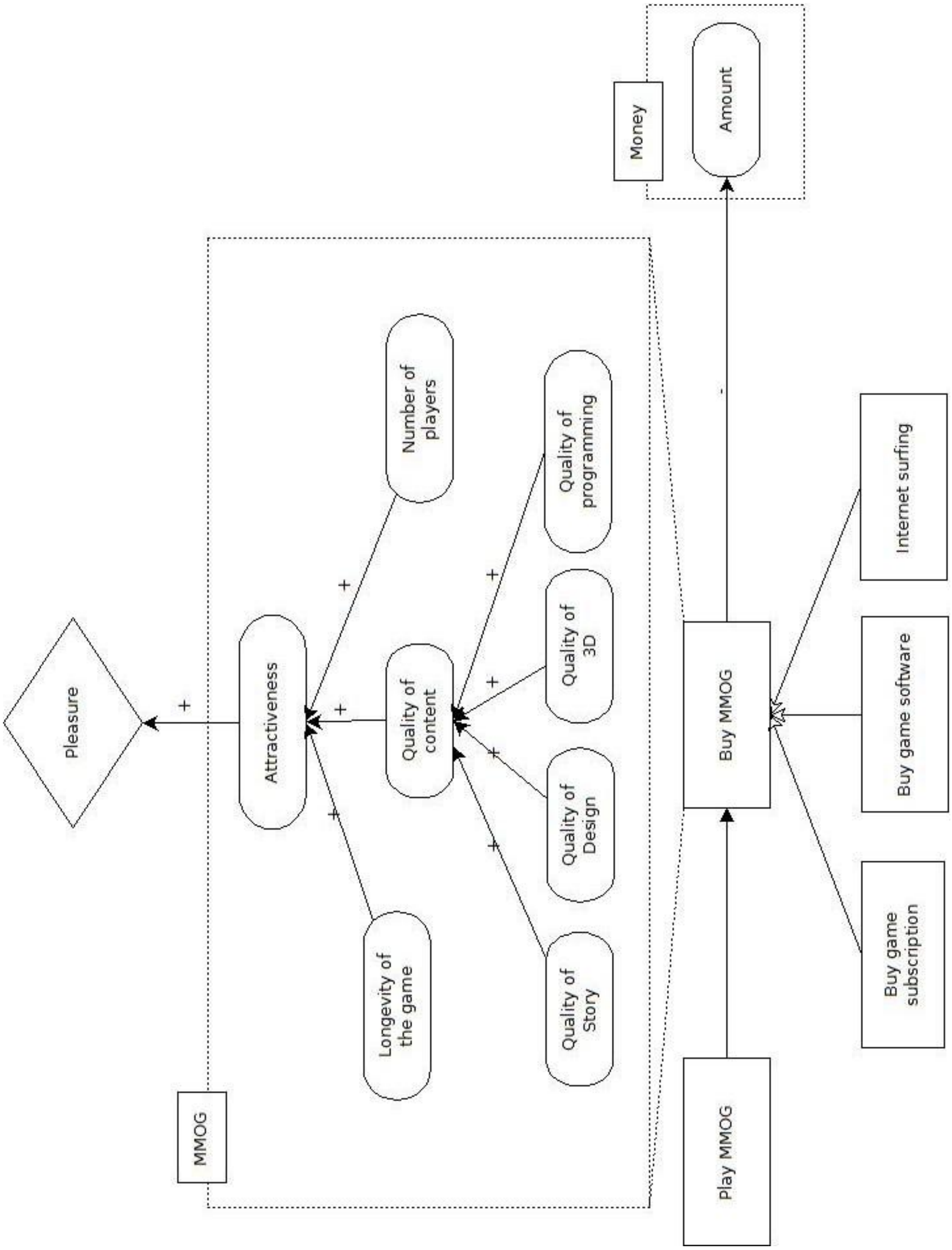


FIGURE 46 THE CUSTOMER'S BBM WITH DEFINITIONAL LINKS

THE ISP PERSPECTIVE (FIGURE 47):

The ISP wants to ensure its survival. He decides to start having hosting structures that he can sell or rent to customers. Afterward, he can decide to provide internet accesses or to offer hosting services. The hosting structure possesses properties as the maintenance which depends on the size of the infrastructure… The more the ISP sells the more he ensures its survival, but the cost of its infrastructure is negative for its purpose; the two factors have to be well balanced.

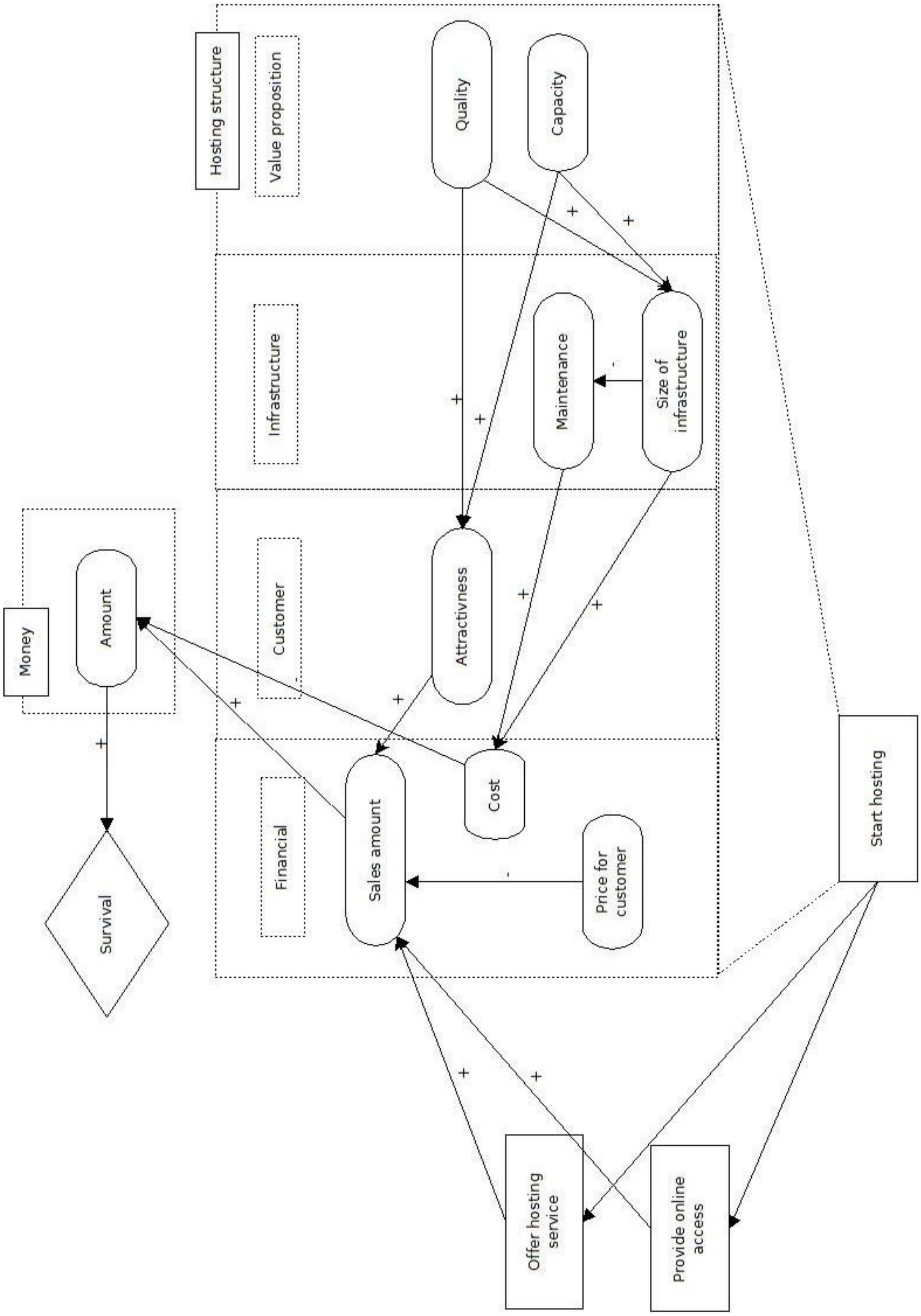


FIGURE 47 THE ISP'S BBM

Bridging the goal model i* with analysis techniques

The second step for bridging layers is to analyze a goal model (i*) and to make it consistent with the BBM instance. To analyze the goal model, we started from an instance of i* for the MMOG problem that has been realized by other authors [21]. The purpose is to evaluate if BBM can bridge (in the sense of the process) the two models (i*, e³value). The technique is described in 4.2.2.

For the comparison, we focus on the game provider perspective.

The i* instance in figure 48 depicts the same problem than the one described for e³value but within a goal perspective. Here is a description of the problem. Note that we do not make the differences between goals and softgoals in the description.

Three actors are involved; the ISP, the game provider, and the customer. The game provider wants to make profit by creating a MMO game. This game has to be sold the customer in exchange of money. Additionally, to play the game online, the customer must pay for a subscription. The game provider has various goals; a scalable infrastructure, low game access, a good longevity of the gameplay, the satisfaction of the client, and a low access cost (a low price for the customer). To achieve those goals, some tasks must be performed; distribute the content of the game, and create the content (with additional subtasks).

The customer has the objective to have fun by playing MMOG (two goals). To achieve those goals, the customer must get a game access, surf on internet (pay for internet access if necessary) and buy the MMOG CD.

The ISP wants to make profit (a goal) by offering hosting service and by providing online access (two tasks).

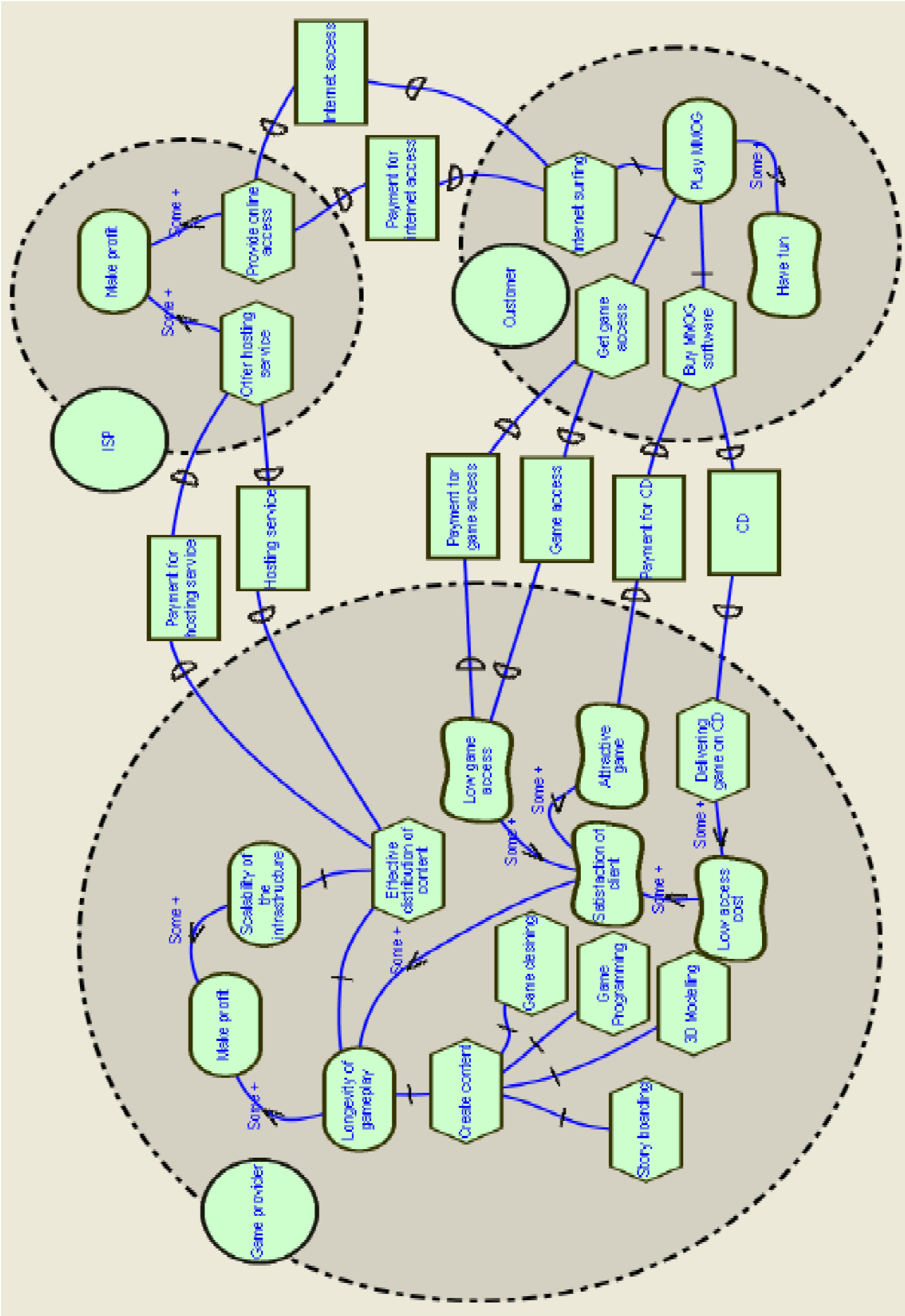


FIGURE 48 INITIAL I* MODEL OF MMOG FROM [21]

When comparing the figure 48 with the figure 45 for the game provider, some differences appear.

The figure 45 has various additional information (within properties) concerning; the number of sales that is positive for the amount of money, the quality of the game and the price. Having the price modeled is important as it is a major factor for the earned profit. Having a good quality game should be a goal that motivates the creation of the content. The quality also influences the satisfaction of the client. Modeling the sales is an important goal as it influences directly the profit.

At the opposite the figure 48 has a goal about the scalability of the infrastructure (which is not present at all in figure 45) and a goal about the satisfaction of the client (present in the customer instance).

Thank to the analysis techniques some other improvement are made. The analysis technique for i* propose to analyze i* on conflicting and synergic relation (*Discovering of conflicts and synergies)* and on the goal fulfillment (*Analysis of goals fulfillment)*. Thank to the synergy of BBM (figure 45), some relations were indeed added. The game content is related to its cost (for the development), but the figure 48 does not express that relation. Having a low price is conflicting with the goal of making profit. But having high price is conflicting with the satisfaction of the client. Concerning the analysis of goals fulfillment, we added some means-end links in the goal model to model the decisions that were observed through value activities. Moreover, a task has been added; rent a hosting service. This task, with its means-end links attached to the low game access, comes from the decision to 'rent hosting service'.

The figure 49 is the improved version of the i* instance in figure 48. The improvements concern the information that have been added; some goals (the price, the quality of the game, and the number of sales), the means-end links, and the relations. The added goals and the added tasks are emphasized in the figure 49 thank to colored boxes

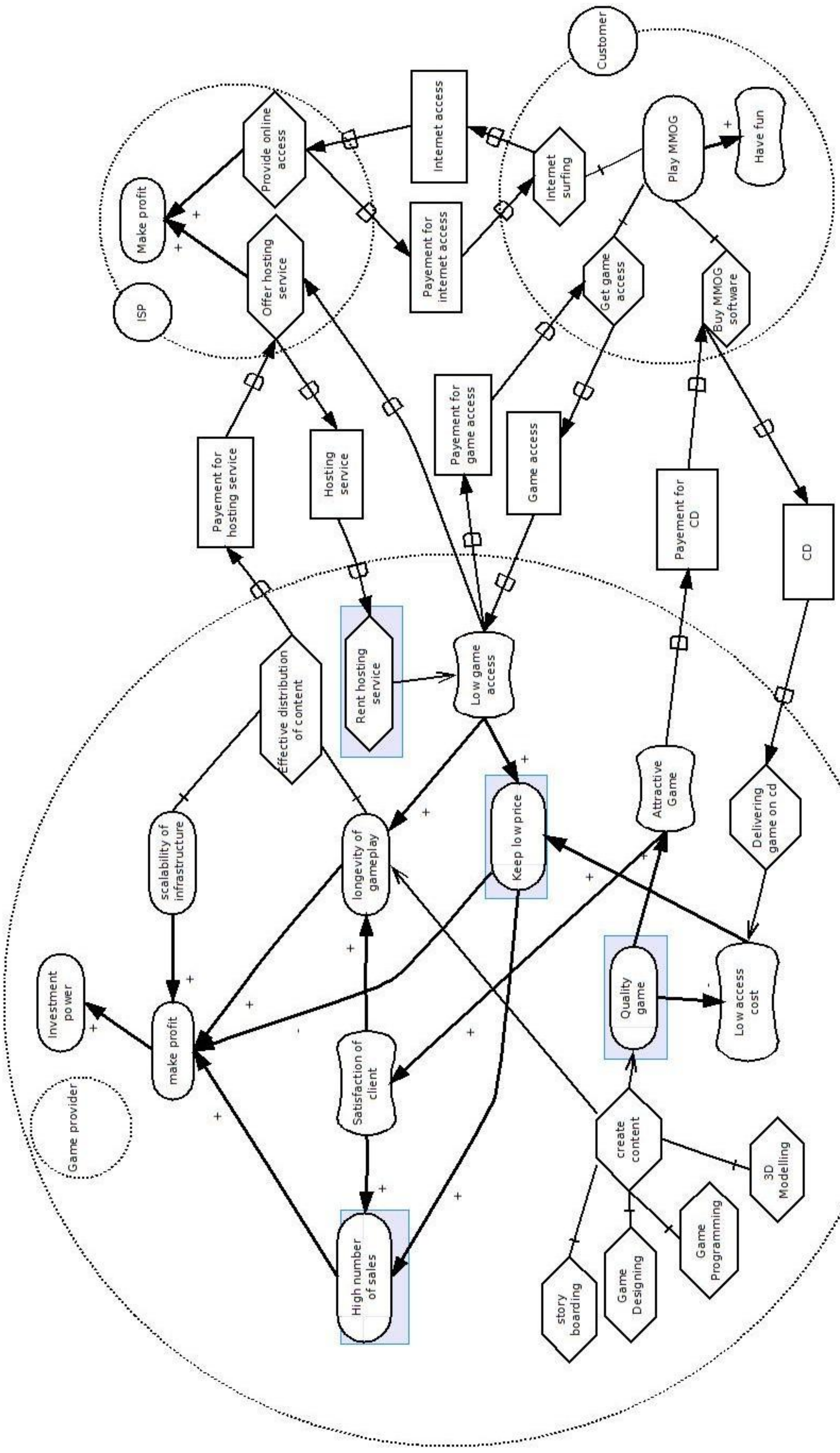


FIGURE 49 I* IMPROVED BY THE BBM ANALYSIS

DERIVING BMM;

The syntax that is used for this example is the one described in the state of art.

The business behavior model clears the way through a business motivation model. This is the content of the figure 50. It shows a BMM instance for the game provider derived from the BBM instance as explained in section 4.2.3.

For reminder; properties are transformed into goals and objectives, and decisions into means. We transformed the hosting resources into influencer. It has been used to emphasize the fact that the hosting resource belongs to another actor (the ISP) and therefore is acting as a constraint for the game provider.

End	**Means**	**Influencer**
Vision • the investment power *Goal* • Increase the wealth – the amount of money • Keep high number of sales • Have an attractive game • High longevity for the game *Objective:* • High number of accesses • Keep low price • Low game cost • Low access cost • Get attractive game	• Get a hosting service • Create the game • Transport the CD • Provide MMOG	• High quality hosting • Low cost hosting • High capacity hosting

The repartition of properties into the goals, or the objectives has been done depending on the level of the properties in the resource. By the level we mean; the closest is the property to the motivation the highest is its level. Low level properties are therefore transformed into objectives and high level properties into goals.

Note that the figure 50 has doted arrows. It has been used to emphasize negative relation instead of using the assessments from BMM.

The doted arrows are used in the three cases;

- The low cost hosting is negative for having a high capacity hosting.
- The objective to obtain a high quality game is conflicting with the desire to have a low game cost
- The low price is conflicting with the goal of increasing the wealth.

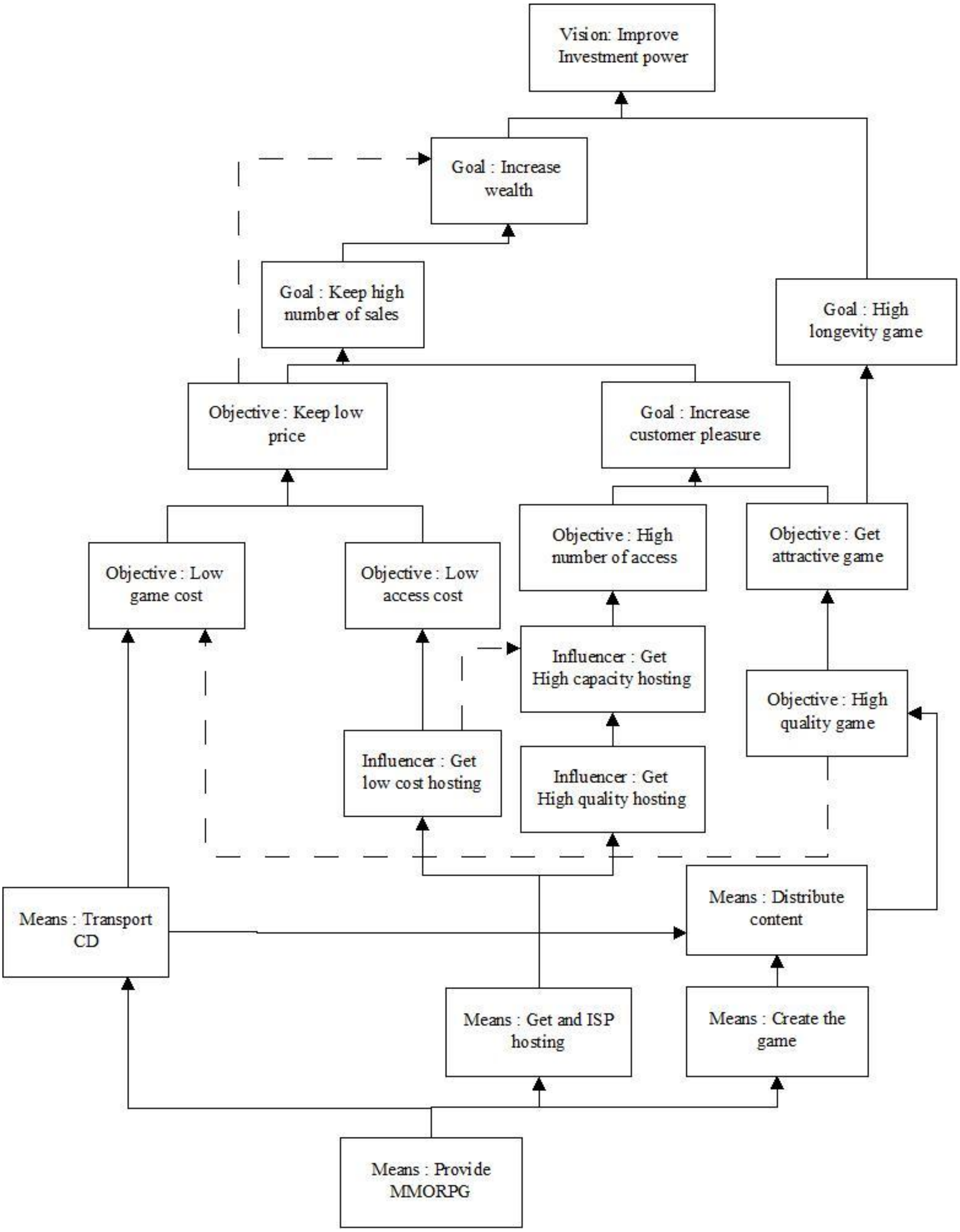


FIGURE 50 BMM INSTANCE OF THE MMOG CASE WITH NEGATIVE RELATIONS (DOTED ARROWS)

5.2.3. DISCUSSION

For this case we have used the bridging process with e³value as a input for constructing instances of BBM. The bridge has been realized with the goal models i* and BMM. For i* we used analysis techniques to improve an existing instance of the problem. For BMM we used the derivation technique to obtain a BMM instance.

This case shows some interesting pros for BBM; The BBM can be used to model problems involving goods. BBM provides a compact view on various elements of the problem thank to the categorization. The model can partially (it still requires calculation) be used for decision making through the simulation (alternative scenarios). Additionally, the described techniques (section 4.2) are applicable and the bridging process is promising;

- Models can be improved through the usage of BBM (figure 49) – the analysis.
- Models can be derived from BBM (figure 50) – the derivation.
- BBM can be constructed from other models (e³value) – the construction.

Concerning the bridging process; it has provide the expected improvement on the i* instance. We can admit that the two models were not consistent and that the bridging process has improved the consistency among the models from different layers and therefore among the two layers.

The first time the BBM has been used on this case, many improvements have been made on the language. The point was to improve the readability of the model. Therefore, we decided to integrate the categorization. Moreover, the case is about the creation of a new resource (MMOG), the creation link itself was not present in the earliest version of BBM; it has been integrated a-posteriori.

5.3. CASE 2: THE HEALTH CARE

The purpose of this case is mainly to evaluate the capacity of BBM to model complex system and to evaluate the merging process on languages that have not been studied.

This health care case is interesting for many reasons. The first reason is that the health care case is involving complex multi-actors dependencies with various exchanges of information and resources. It imposes the modeler to work with a complex system of data that is a real challenge. The second point is that the health care involves service problems with various non-economic resources (health, feeling of safety); services are not products and may be more difficult to model than goods. A third interesting point is that the problem description includes some goal and value models with a language that have not been analyzed in the state of art. Therefore, succeeding in integrating elements from those models into the BBM instances would emphasizes the capacity of BBM to get adapted to other kind of model (one of the aimed objectives). A subsequent purpose lies in finding limitation of the BBM.

The applied merging process (4.3.3) uses the construction technique (Section 4.2.1) based on a problem description and on a value model (figure 51). Afterward, some improvements are made thank to a goal model (figure 52). The two models hold a specific formalism that has not been studied in the state of art.

5.3.1. DESCRIPTION

The problem description comes from the paper “Value and goal modeling in healthcare” [43]. The paper is based on a research led by the REferral Management and Support (REMS) project.

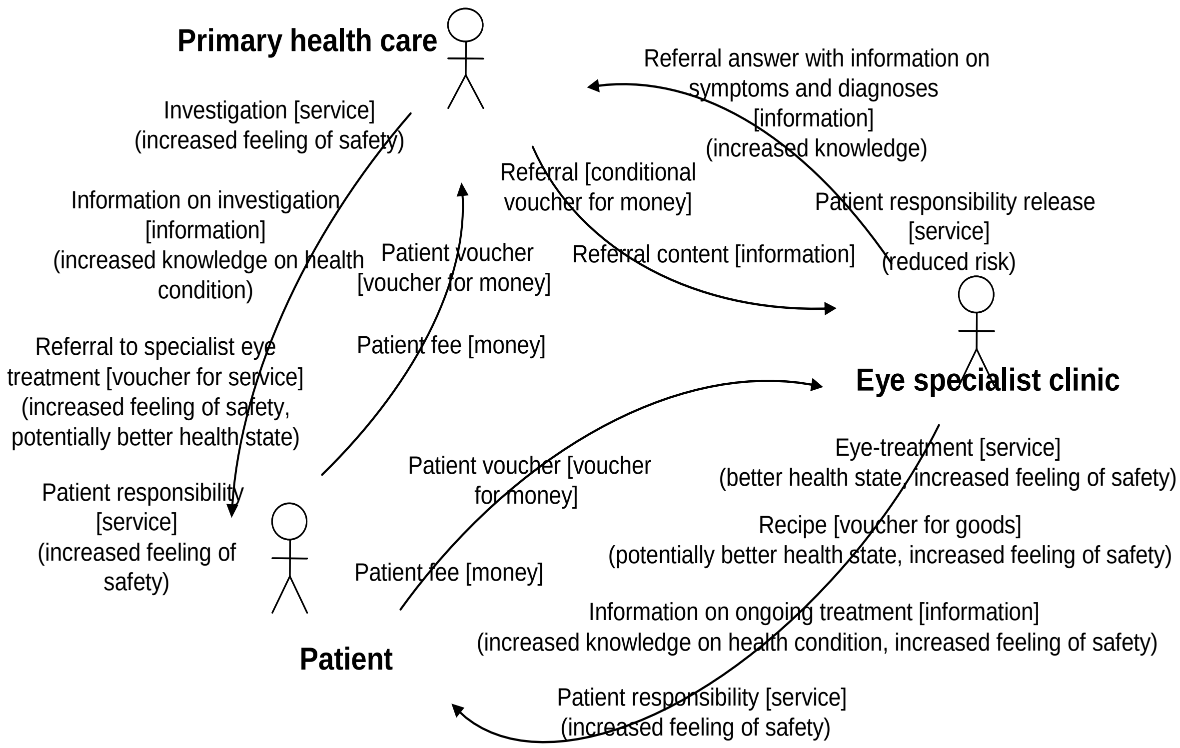


FIGURE 51 AN EXCERPT OF A VALUE MODEL DEFINED IN THE SCOPE OF THE REMS PROJECT FROM [43]

The case involves three actors; a specialized clinic (eye specialist), a hospital (primary health care) and a patient. The patient wants to receive treatment for his eyes; hence two choices are available; going to the hospital or to the clinic. In this case, the patient always went first to the hospital to receive a voucher for further reimbursement. When the patient arrives in the hospital, he firstly gets a health exam. Then, depending on the results (the knowledge on the health condition), he can go to the specialist or stay in the hospital. The decision depends on psychological aspects (feeling of safety), on the expected quality of treatment and on the cost. Other aspects are involved like the responsibility of the healer. The full case description is available in appendix III.

The figure 51 shows the necessary step-by-step operations between two actors at a time. It also includes clues for the decision making (in a rational agent perspective) of the patient (feeling of safety, knowledge on health…). This figure is a complement for the problem description.

5.3.2. APPLICATION

The full problem description (appendix III) has been analyzed to find out relevant elements as described in the section 4.2.1. The principal elements in the problem description are directly colored in the text depending on their natures (see the attached legend).

The problem involves three actors; the customer, the primary health care (or hospital), and the eye care specialist. Those actors possess resources.

RESOURCES

The customer's resources: As well, the customer possesses some money that he wants to spend in the treatment. When the customer firstly goes to the primary health care, he receives a diagnosis (a resource that provides information on his status and his symptoms). Afterward, he receives a treatment (a resource) from the hospital or from the specialist. If the customer decided to get a treatment from a specialist, he receives a referral with information on different specialists. He also receives a voucher for reimbursements and for medicines if necessary; two more resources. Finally, if the customer needs medicines and bought them, he gets a last resource; medicines. That was economic resources. Now the customer also holds on non-economic resources; its health condition and its feeling of safety.

The primary health care's resources: The economic resources of the hospital are; a service, a treatment, a diagnosis for the customers, referrals for specialists, vouchers for reimbursements, and money. The hospital also receives a referral from specialists that took care of customers. This referral contents information on the provided treatment. The non-economic resources are his global knowledge and some finance-related missions (which are not described in the problem description). The first non-economic resource comes from mailing with the author of the paper.

Eye care specialist's resources: Economic resources are the service, the referrals from hospital that content information on customer's diagnosis, the referral answers to be sent to the hospital, vouchers for reimbursements, and money. His mission is not detailed, but it must be financial-related.

Missions of actors are related to their non-economic resource improvement. Their decisions have still to be detailed.

DECISIONS

Decisions for Customer: The customer must first decide to go to the hospital to have exams (in order to have a diagnosis). Then he must decide to go to the specialist to get an advanced treatment or (exclusive) to stay in the hospital to follow a 'normal' treatment. Finally, the customer has to decide to buy or not medicines for its treatment.

Decisions for Primary Health Care: The hospital starts to investigate (makes a diagnosis) the patient and then can propose the customer to follow an advanced treatment (by providing a referral for a specialist) or (exclusive) to follow a treatment in the hospital.

Decisions for Eye Care Specialist: The specialist has the decision to start the treatment.

PROPERTIES

Some properties have been added in order to provide a consistent view of the problem. Those properties do not change the understanding of the problem. Here is the list of the added properties:

For the Customer; For the resource 'Treatment', we added; the quality, the cost of the treatment, and the effect (the real effect of the treatment). For the resource 'Medicine', we added; the price and the effect.

For the Primary Health Care and the Specialist; Concerning the treatment we added the requested price and the cost.

Moreover, the resource 'Voucher for reimbursement' has the property 'reimbursement' that estimates the expectable reimbursement.

EXTENDED MODELS WITH GOALS INFORMATION

The paper [43] also contents a goal model (figure 52) and a table (table 14) that add some information to the problem description (Resource Enhancer Guideline Section from [43]).

The value Enhancers and the High Level Goals layers from the figure 23 have been integrated in a BBM instance. This additional information provides refined properties for the Eye Care Specialist that is included in the figure 56. The purpose is of course to merge the Value Model (figure 22) and the Goal Model (figure 23) into one model; a BBM instance. We also added the reputation (which is influenced by the added properties).

TABLE 14 A LIST OF GOALS FOR DIFFERENT CATEGORIES OF ECONOMIC RESOURCES AS WELL AS THE DELIVERY [43].

	Delivery of resource	***Resource***
Fast	•The delivery of the *information/goods/money/voucher* to the recipient shall be fast. •The delivery, i.e. the waiting time for the *service* shall be short.	•The enactment time of the *service* shall be short. •N/A for *information/goods/money/voucher.*
High quality	•The delivery of the *information/goods/money/voucher/ service* shall be reliable, i.e. the goods/information/money/voucher /service will always reach the recipient and the recipient will always be informed about delays.	•The *information* shall be correct, relevant, and up-to-date, and/or according to specifications. •The *goods* shall be fit for their use, and/or according to specifications. •The *service* shall be enacted fit for use and/or according to specifications. •N/A for *money/voucher*.
Flexible	•The delivery of the *information* shall be customizable, i.e. information shall be delivered in different forms, e.g. paper, digital file sent via Internet or digital file on CD sent via ordinary post. Further, the presentation of the information shall be adapted to the needs of the recipient. •The delivery of the *goods/voucher* to the recipient shall be customizable, i.e. different forms of delivery shall be provided, e.g. home delivery, delivery to the nearest post office. •The delivery of the *money* can be in form of cash, a check, or sent to an account. Further, the cash can also be delivered in different currencies. •The delivery of the *service* to the recipient shall be customizable in space and time, i.e. different forms of delivery shall be provided, e.g. heath care services at home, at health care units close to home, as well as the waiting time shall be adaptable depending on needs and demand.	•The i*nformation* shall be customizable to the needs of the recipient, e.g. an XML file will be more customizable than HTML (since the XML schemas can be changed). •The *goods* shall be customizable to the needs of the recipient, e.g. a chair is adjustable to fit the user. •The enactment of the *service* shall be customizable to the recipient. •N/A for *money and voucher*, but a voucher can have many different forms, such as a ticket or just information on a paper at the people that are responsible for exchanging the voucher for money or services.
Low cost	•The delivery of the *information/goods/money/voucher/service* shall be provided at a low cost.	•The *information/goods/service* shall be provided at a low cost. •N/A for *money and voucher.*
Secure	•The delivery of the *information/goods/money/voucher/service* shall be provided with high confidentiality, high integrity, and accountability.	•The *goods* shall be safe in intended as well as unintended use. •N/A for i*nformation, money and voucher and services.*

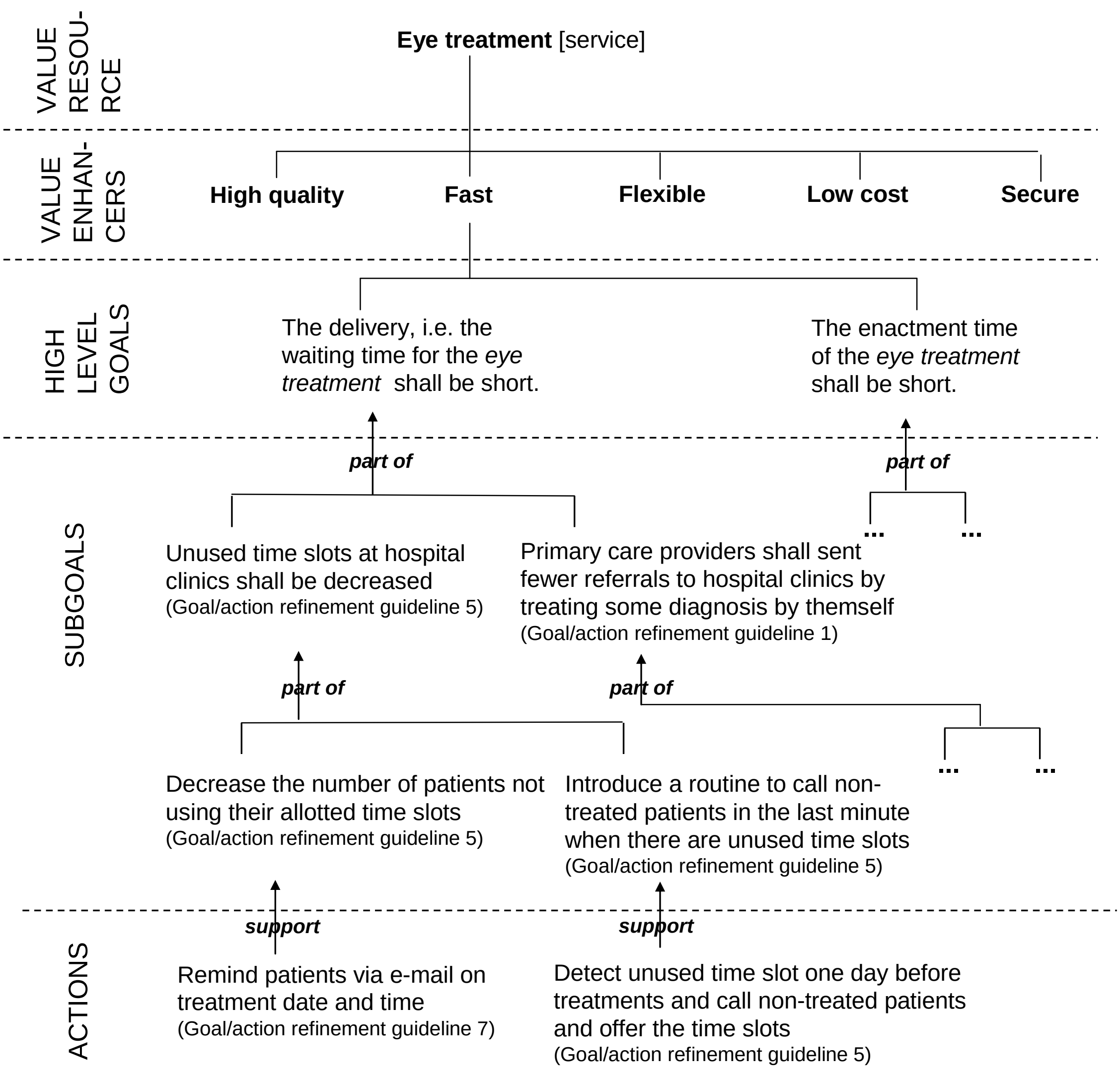


FIGURE 52 GOAL MODEL BASED ON RESOURCE ENHANCER GUIDELINES [43]

BBM INSTANCES AND THEIR DESCRIPTION

This point provides the instance of BBM for every concerned actors plus an additional instance that contents information from the figure 52 and the table 14. Some modeling choices are also described in this point.

The customer (figure 53)

The customer can chose between the specialist and the primary. However, the primary provides a less advanced treatment (quality) as he is not specialized. The quality of the treatment is influenced by the specialist treatment or by the primary treatment (not both). The necessary treatment is influenced by the diagnosis or by the referral depending on the provider of the treatment (referral for the specialist, diagnosis for the primary). The guarantee is a positive property that belongs to the fact that the provider of the treatment is responsible for the customer health. For the customer, the reimbursement depends on the cost of the treatment. As well the reimbursement is beneficial for the amount of money.

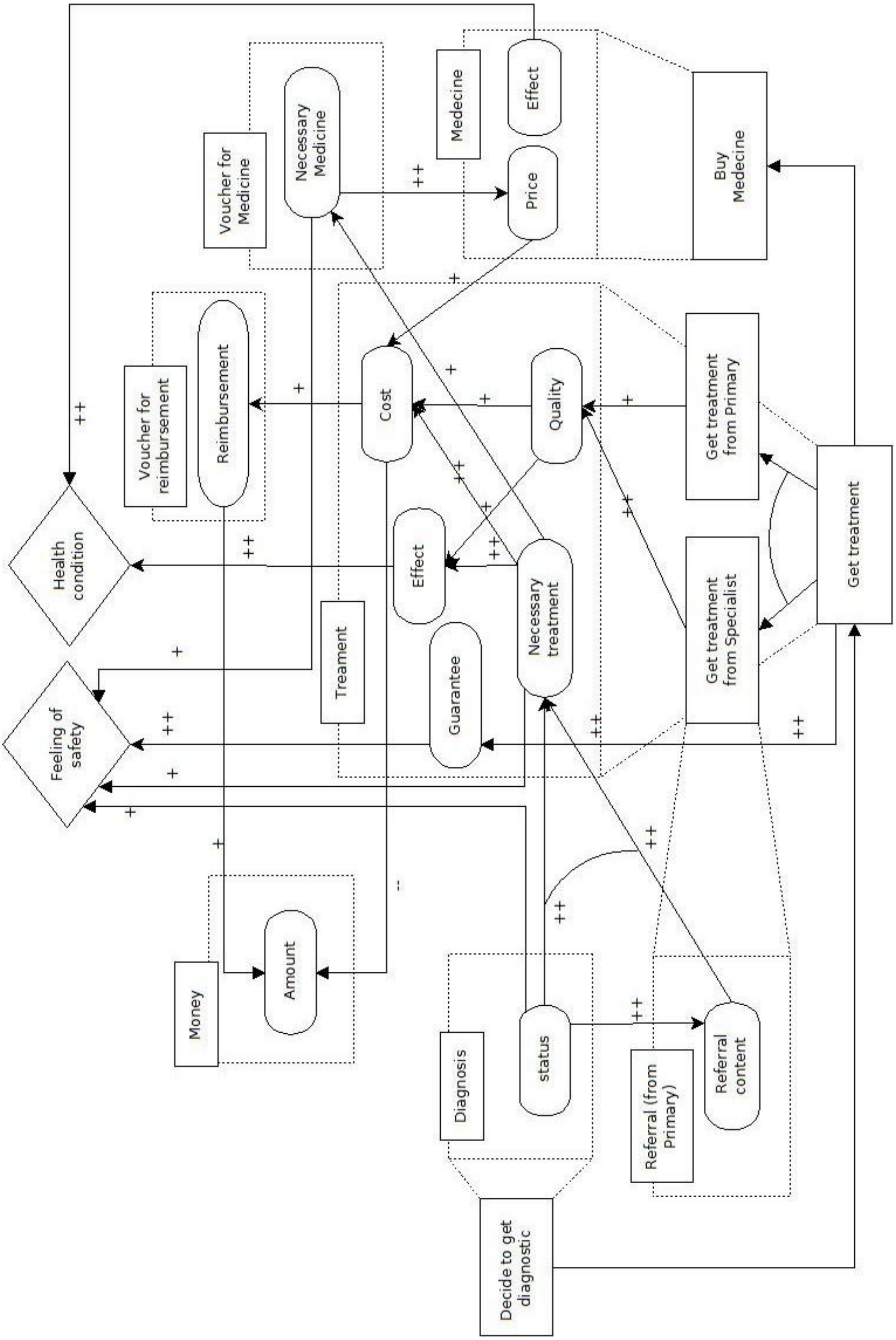


FIGURE 53 BBM OF THE CUSTOMER VIEW

The primary health care (figure 54)

We observed that when a customer gets a treatment at the hospital, three major resources are involved; the diagnosis to evaluate the status of the customer, the treatment itself with some necessary treatment, and the service provide by the hospital. The cost of the diagnosis is fixed, only the decision of having a diagnosis increase the price of the hospital’s service. However, the price of the treatment depends on the necessary treatment that is provided to the customer.

If the Primary decides to provide a referral, it will decrease its responsibility toward the customer. Note that a service has still been provided (the diagnosis) with a cost; the hospital has to be reimbursed by the voucher system for that diagnosis. If the Primary decides otherwise, it increases its responsibility.

We argue that the mission (which is not explicit in [43]) is at least financial-related (money).

The reimbursement system is influenced by the provided treatment and by the cost of this treatment. The reimbursement influences directly the amount of money reimbursed.

Having responsibilities increases the cost as the hospital must be covered by insurance.

The information is a qualitative property. The more information is available the better it is.

The patient status is a property that scales the level of health of the patient. The more the level is higher, the more the patient is sick.

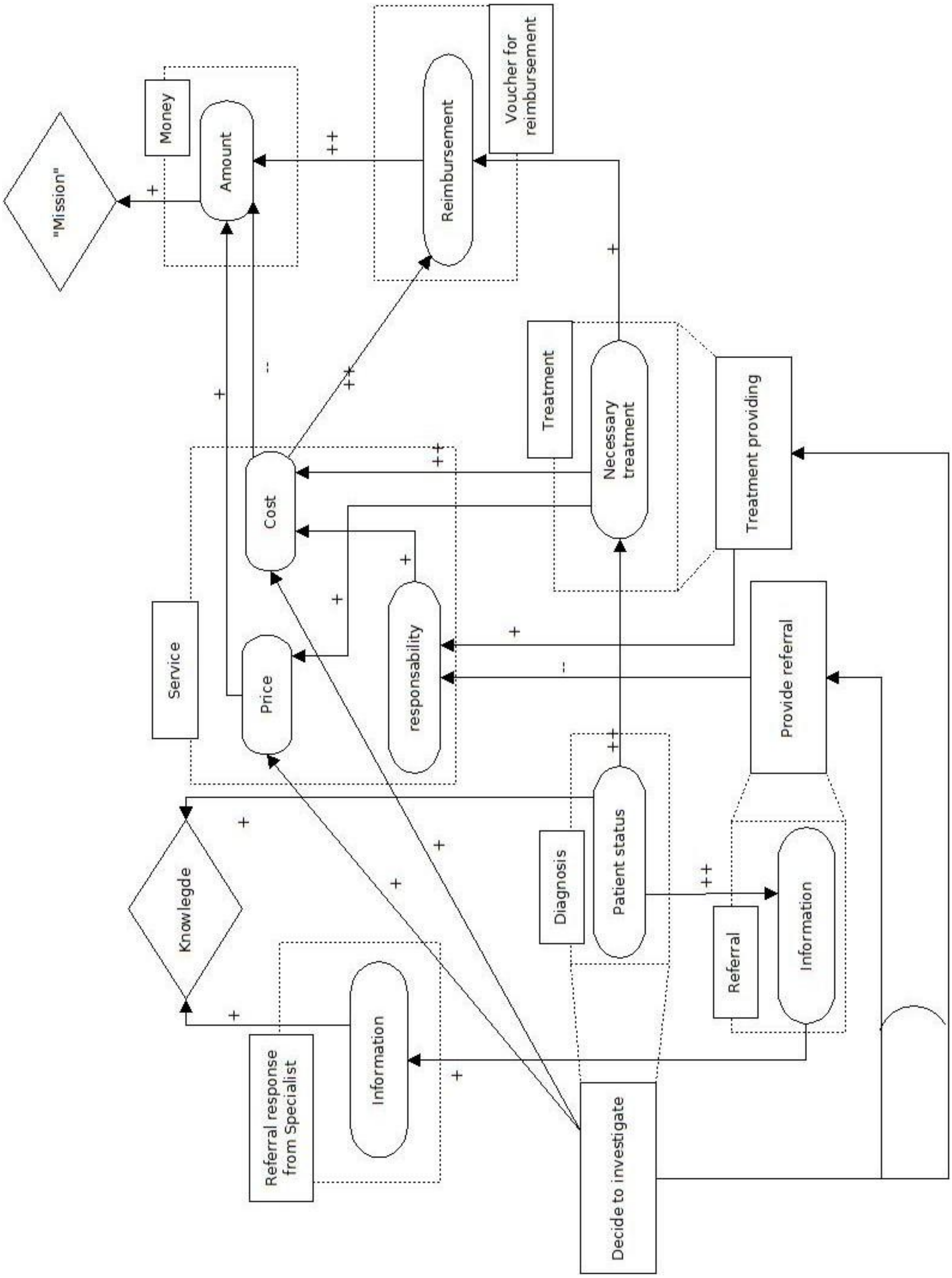


FIGURE 54 BBM OF THE PRIMARY HEALTH CARE VIEW

The specialist (figure 55)

The voucher system for reimbursement works like the one for the Primary. The only exception is that the referral also works as an influencer for the reimbursement. As for the Primary, the mission is supported by money. The treatment serves to make the description of the referral response. Having responsibilities increases the cost as the hospital that must be covered by insurance.

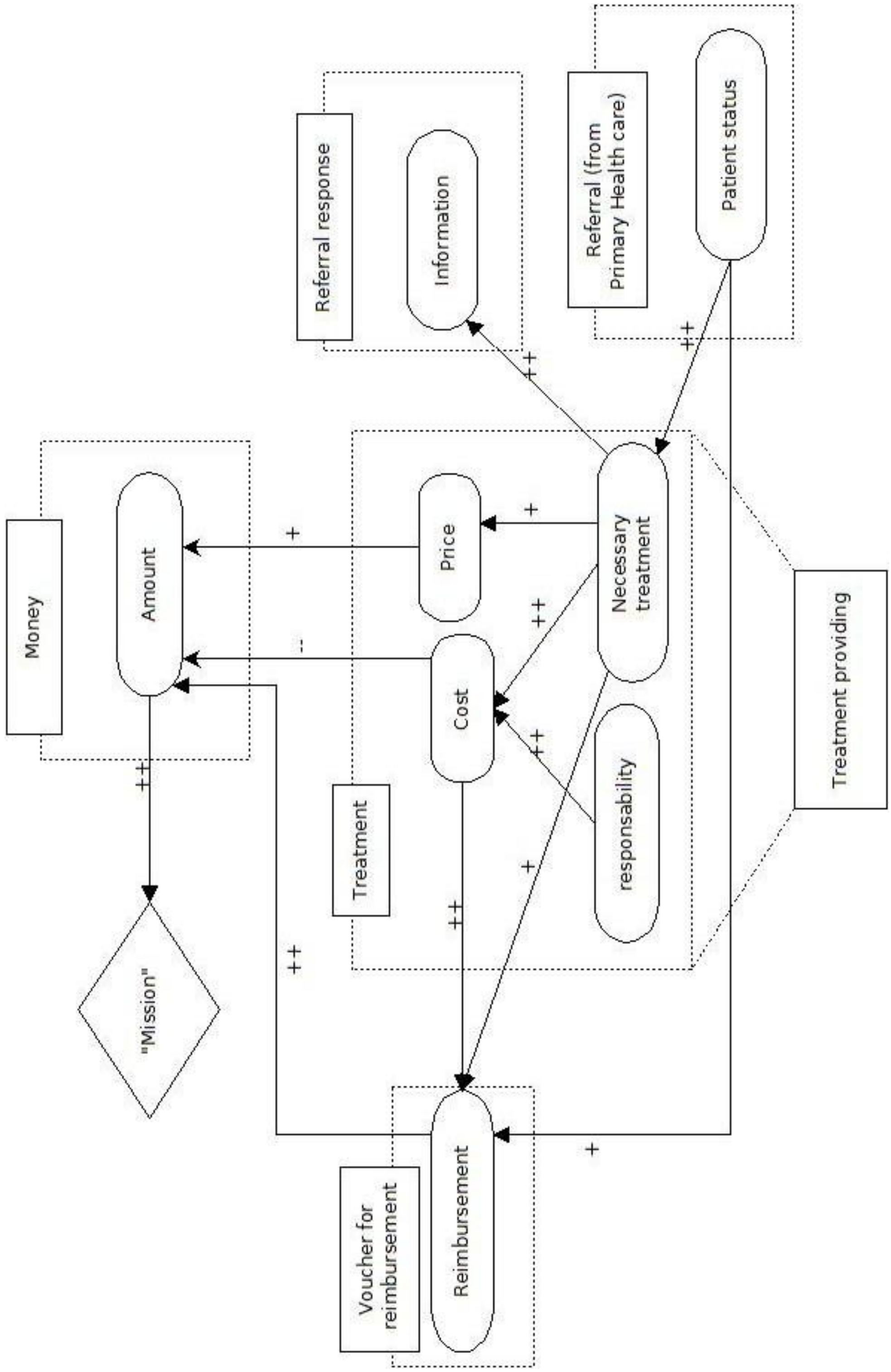


FIGURE 55 BBM OF THE SPECIALIST VIEW

The specialist extended with goal data (figure 56)

A categorization is used to sort out properties in a more readable way. We also argue that the effect of the treatment influences the reputation of the Specialist and so helps to the achievement of the mission (related to the reputation). For this example we have use a simplification to make the instance more readable. The “Information on provided service” should be an economic resource that concerns administrative data, but instead we used a property. The property’s scale works as follow; the better the information is, the better is the value held by the property.

The properties ‘secure’ and ‘flexibility’ concern information issues for the customer, therefore, they attached to the information on the provided service.

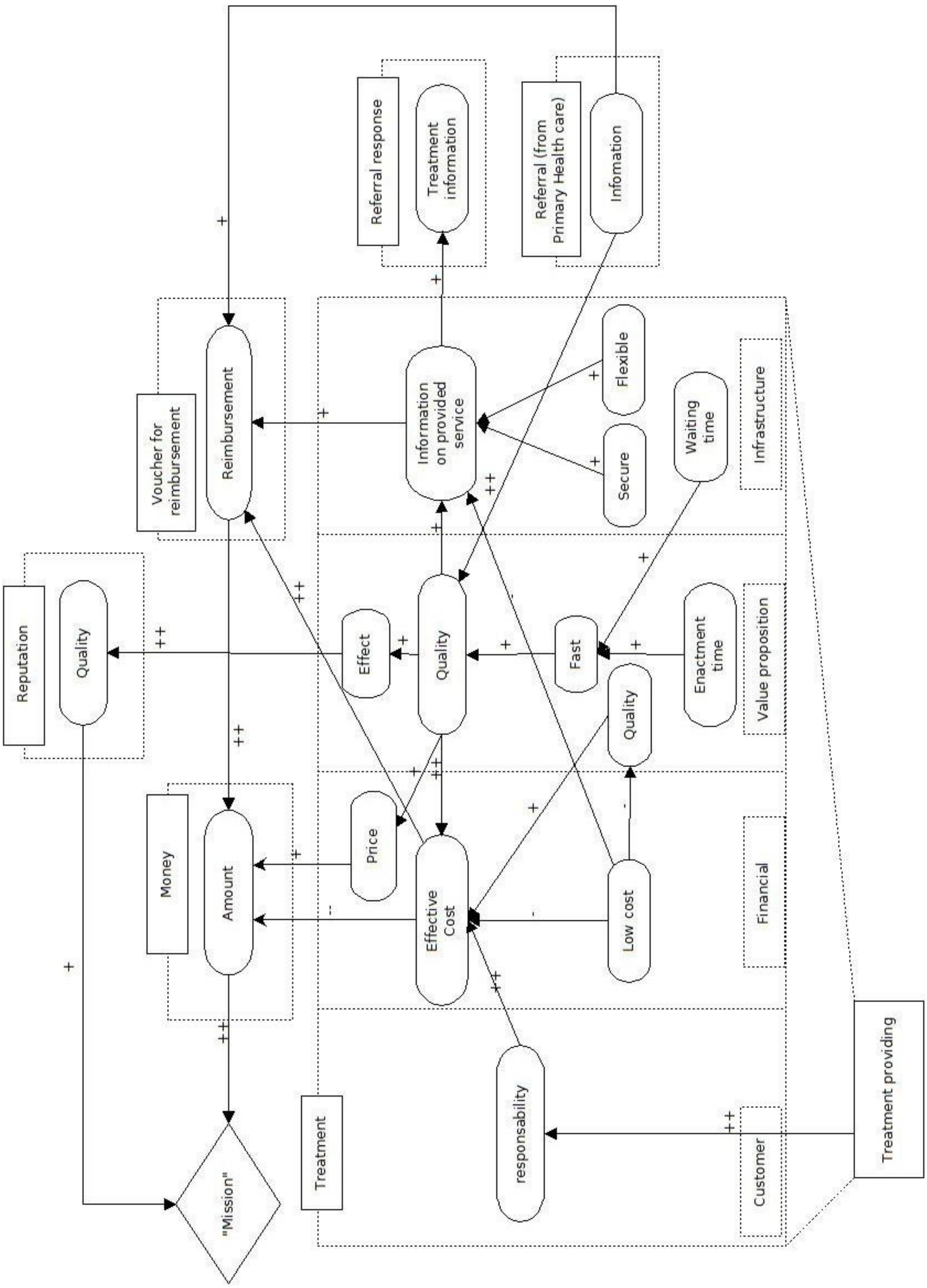


FIGURE 56 BBM OF THE SPECIALIST VIEW WITH EXTENDED PROPERTIES FROM GOAL MODEL

We recommend the reader of those instances to re-transform them into a text starting from the initial decision. As an example for the customer (figure 53);

The customer decides to make a diagnosis. He so receives information on his status by the way of the diagnosis. The customer can now decide to receive a treatment from a specialist or from the primary health care. If he decides to get a treatment from the Specialist he will get a referral with information on the specialist….

It gives the evidence that instantiation are completed and detailed. It is also interesting to deeper the understanding of those instances.

5.3.3. DISCUSSION

The purpose was to use the merging process. The case reveals that it is applicable on different languages and that it provides a quite complete view (regarding the problem description) of the system.

The health care example is a complex case that reveals some limits in the Business Behavior language;

There are elements that are not modelable with the BBM. These elements concern the realized choices in the feasible relation among nodes (described in the meta-model figure 29).

- Decisions can not directly influence the motivation (the non-economic resource). Yet the text underlines some direct effect of decision on the motivation. For example, the feeling of safety of the customer (a motivation) is improved when he decided to receive a treatment.
- Properties cannot influence decision, but in some case it should be possible; the information of the diagnosis should influence the decision of getting an advanced treatment. In the figure 54 we linked the diagnosis with another property; "the necessary treatment". It has not the same meaning but it emphasizes the same idea.

The provided instances of BBM could have been simpler with a lowered level of details. Indeed the BBM can be leveled on the amount of details by making abstraction of certain information that are less relevant (properties, decisions) or by transforming some resources into properties. The differences between the figure 55 and the figure 56 highlight this possibility.

In conclusion, we observed that BBM can achieve a complex problem on the basis of a text. Additionally, this case shows that BBM can be completed with other sources (the value model figure 51, the table 14 and the goal model figure 52) than the models in the state of art. We also observed that BBM is able to model service problems and even health care problems that are challenges. Finally, the case also shows some limits in the proposed language that could be inquired in further researches.

6. Section: Conclusion

A major problem in the area of business & strategy is to ensure that the information available to a layer of the organization is consistent with the others. Those layers are the strategic, the business and the process layers. One demand on the information is that it should be adapted as the organization adapts to changing conditions [32, 34]. In [3] an argument was put forth that alignment of models could be used to meet this demand. Of special interest of that research was the alignment of goal models for the strategic layer [17, 24] and value models for the business layer [20]. The argument was that by properly aligning goal models and value models (together with process models) the information from one layer to another would be more consistent and therefore, the alignment in the organization strengthened.

The objectives of this research were the followings; determine exactly what the limits of this research and the problems were. Then, define how to bridge those two layers. Additionally, the solution had to be precisely defined with syntax and semantic. Moreover, the model had to be adaptable to various models and ideally brought extra-contributions to the domain. A methodology was also desired to determine how to use the developed model considering other sources. As well, both the language and the methodology had to be tested on cases to evaluate their validity. Finally, the most important objective was to improve effectively the alignment.

In order to achieve the fixed objectives, the research was realized considering a precise methodology; the Design science. We followed guidelines from [28] which are used for information system research. The guidelines describe how to lead the research and how to promote it. The obtained results were also directed by the cycle of improvement ‘build and evaluate’ and with the framework from [29] (table 1). This helped having a rigorous work and a common template for the structure of this thesis.

Those guidelines were applied as following. Two artifacts were aimed; a language and a methodology. A state of art has been described to determine firstly the context of the problem but also where were the eventual issues that had to be fixed. Afterward, the artifacts were created and then evaluated through cases (section 5). This thesis does not reflect that fact, but the evaluation on cases has brought several improvements on the language and on the methodology (build and evaluate). When a satisfactory solution had been reached we stopped modifying the artifacts and then promoted the solution through a research paper.

6.1. Result

We argued that the alignment could be improved through a better flow of information from one layer to another. A better flow would bring a better consistency and therefore a better alignment. We opted to work on a model with a language and a methodology to improve the alignment. As our solution is a model, we focused on studying problems and opportunities in other models. Some other theories were analyzed in order to find relevant concepts and ideas. This study is presented in the state of art (section 2).

Through the state of art we spotted out that some intermediate concepts were necessary to improve the flow of information from one layer to another. We based this analyze on the rational agent theory and worked out a solution around decision and motivation. We also spotted flaws in other models and theory; the resources are not enough detailed in the models and the resource based view did not possess any syntax.

Considering those issues, we firstly build a language that could handle the necessary concepts to flow the information from one layer to another. This language is defined through syntax and a semantic and thanks to a meta-model. This language brings some new interesting concepts and is effectively improving the flow of information. The language is also interesting when used with other models; they bring complementarities that allow having a good view on the organization for the two studied layers.

The second artifact that we created is the methodology. The purpose of this methodology is to describe how to use the model depending on the context. This methodology is described through processes (activity diagram) and completed with mapping schemas that links meta-model from studied model with the meta-model of BBM. The bridging process allows improving the consistency from one layer to another. The merging process allows having a complete view on a system that self-contains information for the two layers. The BBM can also be used to analyze directly the organization in a resource perspective. When coupled with the strategic resources analysis, the model could push the competitiveness up.

Those two artifacts were evaluated thank to two cases. Cases taught us that some improvements could still be made on the model and that some choices made on the language were eventually not always the most efficient. Those cases showed the limits of the developed model but also some pros; it can handle service and product problems. Moreover, those cases gave clues on the usefulness of the model to handle the alignment problem. Finally, they partially validated the language and the methodology.

Concerning the aimed objectives, the validation can still be worked out through more cases and with investigations with potential users. The objective concerning the adaptability of the model with a large number of other models is also not fully achieved. We limited the adaptability to three languages which is not sufficient to say that the model is easily adaptable. Yet, we inquired the capacity of the model to be completed by other language (health care case) - it has been promising. Otherwise, other objectives were achieved in a satisfactory way.

Moreover, a paper (appendix VI) has been published and accepted for the BUSITAL conference. It gives some clues that the developed model is promising for the research domain.

Finally, we said in the beginning of the introduction that there are two problems for the alignment; the strategic and business alignment and the Business/IT alignment (BIA). This BIA perspective focuses on information that supports the integration of the information technology within the organization. We have not discuss those matter, yet i* and e³value are also used for IT problem, therefore this research has bring basis for further research on the BIA.

6.2. Future works

The described perspectives (section 3.4.5) show some interesting further elements that could be added to the language of the model. The major improvement is to allow calculations on the model with value and operation on causal links and with value, objectives, and boundaries for properties.

We also observed that some relations that have been moved apart could be reconsidered regarding the health care case. Other aspects as the suppressing links and the detailing of non-economic resources have to be inquired.

Additionally, an important factor for the acknowledgement of BBM is to lead more rigorous validation for both artifacts; experimenting more cases and investigates potential user's experience of the BBM. The investigation can be realized thank to questions based on the BMO's investigation [11] (appendix VIII). More cases have to be experimented to validate the described processes in section 4, they will also allow finding other limitations and issues of the model.

The model analysis can also be theoretically improved through the development of a behavioral design research (Appendix V). The developed artifacts, implemented in an organizational context, would provide information on the impact of the artifact's uses on individuals and organizations depending on the context.

Some esthetic consideration could be improved through the use of more friendly-visual constructs. However, it should respect the selected aspects from the SEQUAL framework for quality modeling [52]. Finally, further research could explore some other process for the methodology and validate them. For example those processes could be oriented in achieving IT information problem for the purpose of the BIA.

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APPENDIX I LEXICON

1. Vision: The desired future state of the enterprise [24].
2. Mission: It is a long-term approach that as the purpose to achieve the vision [24].
3. Strategy: The strategy is a plan, a consciously intended course of action, a guideline to deal with a situation. Strategies have two essential characteristics; they are made in advance of the actions to which they apply, and they are developed consciously and purposefully [59].
4. Tactic: It is a short term concept implementing strategy, when the Strategy is a long term concept with broader scope than tactics [24].
5. Motivation: The psychological feature that arouses an organism to action toward a desired goal; the reason for the action; that which gives purpose and direction to behavior [60].
6. Behavior: The aggregate of the responses or reactions or movements made by an organism in any situation [60].
7. Decision: The act of making up your mind about something [58, 60].
8. Resource: They are assets and capabilities that are available and useful in detecting and responding to market opportunities or threats [16].
9. Non-economic resource: Resource that are not transferable [43].
10. Economic resource: Resource that are transferable [43].
11. Causal relation: A causal relation is an interpropositional relation in which the situation expressed by some proposition(s) is communicated as bringing about the situation expressed by some other proposition(s) (an external relation), or the usage of some other proposition(s) in a reasoning or argument from a premise (an internal relation) [61].
12. Model: A hypothetical description of a complex entity or process [60].
13. Value proposition: Mix of goods and services, and price and payment terms offered by a firm to its customers. [62].
14. Modeler: the agent that models – that creates instance of a problem in a specific language described in a model.
15. Simulation: the act of imitating the behavior of some situation or some process by means of something suitably analogous [60].

APPENDIX II SYNTAXES AND MEANINGS FOR CONCEPT DIAGRAMS

TABLE 15 THE SYNTAX AND DEFINITION USED TO DESCRIBED THE CONCEPTS AND RELATIONS OF LANGUAGE WITHIN THEIR LAYERS.

Name	Syntax	Definition
Concepts	Name	A concept represents a concept of a language. A concept can include other concepts. A concept possesses a name.
Arc	Role →	An arrow between concepts expresses a relation between concepts. The role describes the nature of the relation.
	<<Role>> - - →	A doted arrow between concepts from different languages represents a relation between those concepts. The relation is defined by the role and can be; “embed”, “related”, or “equivalent”.
Layer		A layer is a doted square box that shows the boundary of a layer. The layer is either the business layer, either the strategic layer.

APPENDIX III PROBLEM DESCRIPTION FOR HEALTH CARE CASE

Legend for the text analysis:

- Pink: Causal link
- Yellow: Actors
- Teal: Motivation
- Green: Resource
- Grey: Property
- Turquoise: Decision

"From Primary Health Care to Patient

When a patient experiences an eye health problem, she/he will visit a primary health care provider. The basic/primary resource this provider offers is an investigation service. The intended effect of this investigation is that the patient gets an increased feeling of safety [...]. In this example, the investigation provides a basis for an information transfer, where the provider informs the patient about her/his health status. This information has the intended effect that the patient will get an increased knowledge of her/his health condition. If the patient needs further treatment, either the primary care provider will carry out the treatment (a service, which is not shown in Figure 1) or the provider refers the patient to an eye care specialist at a hospital clinic that is able to provide advanced treatments. To do this, the provider offers a referral to eye specialist treatment, which is a voucher for an eye treatment (service). There are two intended effects as a result of the transfer of the referral. The first effect is direct: the patient will get an increased feeling of safety, since the patient knows that referral can be used for advanced treatment and this will reduce anxiety as the patient knows that she/he will get professional treatment. The other effect is indirect: if the patient uses the referral, the treatment at the hospital clinic may improve the health state of the patient, i.e. another effect of the referral is a potentially better health state. Furthermore, when the primary care provider starts investigating the patient, the primary care gets a responsibility for the patient's health, i.e. the provider is responsible to carry out required actions in order to maintain or improve the patient's health state (depending on the diagnosis). The intended effect of this responsibility transfer is that the patient gets an increased feeling of safety, since she/he knows that a professional health care provider has "promised" the health care system to carry out required actions for the patients. Note that the responsibility will remain on the primary care provider's shoulders until it explicitly hands over the responsibility to another health care provider, e.g. an eye care specialist at a hospital clinic.

Patient to Primary Health Care

When the patient visits the primary health care provider, the following resources are transferred from the patient to the provider: patient fee and patient voucher. The patient fee is the money that the patient pays when visiting the primary care, while the patient voucher is a voucher for money that enables further reimbursement for the expenses from the city council (not shown in Figure 1).

From Primary Health Care to Eye Specialist Clinic

The referral that the patient received is also sent from the primary health care to the eye specialist clinic. For the eye specialist clinic, the referral functions as a conditional voucher for money that gives the clinic a right to reimburse money from the city council. The voucher is conditional since the clinic can only reimburse the city council if the patient will visit the clinic for a treatment. Furthermore, the referral also contains referral content *which is information that the eye specialist clinic uses to assess how urgent the patient's treatment is, as well as to plan and allocate resources at the clinic.*

From Eye Specialist Clinic to Patient

When the patient visits the hospital clinic, she/he will receive an eye treatment service from the clinic. The intended effects of the treatment are two: better health state and an increased feeling of safety. Furthermore, the treatment encapsulates other resources. First, it encapsulates an information transfer, i.e. information on ongoing treatment, with the intended effect increased knowledge on health condition. Secondly, in some cases, the patient also needs certain medicine. The eye specialist clinic provider will then transfer a recipe, which is a voucher for goods; the patient can use the recipe at a pharmacy store and receive the needed medicine. There are two intended effects as a result of the transfer of the recipe. The first effect is direct: the patient will get an increased feeling of safety, since the patient knows that the recipe can be used as exchange for medicine, which may improve her/his health state. The other effect is indirect: if the patient exchanges the recipe for medicine and also uses the medicine, the medicine actually may improve the health state of the patient, i.e. another effect of the recipe is a potentially better health state. Finally, when the eye specialist clinic starts the treatment, the clinic gets the responsibility for the patient's health, which gives the patient an increased feeling of safety.

From Patient to Eye Specialist Clinic

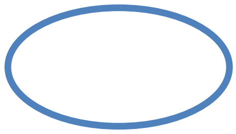
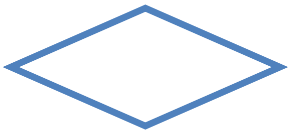
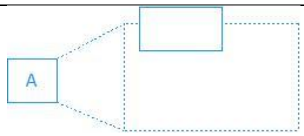
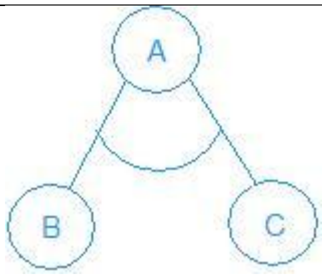
When the patient visits the eye specialist clinic, the clinic will receive patient fee and patient voucher. The patient fee is the money that the patient pays when visiting the primary care, while the patient voucher is a voucher for money that enables further reimbursement for the expenses from the city council.

From Eye Specialist Clinic to Primary Health Care Provider

When the eye specialist clinic starts treating the patient, the eye specialist clinic will explicitly hand over the responsibility for the patient's health state from the primary care. Therefore, the primary care provider will receive the resource responsibility release, with the intended effect: reduced risk. Furthermore, when the eye specialist clinic has treated the patient, the clinic sends a referral answer back to the primary care unit which is information on symptoms, diagnoses and carried out treatments. This information does not lead to any direct actions at the primary care unit. Instead, the referral answer is mainly used to increase knowledge about eye health care for the physicians and nurses at the primary care unit.“ [43].

APPENDIX IV OVERVIEW OF S&S

TABLE 16 SYNTAX& SEMANTIC OF BBM

BBM Name	Representation (syntax)	Semantic
NODES		
Property Chance nodes *		Property that describes a resource. They can be evaluated on a qualitative or quantitative scale. Property concerns large scope of the description of the resources (financial, infrastructural…).
Non-economic resource Utility nodes*		Resources those are not transferable directly to another actor or to another resource. They are concerning inner value for the actor. The health, the pleasure, the investment power…
Economic resource		Resources that are transferable and that are described by a certain amount of properties. One economic resource is present in an actor's instance of BBM if the actor rents or owns the resource. They are concerning business value (goods, knowledge, money, or services) for the actor.
Decision Decision nodes*		Decision nodes represent identification of (alternative chains of) goals and means in order to reach an objective [56].
LINKS		
Precedence link		The decision A is made before progressing to the in-decision B.
Causal link		A has an impact on the value assigned to B depending on value indicator (++,+,-,--).
Definitional link		The connected nodes are decision nodes. The purpose is to improve the definition of a decision by using sub-decisions (which are more precise) [56].
Creation link		The decision node A brings an economic resource in consideration in the model.
CONNECTOR		
Select		The meaning of the select depends on the links involved. The select affects either causal or precedence links. Only one of the affected links (the selected) is evaluated. For causal links it means that it does not influence any node if not selected. For the precedence link it means that one of the nodes connected to the link is not necessary (see Select in section II.3 for more information).

VALUE INDICATOR :		
Strongly positive	++	Strong positive influence.
Positive	+	Positive influence
Negative	-	Negative influence
Strongly negative	--	Strong negative influence

APPENDIX V DESIGN-SCIENCE

The following explanation on design science for information system is based on Hevner 2004 [28].

The information systems discipline is divided into two paradigms; behavioral science and design science. Note that the behavioral science 'seeks to develop and verify theories that explain or predict human or organizational behavior' [28] and so seeks 'what is true', it is not the matter of the research. However, it could be used for further research. The design-science paradigm 'seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artifacts' [28]. Both paradigms are foundational to the IS discipline, positioned (as it is) at the confluence of people, organizations, and technology.

The Design-Science paradigm is originally rooted in engineering and in the sciences of the artificial. It is fundamentally a problem solving paradigm. It is purposed to '*bring innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished'* [28]. Those innovations are represented though artifacts that are built around theoretical sources and introduced in an evaluation process in order to solve the concerned problem.

Artifacts: are defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems). Design-Science's artifacts are represented in a structured form that may vary from software, formal logic, and rigorous mathematics to informal natural language descriptions. Behavioral science's artifacts are the object of the research; the researcher seeks to highlight the usefulness and the impact of the implementation of such artifacts in an organizational context.

The design science includes two *design processes* and four design artifacts. The two processes are 'build' and' evaluate'; the building process produces and addresses the desired artifacts to the unsolved problem when the evaluation process provide the usefulness of those artifacts in solving the problem. The evaluation is furnished by the feedback analysis of the so built artifacts. Those design processes lead to a better understanding of the problem and therefore, to the improvement of the quality of the product and the processes. Design artifacts are constructs, models, methods, and instantiations.

- *Constructs* provide the language in which problems and solutions are defined and communicated.
- *Models* use constructs to represent the design problem and its solution space.
- *Methods* provide guidance on how to solve problems, that is, how to search the solution space. These can be ranged from formal, mathematical algorithms that explicitly define the search process to informal, textual descriptions of "best practice" approaches, or some combination.
- *Instantiations* show that constructs, models, or methods can be implemented in a working system. They demonstrate feasibility, enabling concrete assessment of an artifact's suitability to its intended purpose. They also enable researchers to learn about the real world, how the artifact affects it, and how users appropriate it.

Design-Science is so a constantly shifting design process, that, in one configuration build (or improve) products (i.e; design artifacts) and, in the other, evaluate those products.

Design science interactions:

The framework (figure 57) provides the description of the research space and the involved interactions with the environment of such a development.

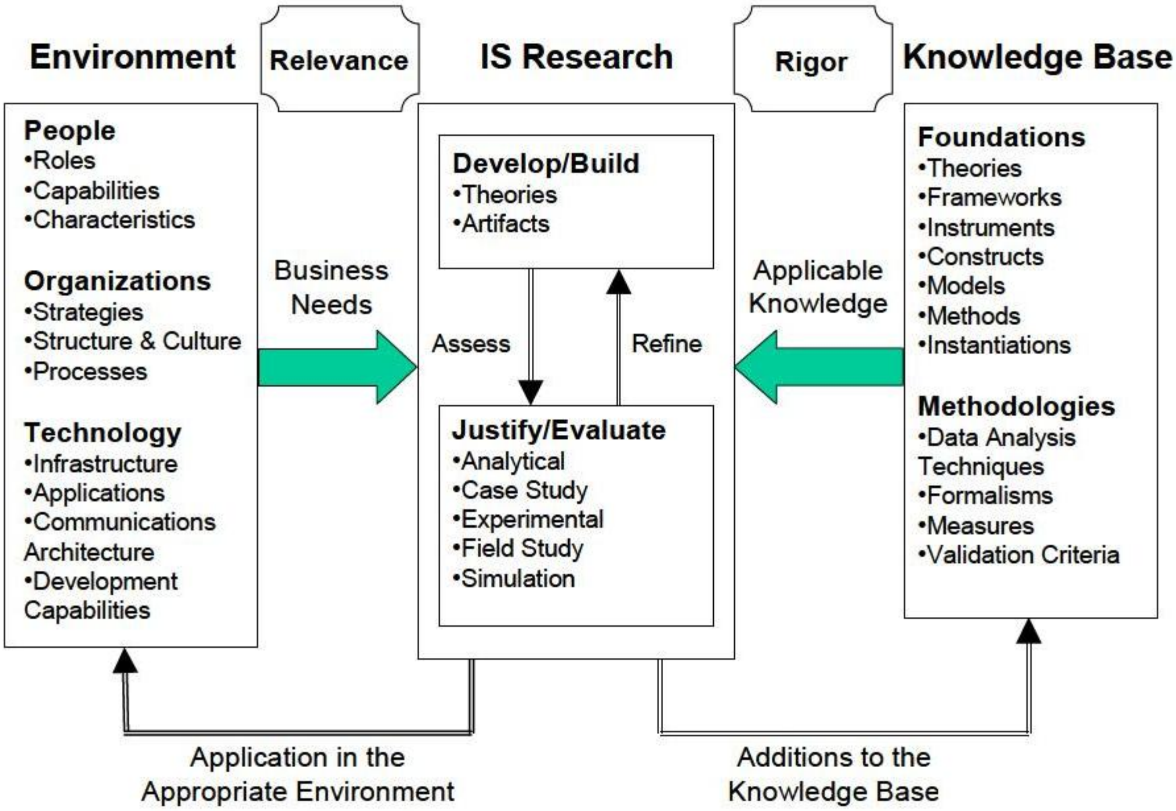


FIGURE 57 : INFORMATION SYSTEMS RESEARCH FRAMEWORK FROM HEVNER 2004 [28]

E*nvironment* defines the problem space in which the phenomenon of interest resides. For IS research, it is composed of people, (business) organizations, and their existence. In it are the goals, tasks, problems, and opportunities that define business needs as they are perceived by people within the organization.

IS research focuses on the justify/evaluate and the develop/build processes. The Develop and Justify processes are from Behavioral Design. Research assessment via justify/evaluate (for design science) activities can result in the identification of weaknesses in the theory or artifact and the need to refine and reassess. This is the cycle of improvement of the research.

The knowledge base provides the raw materials from and through which IS research is accomplished. It is composed of foundations and methodologies.

Business needs are assessed and evaluated within the context of organizational strategies, structure, culture, and existing business processes.

Applicable knowledge is a set of fundamental theories that are used in design science processes.

Rigor and relevance are two linked concepts: Rigor is achieved by appropriately applying existing foundations and methodologies; it is about formalism in the research. Relevance is about how the given solution is effectively efficient to solve the business needs. Overemphasis on rigor in IS research has often resulted in a corresponding lowering of relevance. Those two concepts should be thus well balanced in the research approach.

The design science is purposed to solve a matter in the environment that is transcript in the business needs (i.e.; a need of solution). This problem is characterized by:

- Unstable requirements and constraints based upon ill-defined environmental contexts
- Complex interactions among subcomponents of the problem and its solution
- Inherent flexibility to change design processes as well as design artifacts
- A critical dependence upon human cognitive abilities to produce effective solutions

- A critical dependence upon human social abilities to produce effective solutions

Guidelines for Design Science in Information Systems Research

Hevner et al. [28] propose the following guidelines for a design research:

TABLE 17 DESIGN-SCIENCE RESEARCH GUIDELINES [28]

Guideline	Description
Guideline 1: Design as an Artifact	Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: Problem Relevance	The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
Guideline 3: Design Evaluation	The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: Research Contributions	Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
Guideline 5: Research Rigor	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
Guideline 6: Design as a Search Process	The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: Communication of Research	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

ADDITIONAL INFORMATION FOR THE GUIDELINES;

Guideline 3: Design Evaluation

The utility, quality, and efficiency of a design artifact must be rigorously demonstrated via well executed evaluation methods. IT artifacts can be evaluated in terms of functionality, completeness, consistency, accuracy, performance, reliability, usability, fit with the organization, and other relevant quality attributes.

Design Evaluation:

1. Observational

- Case Study: Study artifact in depth in business environment
- Field Study: Monitor use of artifact in multiple projects

2. Analytical

- Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
- Architecture Analysis: Study fit of artifact into technical IS architecture
- Optimization: Demonstrate inherent optimal properties of artifact or provide optimal bounds on artifact behavior
- Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)

3. Experimental

- Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
- Simulation: Execute artifact with artificial data

4. Testing

- Functional (Black Box) Testing: Execute artifact interfaces to discover failures and to identify defects
- Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation

5. Descriptive

- Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact’s utility
- Scenarios: Construct detailed scenarios around the artifact to demonstrate its usefulness

Guideline 4: Research Contributions

Effective design-science research is purposeful and then must provide a feedback in form of contribution for the domain in which the research is led. Contribution is provided under the form of the design artifact, design construction knowledge (*foundations* in figure 10), and/or design evaluation knowledge (*methodologies* in figure 10).Design-science research holds the potential for three types of research contributions based on the novelty, generality, and significance of the designed artifact.

1. The Design Artifact. Cases where the design artifact is the contribution itself. The artifact must contribute to improve initial problem in the environment. The contribution we seek to bring via this research.
2. Foundations. The research improves the existing foundations in the knowledge base.
3. Methodologies. The research improves the existing methodologies in the knowledge base.

APPENDIX VI RESEARCH PAPER

The following research paper has been accepted for the BUSITAL'10. This version has been re-formatted for the purpose of this thesis.

THE BUSINESS BEHAVIOR MODEL

Denis Lemaire [1], Birger Andersson [2]

[1]Faculty of Namur, Department of Computer Science rue Grandgagnage 21,5000 Namur, Belgium. lemaired@student.fundp.ac.be

[2]Stockholm university, Department of Computer and System Sciences SE-164 40 Kista, Sweden. ba@dsv.su.se

Abstract. For solving problems related to business/IT-alignment we propose a model called the Business Behavior Model. The main idea behind the model is to capture the motives that drive an agent to take decisions about what resources he should exchange in a business collaboration. The model draws from the rational agent theory, the resource-based view, the business model ontology, and causal graphs. The usefulness of the model is illustrated through a small case study. The result indicates that the business behavior model is interesting and useful as a complement to goal models and value models.

1 INTRODUCTION

A major problem in the area of business/IT-alignment is to ensure that the information technology available to an organization provides the support the organization needs. One demand on the support is that it should be adapted as the organization adapts to changing conditions [1, 13]. In [2] an argument was put forth that alignment of models could be used to meet this demand. Of special interest of that paper was the alignment of goal models [3, 5] and value models [6]. The argument was that by properly aligning goal models and value models (together with process models) sufficient information was available to be able to adapt IT resources to the organization's needs. Thus, alignment of models was considered a means to a Business/IT-alignment end.

In this paper we look further into the link between goal models and value models. We argue that the information contained in both those models can be complemented in order to give a more complete view of the link. Limiting our analysis to some well-known goal models (BMM [5] and i* [3,4]) and value models (e^3value [6]), we note that, for example, the goal model is good at describing goals and dependencies between them, but less good at describing the decisions and motivations that lead to the formulation of those goals. We note that the value model is good for describing exchanges of resources, but less good for describing the structure of those resources.

To capture and present this complementary information we propose a model called Business Behavior Model (BBM). We chose to include "behavior" in the name as we aim at capturing the way the agent could interact with its own organization and environment based on its motivation. We have three goals in this paper; first, providing a clear and understandable definition of the BBM. The second is to define the context in which the BBM could be applied and used. The last one is to provide some clues on the usefulness of the model.

The rest of the paper is structured as follows; in section 2 we overview theories that the BBM draws from. In section 3 we define, develop, and explain the BBM. We also discuss how it can be used. Section 4 contains an illustrative example of its use in the form of a case study. An analysis of the case study is done in section 5. Section 6 ends the paper with a concluding discussion and directions for future research.

2 FOUNDATIONS

The Rational Agent Theory. In this paper we assume that the agents being modeled are rational. The Rational Agent [8] theory is a widely used concept in the Decision theory [10] and Game theory [11]. The rational agent theory aims at describing how actors react in various contexts that involve decision making. An agent is being represented as having beliefs, desires and intentions (BDI, a set of mental attributes) [8]. Beliefs are information about the agent's view of its environment. Desires are information about the agent's motivation. Intentions are about deliberative states of the agent. A rational agent has clear preferences and aims at performing action that result in the optimal outcome from among all feasible actions. In other words, based on its beliefs, an agent takes decisions with the intention to fulfill its desires. In a resource-based view those desires are fulfilled by exchange of resources.

The Resource-Based View of the firm. The Resource-Based View (RBV) [9, 19, 20] is an economic tool used to determine the strategic resources available to a firm. All firms possess resources. A subset of those resources could provide a competitive advantage and a further subset (the strategic resources) could lead to the sustainable competitive advantage. Whether a resource is considered strategic depends on its properties and how well those meet a set of criteria. Commonly used criteria in RBV are proposed by Barney [20]. He suggests that a strategic resource must possess the following properties: value, rareness, inimitability and non-substitutability [14]. In other words, in the resource-based view of the firm an agent, in order to survive, must exchange resources considered valuable for its environment. We note, however, that some resources are not exchangeable but actor inherent. Those resources are valuable in the sense that they are used to produce exchangeable resources.

The Business Model Ontology The Business Model Ontology (BMO) [17] describes the logic of a "business system" for creating valuable resources. In BMO a business model is understood as the conceptual and architectural implementation of a business strategy and as the foundation for the implementation of business processes that uses and produces resources. The BMO is useful for sorting out a resource's properties in an elegant and structured way. This framework is composed of four pillars representing four different aspects of the business organization:

- Offering: Value proposition, target customer segment and capabilities;
- Infrastructure management: Activity configuration, resources and assets and partner network;
- Customer relationship: Information strategy, channels and trust and loyalty;
- Financial: The financial aspect is modeling the firm's profit and therefore its ability to survive in competition.

We learn from BMO that the resources handled by an agent have properties (reflecting four different aspects of the organization) and depending on from which aspect the organization is analyzed those properties become more or less relevant.

The Causal graph. A Causal graph is a set of nodes and arcs. The Causal graph was chosen as the syntactical basis for the BBM as it is well-founded and contains the concepts we needed for BBM development structured in a coherent way. Table 1 overview the basic concepts of the Causal Graph.

Table 1. Basic concepts of Causal Graph [14].

Nodes	Arcs
Chance: A variable that could conditionally be influenced by other nodes.	*Informational:* The out-node is considered before the in-node is analyzed.
Utility: The expected utility of the outcome from decision nodes.	*Causal:* The in-node has conditional probability to take a certain value considering a previous out-node.
Decision: The alternatives that are possible considering the studied domain.	*Definitional:* The in-node is composed of the all nodes linked to it.

Related models. For this research, some models from strategic and business layers are used as comparison basis. For the strategic layer: i* and BMM and for the business layer: e³value. i* is a goal and agent oriented framework developed to model the goals of an agent or organization. The main idea of i* is to model an agents intentions, i.e. its goals, beliefs, abilities, or commitments [16]. Business Motivation Model is a model for expressing means for an agent to achieve goals or objectives. The BMM answers the following questions [5]; what is needed to achieve what the enterprise wishes to achieve? Why does each element of the business plan exist? BMM is present in this paper because it offers a compact notation that makes it convenient for short case study. e³value model is a value model focused on the analysis of a value proposition [6]. The e³value provides concepts for showing which parties exchange resources of economic value with whom, expecting what in return.

3 The Business Behavior Model

3.1 Definition

The definition of the BBM is based on three concepts that come directly from the Rational Agent theory and the Resource Based View – decision, resource and motivation. Those concepts are not independent and are therefore linked through causal relation with a value that indicates the intensity of the link (table 2).

Definition: *"The Business Behavior Model is a model which describes the impact of the participation of agents in a business by integrating their resources in a causal graph. The participation is realized through decisions and driven by motivations."*

3.2 Syntax and semantics

Table 2. Syntax and semantics of BBM (see also figure 4)

BBM Name	Syntax	Semantic
Economic resource properties	Rounded box	Property of a resource evaluated on a qualitative or quantitative scale. Property concerns inner characteristics but also customer, financial and infrastructural aspects
Non-economic resource	Diamond box	Resources which are not transferable directly to another actor or to another resource. They are concerning inner value for the actor.
Economic resource	Dotted square box	Resources which are transferable and described by a set of properties. One economic resource is present in the actor model if the actor rents or owns the resource.
Decision	Square box	Decision nodes represent identification of (alternative chains of) goals and means in order to reach an objective
Informational link	Arrow	The information from the out-node decision is available at the time the in-node decision is taken. Similar to a temporal meaning.
Causal link	Arrow with value link	Out-node has an impact on the value assigned to the in-node depending on the value link.
Definitional link	Empty arrow	The connected nodes are decision nodes. The purpose is to improve the definition of a decision by using sub-decisions (which are more detailed).
Creation link	Dotted links	Creation link are used in order to trace the reason why a resources is analyzed. The reason is linked to a specific decision.

XOR-relation	Bounded connector	A connector between links of same type. Those connectors act as constraint on the nodes attached to the links; at least one out-node have to be considered to grant the consideration of the in-node but not all of them.
AND-relation	Double bounded connector	A connector between links of same type. Those connectors act as constraint on the nodes attached to the links; all out-nodes have to be considered to grant the consideration of the in-node.
Value indicator		
Strongly positive	++	Strong positive influence.
Positive	+	Positive influence.
Negative	-	Negative influence.
Strongly negative	--	Strong negative influence

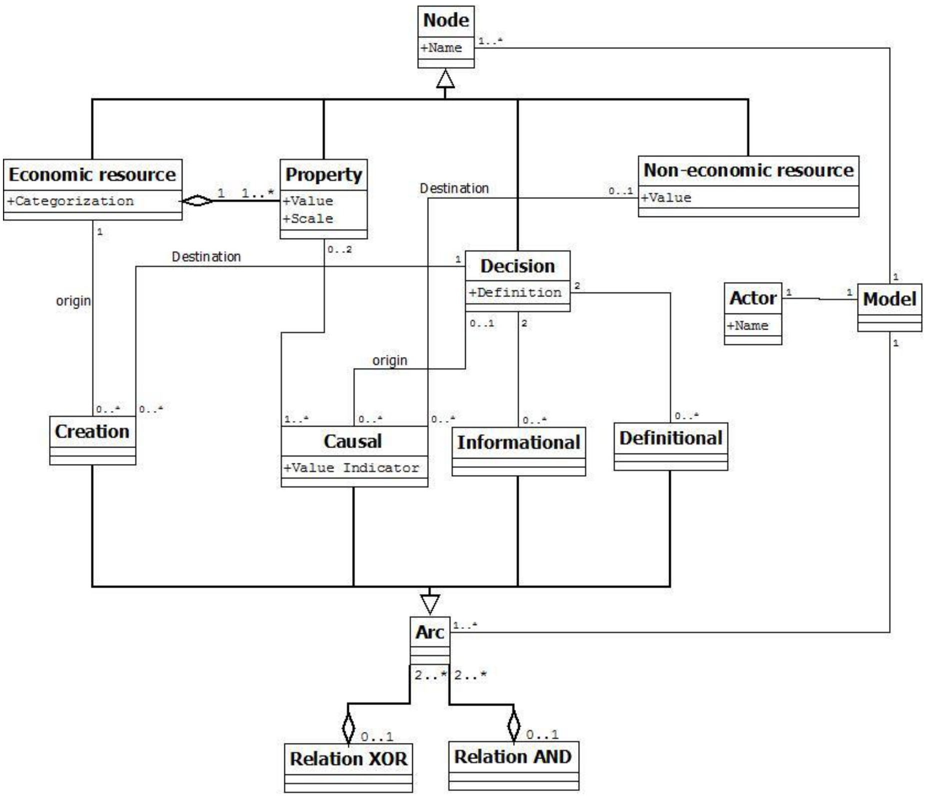


Figure 1. Meta-model of BBM

To complement the meta-model of figure 1 we use an additional methodological tool which we call a categorization. The main point of categorizing a resource is to emphasize from what aspect a resource's property is important for a particular analysis. This tool is inspired by the Balanced Score Card (BSC) [18] approach. The categories we use, however, come from the four pillars of BMO as those pillars are more adapted to the RBV. Figure 4 shows this categorization of the MMOG resource (rectangle box). Note that we do not prescribe that all resources should be subject to categorization at all times; this is determined by the modeling purpose.

Motivation for syntax and semantics. A rational agent has beliefs, desires, and intentions. It chooses from a set of available actions and performs one in order to reach an optimal outcome. Therefore the model is structured according the following pattern (figure 2): actors have motivations (desires-outcome) that are fulfilled by actions and supported by decisions (Intention-actions) in the presence of environmental constraints (belief). In order to integrate RBV, actions are led on resources that are changed and exchanged through agent activities. Furthermore, to provide a deepest view of resource, the model analyzed them through their properties as proposed by Petit [12]. Figure 2 captures the idea of this pattern starting from decision in the bottom and ending at the motivation at the top. Figure 2 also positions the developed model between the goal layer and the business layer and shows the added value of the model (detailed in section 5).

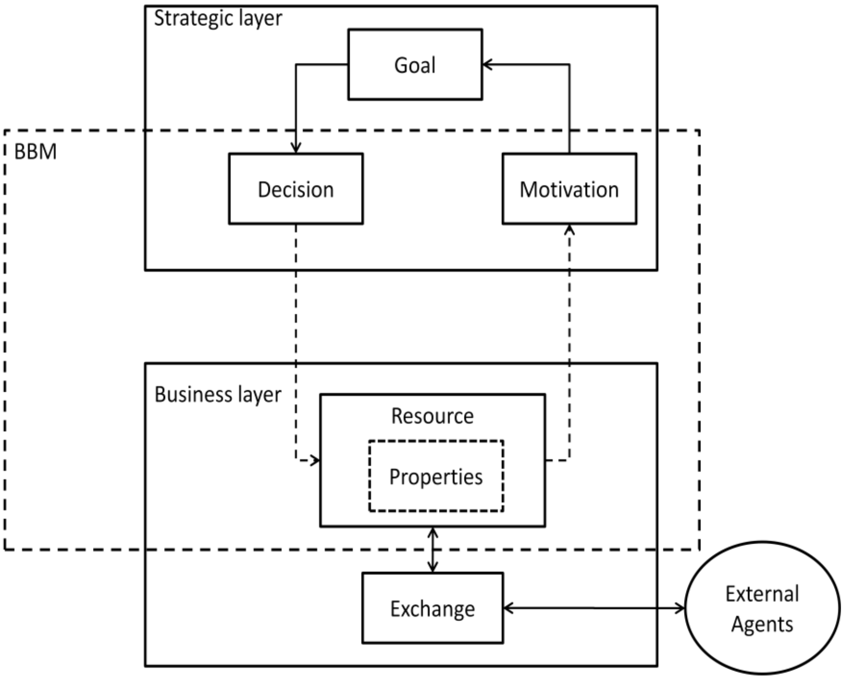


FIGURE 2. THE POSITION OF BBM AND THE ADDED VALUE FOR ALIGNMENT (DOTTED ELEMENTS)

As action are completed on resource, motivation is the result from improvement on specific resources; non-economic resources. Those non-economic resources emphasize the selfish process of the outcome's optimization (the motivation). For instance, profit is often not an end in itself but a specific feeling is. The feeling of high esteem or respect in the society is a resource as it can help in forging new alliances, but it is not an economic resource as it cannot be traded. It is strictly attached to a particular agent.

3.3 USAGE

As we focus on the alignment of models on goal and business layers we use i* [3, 4] and the Business Motivation Model (BMM) [5] as goal models and e³value [6] as a value model for illustrative purpose in this paper. Finding correspondences between the notions of the different models is important for solving model alignment problems.
As shown in figure 1 the BBM model is based on three notions; decision, actor, and resource. Moreover, the model includes the notion of property and captures different kinds of relations. Motivation is, as said, a derived notion in the model.

Decisions. As Means-End links in i* are an envisaged solution for the accomplishment of a goal, they are translatable in term of valuable decision. Indeed, a solution to fulfill a goal has to lead to a decision in the business process or otherwise the goal will not be achieved. Decision that implies actions toward another actor also emphasizes the Dependency Link between actors in i*. From a different perspective, a decision is taken as it generates valuable improvement for the motivation and Value Activities are themselves generating value. Therefore, a Decision can be transformed in a Value activity, but not all the value activities are related to a decision. Start stimulus are also interesting as they emphasize the initial need of the participation, therefore they are providing information on feasible initial decision. Considering the Business Motivation Model, decisions that appeal to factual means can be translated in terms of 'Means'.

Non-economic resources. The End node with a Vision semantic [5] of BMM is similar to a motivation, therefore this node is transformable into a non-economic resources. For i*, top level nodes are sometimes parented with the motivation meaning.

Economic resources. The Resources from i* are economic resources for BBM and their exchanges between actors in i* are modeled by causal links that cross economic resources: an exchange implies modification on properties of the resource (decrease of a resource to the profit of another). Resources are also present in the Value Model e³value within the Value Object.

Properties. Properties are related to the tasks, goals and soft goals of i* considering the fact that those elements are directed in the growth of aspects of a resource for the agent and therefore can provide indices on strategic properties. Properties are related to 'Means', 'Ends' or 'Influencers' from BMM for the same reason. 'Means' are usually related to low level properties at the opposite of 'End' nodes. Influencers are external constraints that can be associated with properties from rented or purchased resources. Indeed, those resources possess properties that are not directly controllable by the actor.

Table 3. Translation table of related notions. Translation for links is based on semantic comparison. This table should help the modeler to find relevant information in other models for the BBM or the opposite.

BBM	e³value	i*	BMM
Actor	Actor	Actor	
Property		Goal, Task, Means Soft-goal	End, Means, Influencer
Decision	Value activity Start stimulus	Means-end link	Means
Motivation		Goal	End : Vision
Causal link	Value exchange	Decomposition link Contribution link Dependency link	Links among nodes
Informational and definitional	Value exchange between value activity of one actor	Contribution link	
Resource	Value object	Resource	
Value link		Contribution link	
Alternative decisions	UCM extension (trivial)	Means-end link	

Table 3 emphasizes that it is possible to construct the Business Behavior Model on the basis of the other models or to construct (derive) those models on the basis of BBM. Constructing BBM on the basis of other models or the other way around results in models which are aligned on the same ideas – this reinforces the consistency among models and increases the alignment. For example, in the illustrative case in section 4, a BBM is constructed from an e³value model and subsequently a goal model (using the BMM notation) is constructed from the obtained BBM; the BBM bridges e³value and BMM.
Another way of using BBM is to use it for simulation; the final objective is to optimize the motivation, hence the necessity to improve the related non-economic resource (attached to the motivation). When looking at the model, the improvement comes from Causal Links emerging from properties influenced by decisions (figure 1). Therefore, to optimize the motivation, the user has to optimize the improvement on the path through the non-economic resource by selecting the most efficient alternative decisions. By optimizing the improvement is meant comparing the value indicators on the causal links and selecting the one that provide the best end-effect. A simulation is also illustrated in the case study.

4 ILLUSTRATIVE CASE STUDY

The following example is based on the case of a massive multimedia on-line game (MMOG [16]) provisioning. This case implies exchange of product (the game) and exchange of service (hosting). The idea is to *bridge* e³value and BMM through an intermediate model – the BBM. The first step is to build the BBM from the e³value model and then continue with deriving a BMM from it.

THE E³VALUE MODEL

The MMOG case relates the case of a company selling online games (that the company created) for customers. An online game requires a hosting service and internet access as the game is hosted on distant servers. The game is sold in part on CD (in exchange of money), and in part with an access to a game server (also for money).

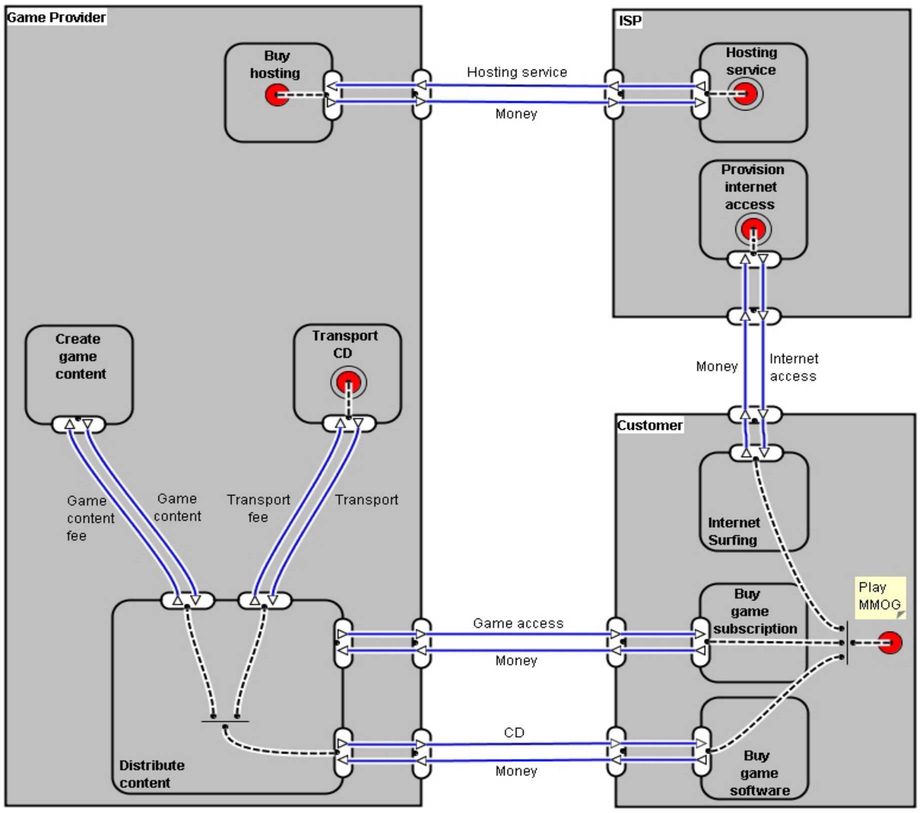


Figure 3. e³value model of the MMOG case (from [16])

By analyzing figure 3 we can sort out the decisions (value activity) and resources (value exchange). The final model considers one resource for both the CD and the Game Access – the MMOG. Motivation (a non-economic resource) is not present in figure 3, but is derived from reasoning about why an actor participates in the business collaboration.

CONSTRUCTING A BUSINESS BEHAVIOR MODEL

As no more information is available in the e³value, the modeler should start to furnish the model with properties and link them together. This information is present in the problem description, and the BBM in figure 4 has been complemented based on this information. The final model is obtained by adding a categorization for the MMOG resource.

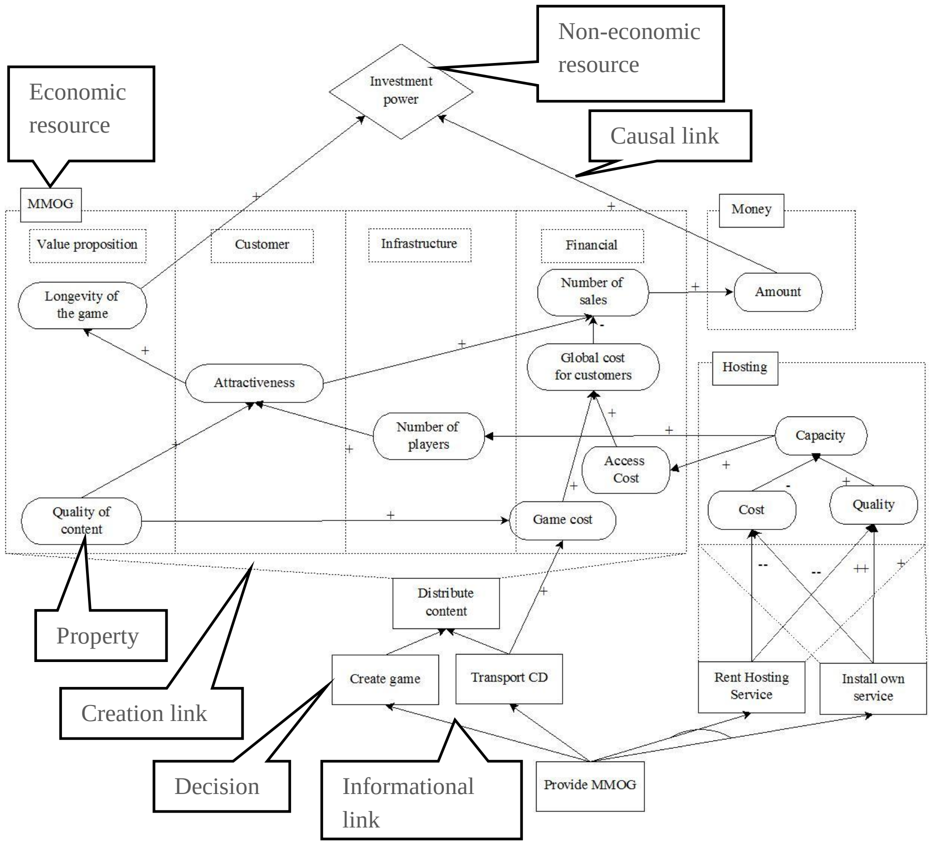


Figure 4. Business Behavior Model (Game provider's view)

Figure 4 shows the initial motivation of the business (improve the investment power), it could have been different but we do not possess the information in the source case. From there, the company decides to provide Massively Multiplayer Online Game. This requires creating the game, preparing a support (CD) and shipping them. On the other hand, the online aspect requires hosting capacity. The result is a MMOG resource with some properties separated in four categories (from BMO) and a Hosting. The company possesses some money as well (a third resource). Properties from the three resources are connected and act as constraints (resources that are not variable by the considered agent) but also as variables whose values the decision makers can vary.
Figure 4 also illustrates simulation: the model proposes an alternative decision for the hosting resource which is to install a hosting service that would be owned by the game provider (shown in the lower right corner). When comparing Value Link on both out-relations from the two decisions:

- They cost the same (two double minus). For short term the renting is more advantageous, but in the long run owning is more advantageous.
- Quality varies (one is double minus and is one double plus). Renting provide the insurance of experience strengthen by contract. The installation requires experts that are maybe not present inside the companies; therefore, quality may be reduced.

In this case, the choice is quite easy; renting seems to be the better decision.
Similar models are constructible for the customer's and the ISP's point of view.

BUSINESS MOTIVATION MODEL

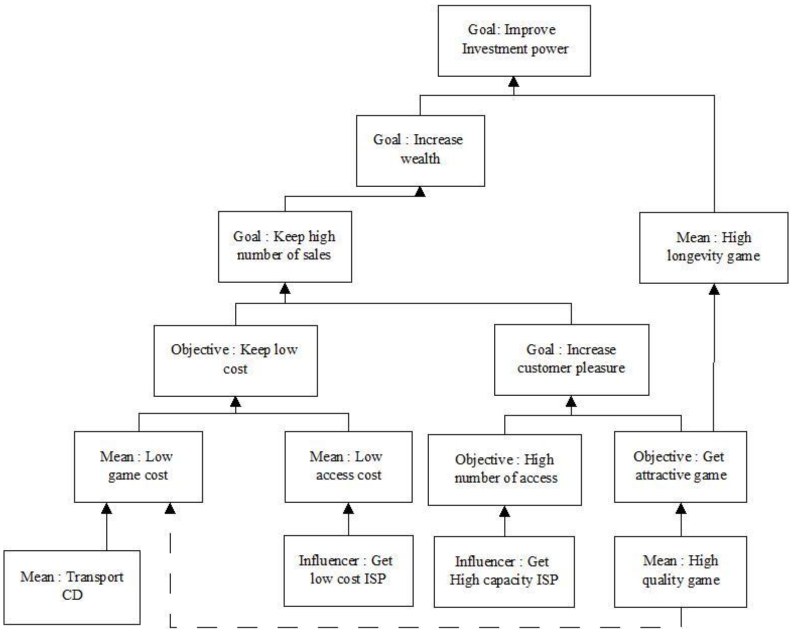


Figure 5. BMM of the MMOG case with conflicting relation

Figure 5 shows a BMM built on the basis of the BBM of figure 4. We opted in this paper to show a BMM instead of an i* model as it is more compact. The used process did not consider the non-influencing decisions and focuses on the properties to sort them out in one of the following category of nodes: “End”, “Means” and “Influencer”. “End” nodes are top level properties in the graph of the BBM (figure 4). “Means” are low level properties (or leaves of the graph). “Influencer” nodes are external constraints. In our case the constraints come from the renting of the hosting service – the ISP is the one who fix the price and the capacity. The influencing decision (Transport CD) is also “means”. As it is visible in figure 5, the BMM conserves all the relation among nodes from figure 4. The negative causal relation between the “Game cost” and the “Quality of content” (in figure 4) is modeled through a dotted link in the figure below to avoid using Assessment elements from BMM.

5 RESULTS

5.1 ADDED NOTIONS

Motivation oriented: Motivation is the engine that drives problem solving for a business. Therefore, modeling the engine of the participation is crucial to reach an optimal solution. Including motivation also brings the possibility of giving a non-profit oriented view of the business by focusing on this non-economic resource. The motivation can be present in goal model, but in our case, the motivation is linked with actions on resources (figure 2).

Decision oriented: Decisions are the first step towards the achievement of a solution. Plus, alternative decisions provide the possibility of reflecting on which solutions are the best for the business through simulation. In terms of alignment, it bridges the establishment of goals with their application in the value proposition. Once again, some decisions could be drawn in the strategic layers but here we connect them with motivation and action on the resource (figure 2).

High resource granularity: Modeling resources as a set of properties gives insights about the weakest and the strongest points of resource configurations. The categorization of resource properties improves the structured view of the resource. Modeling inter-resource relations gives a wider and a sharper view of the studied system and detailed descriptions of property dependencies emphasizes different aspects of a system.

RBV (resource based view): The Business Behavior Model is not a tool to determine the strategic resources. However, it is a view of the internal and external mechanisms that involve those strategic resources. Indeed, the analysis of the properties and their impact on the global system gives a wider understanding of the engaged resources. As far as the BBM is connected to the RBV [19, 20] and gives interesting analysis of the resources management, it should be considered as a step towards obtaining a strategic advantage.

5.2 The usefulness of the BBM as an analysis tool for the business

The use of the developed model improves the analysis of the business on several aspects thanks to the introduction of new aspects for the studied layers. Indeed, the business and the goal layers are focused on goal and value proposition. The BBM brings a new approach by the way of the motivation, the resources view and the possible decisions. The introduction of the decision concept allows analyzing whether or not the motivation is fulfilled by decisions and how. Decisions are also the basis of simulation for optimization through their alternativity. The developed model also emphasizes the weakest and strongest point of resources by pointing out their negative and positive impacts. The analyst gets a view on the mechanisms that are linked to the resource and therefore, he owns clues for further improvement of the organization (considering the RBV). The model also improves on the possibility to analyze interdependencies between resources as it shows those interdependencies at a sublevel (as relations between properties).

6 Discussion

In this paper we have proposed a novel model, the Business Behavior Model, to be used when solving a part of the business/IT-alignment problem. The underlying idea of the model is to understand what are the motives that drive a collaborating agent to take decisions about resource exchanges. The alignment problem is a complex issue that hits the organizations in their process of adaptation to the changing environment. In that context, this research aimed at achieving a support to improve the adaptation capacity. To do so, we had three goals; providing a clear and understandable definition of the developed model that we called the Business Behavior Model. The second was to define the context in which the BBM could be applied and used. The last one was to provide some clues on the usefulness of the model. This research has fulfilled the desired goals by the use of various theories, e.g. the causal graph, the resource-based view and BMO. The result of this research is a definition of the model and an indication of the usefulness of the model for solving the alignment problem. This is due to an analysis of the related model (BMM, i*, e³value) and the treatment of cases such as the MMOG. As shown, the BBM supports the bridging of two layers in an organization – the goal layer and the business layer. Through this research we also pointed out that the BBM could be used as an independent tool. It can emerge as a third kind of model next to the goal model and the value model with its own independent usage.

Future work: Improving the valuated causality relation among nodes by giving them real values is the most relevant further work. Doing so opens the possibility of using calculation on large and complex models that are based on the Markov theory [15]. A non-economic resource could also be analyzed analogously to economic resources for the benefit of improved understanding of motivations. Additional modeling and evaluation of cases with different generic scenarios is also relevant for the study of the Business Behavior Model. This could widen the scope of usage and also establish the boundary of the model.

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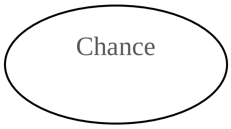
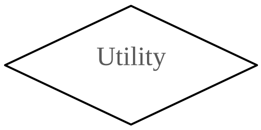
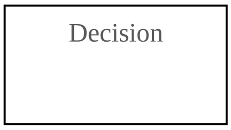
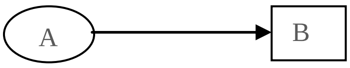
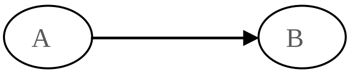
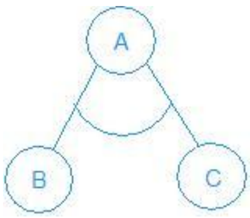
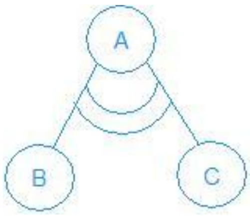
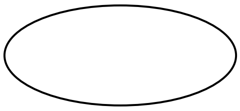
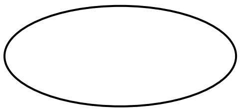
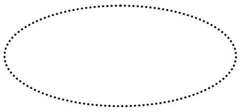
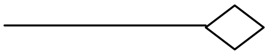
APPENDIX VII SYNTAX AND SEMANTIC OF CAUSAL GRAPHS

TABLE 1 SYNTAX AND SEMANTIC OF CAUSAL GRAPH

Object	Representation (syntax)	Semantic
	NODE	
Chance		A variable that could conditionally be influenced by other nodes.
Utility		The expected utility of the outcome from decision nodes.
Decision		The alternatives that are possible considering the studied domain.
	LINK	
Informational		For B a decision. B has to occur after A. The information at the source of the arc (A) is available at the time the decision (B) is made.
Causal **According to [35]**		For A a decision or a chance node and B a node. B has a conditional probability (defined in a CPT*) to take a certain value considering A.
	CONNECTOR (from causal graph)	
And		A relation where the value of A and B both influence (thank to conditional probabilities) C in the same time. The 'And relation' connects causal links.
Or		A relation where one or both of the value of A and B influence (thank to conditional probabilities) C. The 'And relation' connects causal links.
	VALUE LINK (from causal graphs)	
Enable	++	Strong positive influence.
Supports	+	Positive influence

<table>
<tr><td>Undercuts</td><td>-</td><td>Negative influence</td></tr>
<tr><td>Disables</td><td>--</td><td>Strong negative influence</td></tr>
<tr><td colspan="3">NODE FROM EID</td></tr>
<tr><td>Lexically defined</td><td></td><td>Lexically defined; defined by a text that provides sufficient information to define the node. A node is defined when its meaning can be understood.</td></tr>
<tr><td>Stipulatively defined</td><td></td><td>Defined by other lexically defined nodes using the definitional relation.
The syntax differs from the lexically def. by the entering links (definitional links).</td></tr>
<tr><td>Undefined</td><td></td><td>Undefined node. There is no definition attached to those links.</td></tr>
<tr><td colspan="3">LINK FROM EID</td></tr>
<tr><td>Definitional relation</td><td></td><td>Relation between a stipulatively defined node and defined nodes. The link act as the UML aggregation. The stipulatively defined node is composed of the entire participants linked to the relation.</td></tr>
<tr><td colspan="3">Conditional probability table (CPT)</td></tr>
<tr><td>The matrix for 2 nodes z and y:</td><td><table>
<tr><td colspan="2">Z</td><td>Z1</td><td>Z2</td></tr>
<tr><td rowspan="2">Y</td><td>Y1</td><td>Pr(Y1|Z1)</td><td>Pr(Y1|Z2)</td></tr>
<tr><td>Y2</td><td>Pr(Y2|Z1)</td><td>Pr(Y2|Z2)</td></tr>
</table></td><td>A matrix with n*n entry where n are value nodes. Each value(y,z) in the CPT is the conditional probability associated to the link (y,z).
Pr (Y1|Z1) is the probability to have Y1 considering the value of Z1</td></tr>
</table>

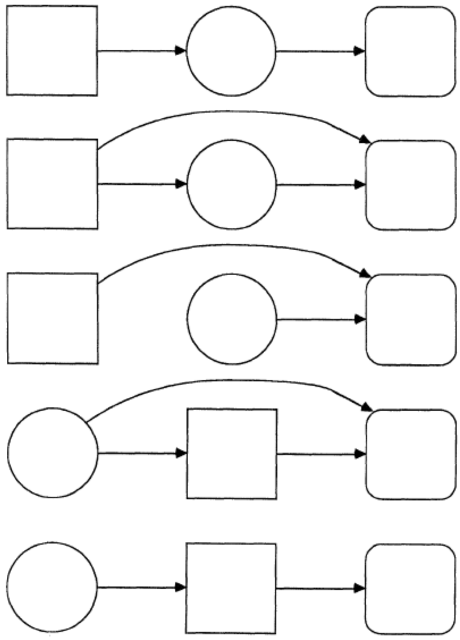


FIGURE 58 SOME POSSIBILITIES WITH A CHANCE, DECISION, VALUE NODE, CAUSAL LINKS, AND INFORMATIONAL LINKS [8]. ROUNDED BOXES ARE UTILITY NODES. THE SYNTAX DIFFERS SOMETIMES FROM ONE EXPLANATION TO ANOTHER.

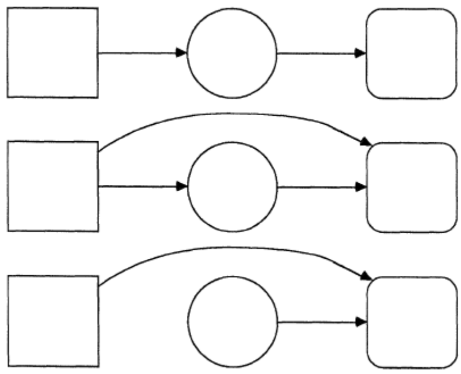


FIGURE 59 SOME POSSIBILITIES WITH A CHANCE, DECISION, VALUE NODE, AND CAUSAL LINKS [8]. ROUNDED BOXES ARE UTILITY NODES. THE SYNTAX DIFFERS SOMETIMES FROM ONE EXPLANATION TO ANOTHER.

APPENDIX VIII POSSIBLE QUESTION FOR INVESTIGATING THE MODEL

The first step is to define who to interview. It should be relevant persons for the domain – decision makers, resource managers.... Here is a structured way of interviewing concerned persons. The following questions are adapted from [11].

Questions on the use of business concepts & tools

How do you plan the general business objectives of your company? Do you use any conceptual tools to plan your business or to sketch the general direction in which your firm is heading?

If yes, do you use any specific formalism(s) to do this?

If yes, do you use any specific software tool to do this? If yes, which one(s)?

Demonstrations & Explanation of the Ontology

Use the cookies production case, the MMOG case or the health care case.

Questions on the fidelity with real word phenomena

In your opinion, what elements are missing in the model presented before?

In your opinion, what elements should not belong to the model presented before?

How could such a model help you define business indicators?

How could such a model help you or a group of managers make better decisions?

How could such a model improve the alignment of an organization?

How could such a model foster the perspective on strategic resources?

How do you think such a model could improve business process design and engineering?